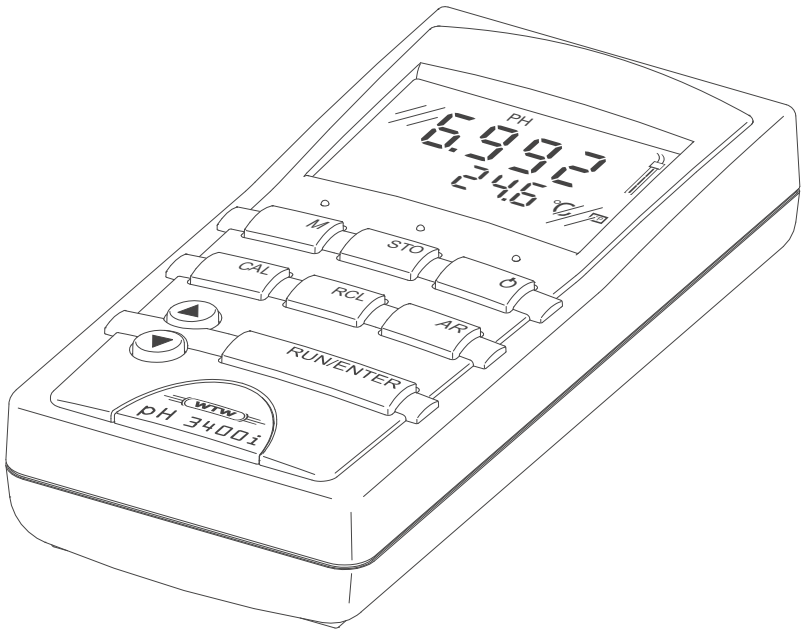
Operating manual

Handheld meter
pH 3300i/3400i



pH measuring instrument

ba75682e02 03/2008

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.

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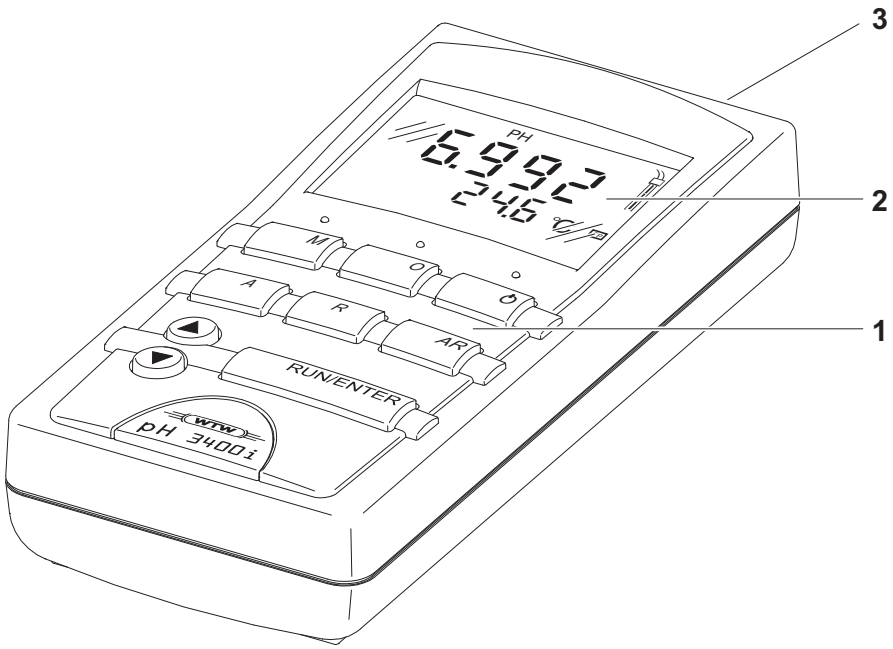
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1 Overview

The compact precision handheld meter pH 3300i/3400i enables you to carry out pH measurements rapidly and reliably.
The pH3300i/3400i handheld meter provides the maximum degree of operating comfort, reliability and measuring certainty for all applications.

The proven MultiCal® calibration procedure and the special *AutoRead* function support you in your work with the pH handheld meter.



1	Keypad
2	Sample display
3	Jack field

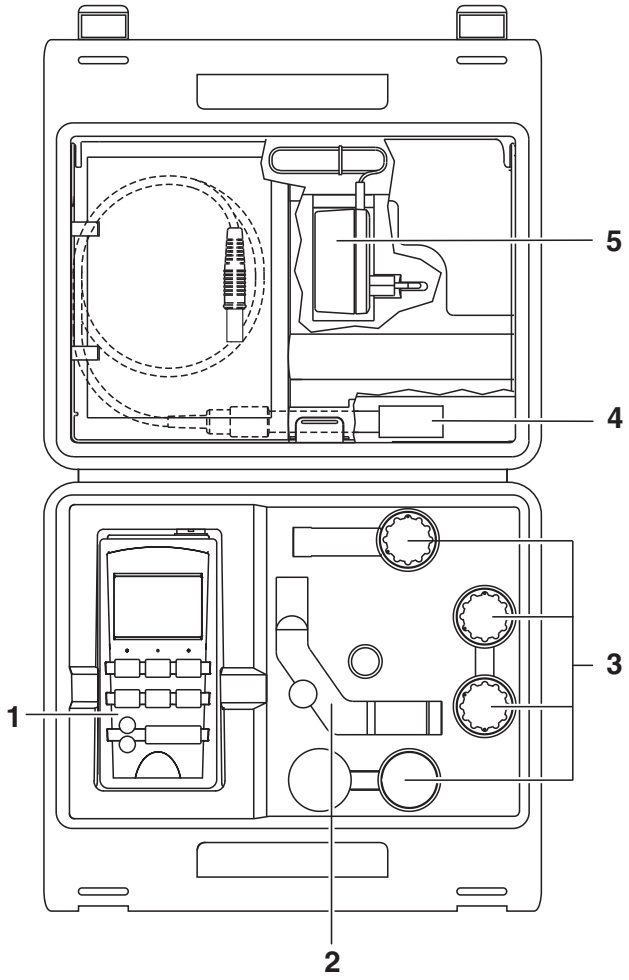
Note
If you need further information or application notes, you can obtain the following material from WTW:

- Application reports
- Primers
- Safety datasheets.

You will find information on available literature in the WTW catalog or via the Internet.

1.1 SETs of equipment

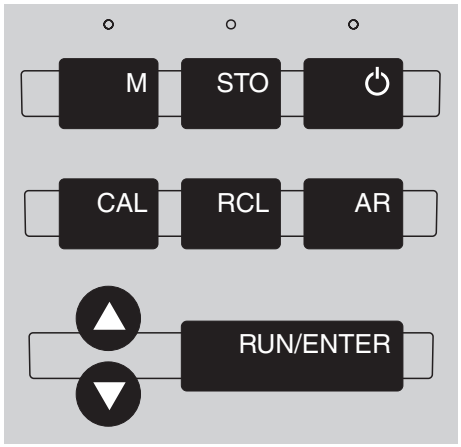
The measuring instrument is also available as part of individual SETs of equipment. You will find additional information on this and other accessories in the WTW catalog or via the Internet.



Set (sample configuration):

1	Measuring instrument, pH 3300i/3400i
2	Stand
3	– KCl solution for electrodes – 50 ml pH buffer solution, STP 4 – 50 ml pH buffer solution, STP 7 – Beaker, 50 ml
4	pH electrode
5	Plug-in power supply, optional (3400i only)

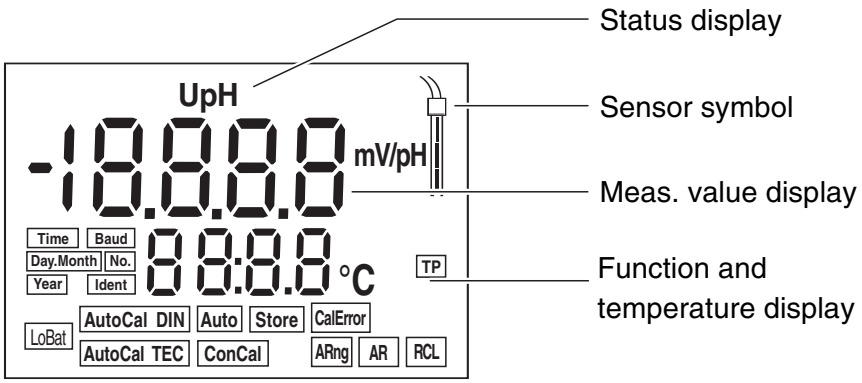
1.2 Keypad



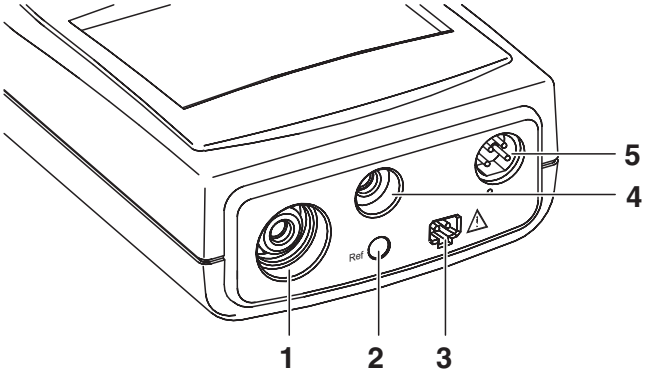
Key functions

M	Select the measuring mode **<M>**: – pH value – ORP voltage
STO	Save a measured value **<STO>**
⏻	Switch measuring instrument on/off **<ON/OFF>**
CAL	Calibration of the current measured variable; **<CAL>**
RCL	Display/transmit measured values **<RCL>**
AR	Activate/deactivate the AutoRead function **<AR>**
▲	Select the measuring mode, Increase values, scroll **<▲ >**
▼	Select the measuring mode, Decrease values, scroll **<▼ >**
RUN/ENTER	Confirm entries, start AutoRead **<RUN/ENTER>**

1.3 Display



1.4 Jack field



1	pH electrode or ISE single-rod measuring electrode/electrode
2	Reference electrode
3	Plug-in power supply (pH 3400i only)
4	Temperature probe
5	Serial interface RS 232 / analog output (recorder) - only pH 3400i



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

2 Safety

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the pH 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 measuring system.

Target group

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

Safety instructions

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

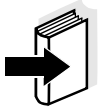


Warning
indicates instructions that must be followed precisely in order to avoid the possibility of slight injuries or damage to the instrument or the environment.

Further notes



Note
indicates notes that draw your attention to special features.



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

2.1 Authorized use

The authorized use of the measuring instrument consists exclusively of the pH and ORP measurement in the field and laboratory.
The technical specifications as given in chapter 7 TECHNICAL DATA must be observed. Only the operation and running of the measuring instrument according to the instructions given in this operating manual is authorized.
Any other use is considered to be **unauthorized**.

2.2 General safety instructions

This instrument is built and inspected according to the relevant guidelines and norms for electronic measuring instruments (see chapter 7 TECHNICAL DATA).
It left the factory in a safe and secure technical condition.

Function and operating safety

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

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

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

Safe operation

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

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

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

Obligations of the purchaser

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

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

3 Commissioning

3.1 Scope of delivery

- Handheld meter, pH 3300i or 3400i
- Plug-in power supply, optional (3400i only)
- Operating manual and short operating manual
- 4 batteries, 1.5 V Mignon type AA (in the instrument)

3.2 Initial commissioning

Perform the following activities:

- Set the date and time
- Connect the plug-in power supply, optional (3400i only)

Setting the date and time

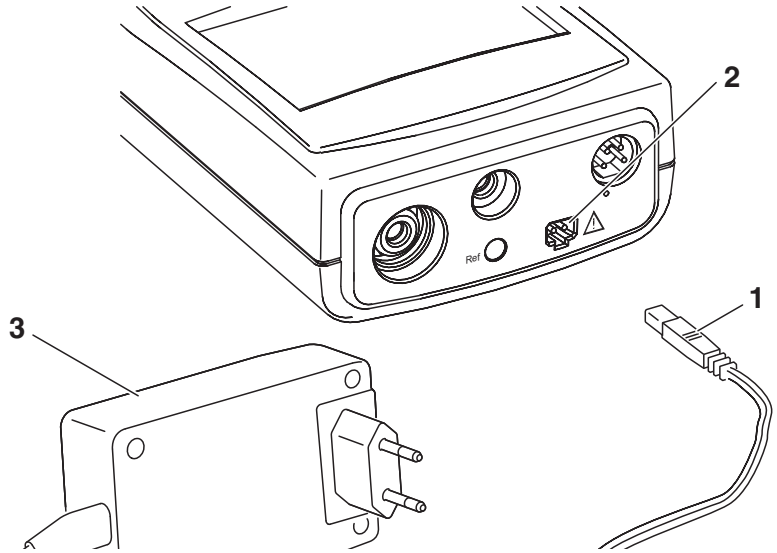
1	Press the **<M>** key and hold it down.
2	Press the **<ON/OFF>** key. The display test appears briefly on the display.
3	Press the **<RUN/ENTER>** key repeatedly until the date appears on the display.
4	Set the date of the current day with **<▲> <▼>**.
5	Confirm with **<RUN/ENTER>**. The date (month) flashes in the display.
6	Set the current month with **<▲> <▼>**.
7	Confirm with **<RUN/ENTER>**. The year appears on the display.
8	Set the current year with **<▲> <▼>**.
9	Confirm with **<RUN/ENTER>**. The hours flash on the display.
10	Set the current time with **<▲> <▼>**.
11	Confirm with **<RUN/ENTER>**. The minutes flash on the display.
12	Set the current time with **<▲> <▼>**.
13	Confirm with **<RUN/ENTER>**. The instrument switches to the pH measuring mode.
14	Switch the instrument off using **<ON/OFF>**.

Connecting the plug-in power supply (3400i)

You can either operate the measuring instrument with batteries or with the plug-in power supply. The plug-in power supply supplies the pH meter 3400i with low voltage (12 V DC). This saves the batteries.

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

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



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

Note
You can also measure without the plug-in power supply.

4 Operation

4.1 Switching on the measuring instrument

1	Press the **<ON/OFF>** key. The display test appears briefly on the display. Subsequently, the slope and asymmetry used appear for approx. one second one after the other. In addition, the calibration procedure of the last calibration is shown (*AutoCal TEC* or *AutoCal DIN* or no display in the delivery state or following initialization). The measuring instrument then automatically switches to the measuring mode that was last selected.



Note
The measuring instrument has an energy saving feature to avoid unnecessary battery depletion. The energy saving feature switches the measuring instrument off if no key has been pressed for an hour. The energy saving feature is not active when the AutoStore function is active.

Measuring instrument 3400i

The energy saving feature is also not active

- if the power is supplied by the plug-in power supply,
- if the communication cable and a PC with a running communication program are connected,
- if the recorder cable is connected,
- if the printer cable is connected (for external printers).

4.2 Measuring

4.2.1 General information

You can measure the following variables:

- pH value
- ORP voltage

Preparatory activities

Perform the following preparatory activities when you want to measure:

1	Connect the electrode to the measuring instrument.
2	Adjust the temperature of the buffer solutions or test solutions, or measure the current temperature, if you measure without a temperature sensor.
3	In conjunction with the electrode, check or calibrate the measuring instument. How to calibrate is described in section 4.3.
4	Select the measuring mode with **<M>**.



Warning
When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result. The RS 232 interface is not galvanically isolated.



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

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*.



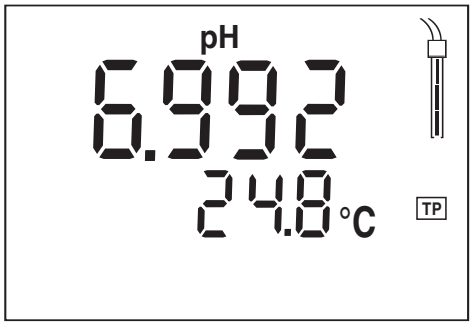
Note
The measuring instrument automatically recognizes the type of the temperature sensor used. Therefore, you can connect temperature sensors of the NTC30 or Pt1000 type.

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 of the test sample using a thermometer.
2	Enter the temperature on the instrument: Set the temperature value of the test sample using **<▲ > <▼>**.

4.2.2 Measuring the pH value

1	Perform the preparatory activities according to section 4.2.1.
2	Immerse the pH electrode in the test sample.
3	Press the **<M>** key until *pH* appears on the status display. The pH value appears on the display.



Setting the resolution

The measuring instrument shows the pH value with a resolution of 0.01 or 0.001. (Default setting is 0.01). To change the resolution, press the **<M>** key while pressing the **<RUN/ENTER>** key.

AutoRead (drift control)

The AutoRead function (drift control) checks the stability of the measurement signal. The stability has a considerable impact on the reproducibility of the measured values.

For identical measurement conditions, the following criteria apply:

Reproducibility	Response time
Better than 0.02	> 30 seconds

1	Call up the pH measuring mode with **<M>** and **<▲> <▼>** .
2	Activate the AutoRead function with **<AR>**. The current measured value is frozen (hold function).
3	Start AutoRead with **<RUN/ENTER>**. *AR* flashes until a stable measured value is reached. This measured value is transmitted to the interface.
4	If necessary, start the next AutoRead measurement with **<RUN/ENTER>**.
5	To terminate the AutoRead function: Press the **<AR>** key.

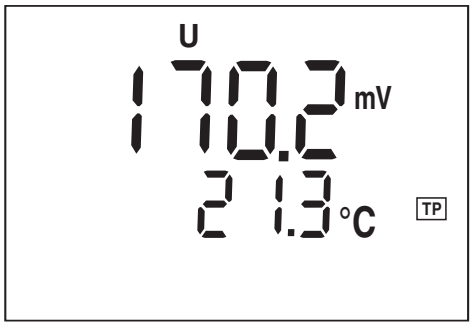


Note
The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing <RUN/ENTER>.

4.2.3 Measuring the ORP voltage

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

1	Perform the preparatory activities according to section 4.2.1.
2	Immerse the ORP electrode in the test sample.
3	Press the **<M>** key until U appears on the status display. The ORP voltage (mV) of the test sample appears on the display.
4	Wait for a stable measured value.



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

4.3 Calibrating

Why calibrate?

pH electrodes age. This changes the asymmetry (zero point) and slope of the pH electrode. As a result, an inexact measured value is displayed. Calibration determines the current values of the asymmetry and slope of the electrode and stores them in the measuring instrument.
Thus, you should calibrate at regular intervals.

When to calibrate?

- After connecting another electrode
- When the sensor symbol flashes:
  - after the calibration interval has expired
  - after a voltage interruption, e. g. after changing the batteries

Calibration interval

The calibration interval (Int 3) is set to 7 days in the factory. You can select the interval in the range of 1 ... 999 days (see section 4.6 CONFIGURATION).

You can select between 3 calibration procedures:

AutoCal TEC

is specially adapted to the WTW technical buffer solutions as a fully automatic **two-point** or **three-point calibration**. The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.6 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV. The calibration can be terminated after the first buffer solution. This corresponds to a **single-point calibration**. For this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

AutoCal DIN

is specially adapted to the permanently programmed buffer solutions in accordance with DIN19266 as a fully automatic **two-point** or **three-point calibration**. The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.6 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV. The calibration can be terminated after the first buffer solution. This corresponds to a **single-point calibration**. For this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

ConCal

This function is a conventional **two-point calibration** using two buffer solutions (pH 7.0 ± 0.5 and any other buffer solution) or a **single-point calibration** using any buffer solution and is used as a high-speed method.

AutoRead

When calibrating with AutoCal TEC and AutoCal DIN, the *AutoRead* function is automatically activated.
The current AutoRead measurement can be terminated at any time (accepting the current value) by pressing **<RUN/ENTER>**.

Displaying calibration data

Each time the instrument is switched on, the calibration data are shown on the display for a short time (see section 4.1 SWITCHING ON THE MEASURING IN-

STRUMENT). In order to view the calibration data, switch the measuring instrument off and switch it on again.

Printing the calibration record (3400i)

The calibration protocol contains the calibration data of the current calibration. You can transmit the calibration protocol to a printer via the serial interface (see page 40).

Note
You can automatically print a calibration protocol after the calibration. To do so, connect a printer to the interface according to section 4.5.3 before calibrating. After a valid calibration, the record is printed.

Sample printout:

```
CALIBRATION PROTOCOL
 02.03.99     14:19
Device No.: 12345678
Calibration pH
Cal time: 01.03.99 / 15:20
Cal interval:   7d
AutoCal DIN   Tauto
Buffer 1   1.679
Buffer 2   4.008
Buffer 3   6.865
Buffer 4   9.180 *
C1      174.1 mV  25.0°C
C2     -133.3 mV  25.0°C
S1     -59.4 mV/pH
ASY1   -   4 mV
Probe:     +++
```

Calibration evaluation

After the calibration, the measuring instrument automatically evaluates the current status of the electrode. The asymmetry and slope are evaluated separately. The worst evaluation appears on the display.

Display	Asymmetry [mV]	Slope [mV/pH]
	-15 ... +15	-60.5 ... -58
	-20 ... +20	-58 ... -57
	-25 ... +25	-61 ... -60.5 or -57 ... -56
 Clean the electrode according to the electrode operating manual	-30 ... +30	-62 ... -61 or -56 ... -50
E3 Eliminate the error according to chapter 6 WHAT TO DO IF...	< -30 or > 30	... -62 or ... -50

Preparatory activities

1	Switch on the measuring instrument with **<ON/OFF>**.
2	Connect the pH electrode to the measuring instrument.
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.

4.3.1 AutoCal TEC

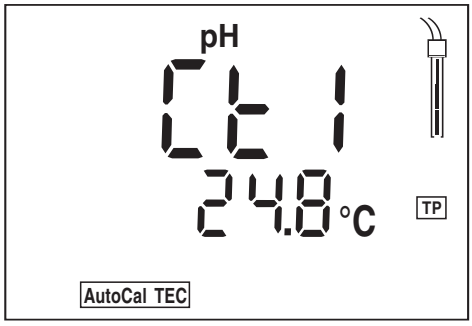
For this procedure, use any two or three WTW technical buffer solutions in ascending or descending order
(pH values at 25 °C: 2.00 / 4.01 / 7.00 / 10.01).

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

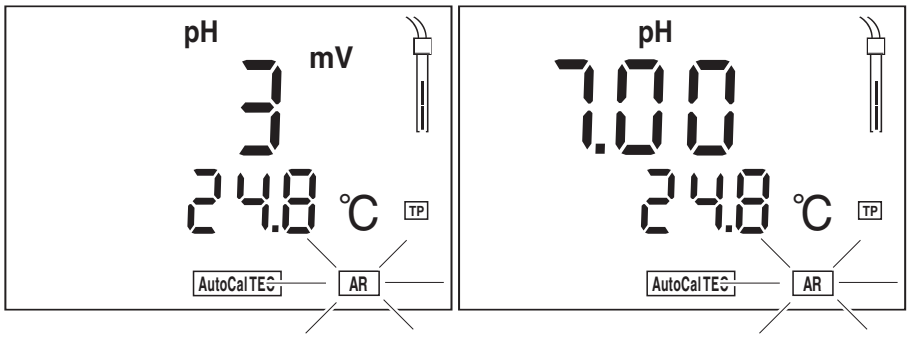
Note
The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.6 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV.

Note
Skip the steps 2, 7 and 14 if you use a temperature sensor.

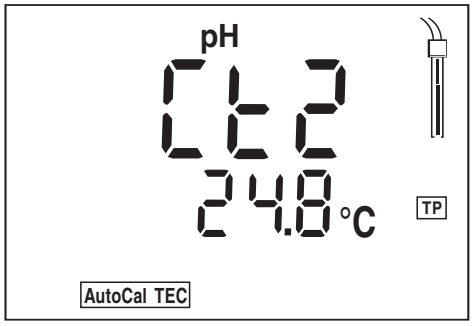
1	Press the **<CAL>** key repeatedly until the *Ct1* display indicator and the function display *AutoCal TEC* appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset).



2	If necessary, enter the temperature of the first buffer solution with **<▲> <▼>**.
3	Immerse the pH electrode in the first buffer solution.
4	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. Example:

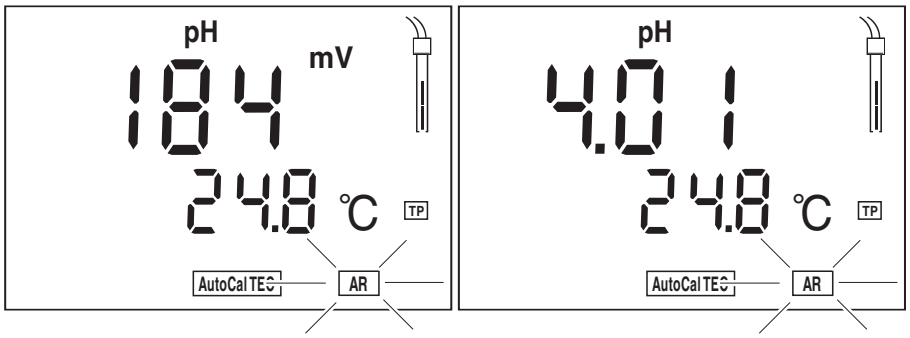


5	When the measured value is stable, *Ct2* appears.

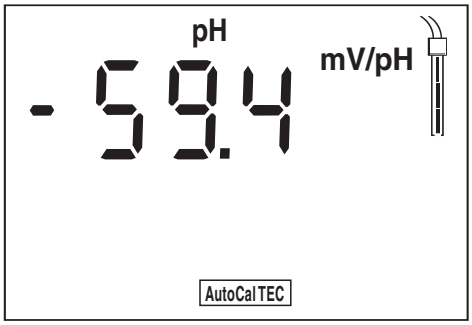


Note
At this point, the AutoCal TEC calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. For this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.

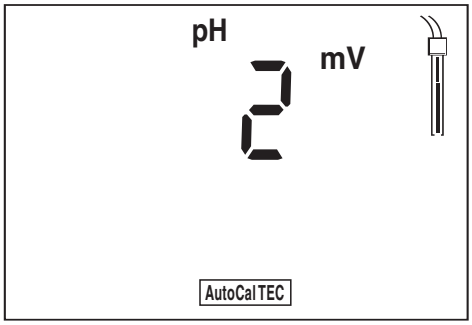
6	To continue the **two-point calibration**, thoroughly rinse the electrode with deionized water.
7	If necessary, enter the temperature of the second buffer solution with **<▲> <▼>**.
8	Immerse the pH electrode in the second buffer solution.
9	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. Example:



10	When the measured value is stable, *AR* disappears. The instrument displays the value of the slope (mV/pH) and the evaluation of the calibration in calibration range I.



11	Press the **<RUN/ENTER>** key. The instrument displays the value of the asymmetry in calibration range I.



Note
At this point, the AutoCal TEC calibration can be terminated with **<M>**. This corresponds to a **two-point calibration.**
The instrument uses the slope and asymmetry of the calibration range I.

Three-point calibration

12	Press the **<RUN/ENTER>** key to continue the **three-point calibration**. *Ct3* appears on the display.
13	Thoroughly rinse the electrode with distilled water.
14	If necessary, enter the temperature of the third buffer solution with **<▲> <▼>**.
15	Immerse the pH electrode in the third buffer solution.
16	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. When the measured value is stable, *AR* disappears. The instrument displays the value of the slope (mV/pH) and the evaluation of the calibration in calibration range II.
17	Press the **<RUN/ENTER>** key. The instrument displays the value of the asymmetry in calibration range II. The three-point calibration is completed.
18	To return to the measuring mode: Press the **<M>** key.



Note
You can prematurely terminate the three-point calibration by pressing **<M>**. The values of the two-point calibration for slope and asymmetry will then remain stored.

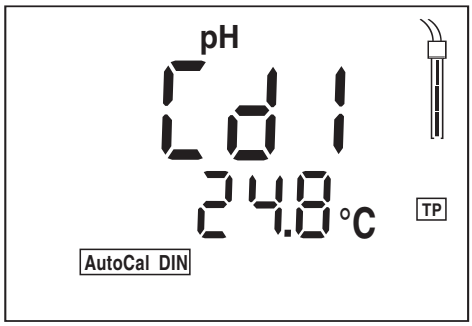
4.3.2 AutoCal DIN

For this procedure, use two or three different standard buffer solutions according to DIN 19266 in ascending or descending order (type A, C, D or F with pH values at 25 °C of: 1.679 / 4.006 / 6.865 / 9.180).

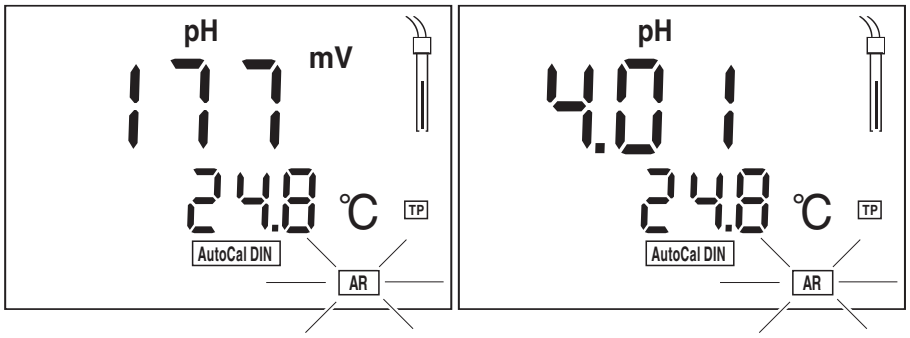
Note
The buffer solutions are automatically recognized by the measuring instrument. Depending on the instrument setting (see section 4.6 CONFIGURATION), the instrument displays the relevant buffer nominal value or the current electrode voltage in mV.

Note
Skip the steps 2, 7 and 14 if you use a temperature sensor.

1	Press the **<CAL>** key repeatedly until the display *Cd1* and the function display *AutoCal DIN* appear. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset).

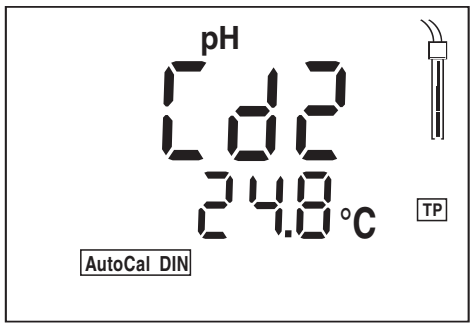


2	If necessary, enter the temperature of the buffer solution with **<▲>** **<▼>**.
3	Immerse the pH electrode in the first buffer solution.
4	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. Example:

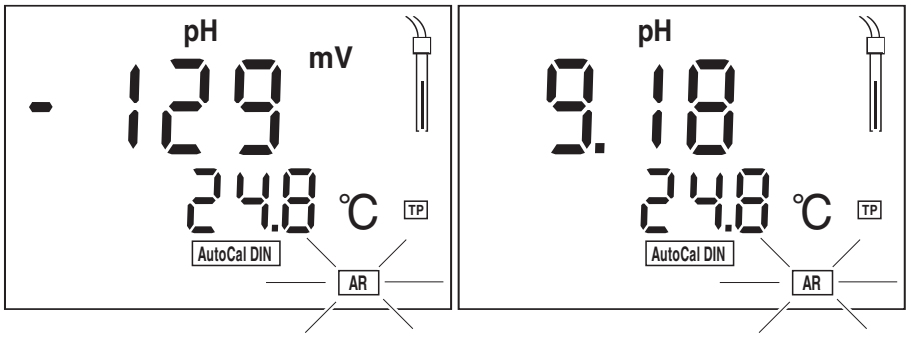


5	When the measured value is stable, *Cd2* appears.

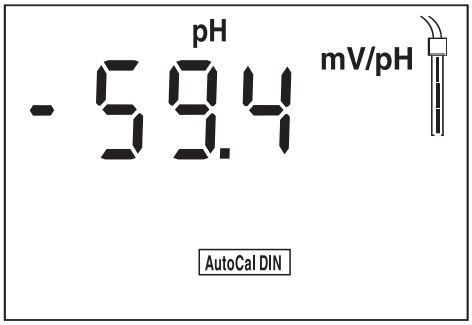
Note
At this point, the AutoCal DIN calibration can be terminated with **<M>**. This corresponds to a **single-point calibration**. For this, the instrument uses the Nernst slope (-59.2 mV/pH at 25 °C) and determines the asymmetry of the electrode.



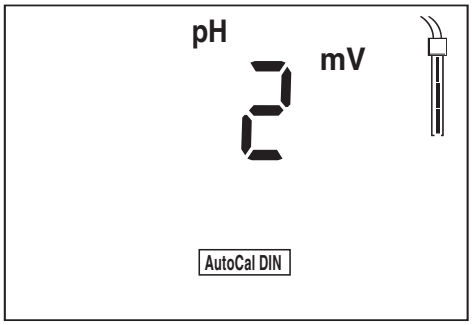
6	To continue the **two-point calibration**, thoroughly rinse the electrode with deionized water.
7	If necessary, enter the temperature of the second buffer solution with **<▲> <▼>**.
8	Immerse the pH electrode in the second buffer solution.
9	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. Example:



10	When the measured value is stable, *AR* disappears. The instrument displays the value of the slope (mV/pH) and the evaluation of the calibration in calibration range I.



11	Press the **<RUN/ENTER>** key. The instrument displays the value of the asymmetry in calibration range I.



Note
At this point, the AutoCal DIN calibration can be terminated with **<M>**. This corresponds to a **two-point calibration.**
The instrument uses the slope and asymmetry of the calibration range I.

Three-point calibration

12	Press the **<RUN/ENTER>** key to continue the **three-point calibration**. *Cd3* appears on the display.
13	Thoroughly rinse the electrode with distilled water.
14	If necessary, enter the temperature of the third buffer solution with **<▲> <▼>**.
15	Immerse the pH electrode in the third buffer solution.
16	Press the **<RUN/ENTER>** key. The *AR* display indicator flashes. The electrode voltage (mV) or the buffer nominal value appears on the display. When the measured value is stable, *AR* disappears. The instrument displays the value of the slope (mV/pH) and the evaluation of the calibration in calibration range II.
17	Press the **<RUN/ENTER>** key. The instrument displays the value of the asymmetry in calibration range II. The three-point calibration is completed.
18	To return to the measuring mode: Press the **<M>** key.



Note
You can prematurely terminate the three-point calibration by pressing **<M>**. The values of the two-point calibration for slope and asymmetry will then remain stored.

4.3.3 ConCal

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.

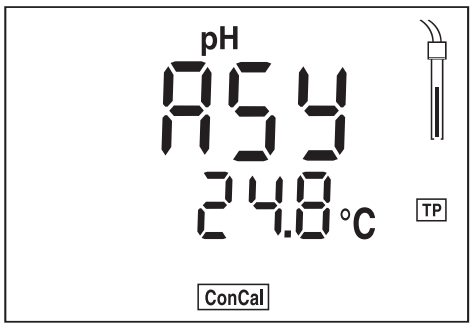
Two-point calibration

For this procedure, use two buffer solutions:

- pH 7.0 ± 0.5
- any other buffer solution

Note
Skip the steps 2 and 9 if you use a pH electrode with a temperature sensor.

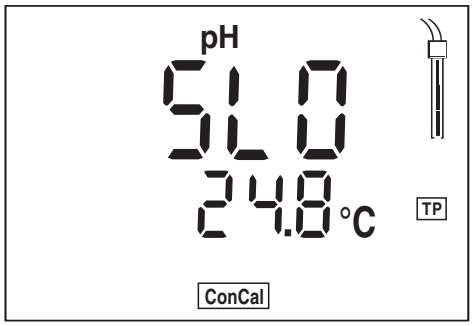
1	Press the **<CAL>** key repeatedly until the display *ASY* and the function display *ConCal* appears. The sensor symbol displays the evaluation of the last calibration (or no sensor symbol in the delivery state or after the measurement parameter has been reset).



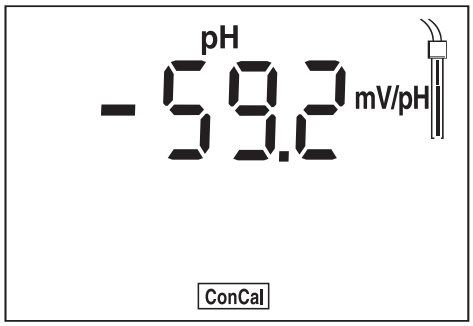
2	If necessary, enter the temperature of the first buffer solution with **<▲> <▼>**.
3	Immerse the pH electrode in the first buffer solution (pH 7.0 ± 0.5 in two-point calibration).
4	Press the **<RUN/ENTER>** key. The measured pH value appears on the display.
5	Set the measured value to the nominal pH value of the buffer solution (at the current temperature) with **<▲> <▼>**.
6	Press the **<RUN/ENTER>** key. The value of the asymmetry (mV) and the sensor symbol appear on the display.
7	Press the **<RUN/ENTER>** key. *SLO* appears on the display.

Note
At this point, the ConCal calibration can be broken off with **<M>**. This corresponds to a **single-point calibration**. For this, the instrument uses the

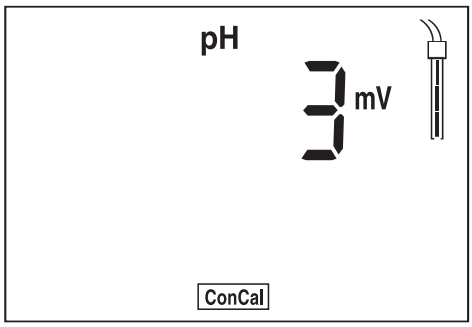
Nernst slope (-59.2 mV/pH at 25 °C) and the specified asymmetry of the electrode.



8	To continue the **two-point calibration**, thoroughly rinse the electrode with deionized water.
9	If necessary, enter the temperature of the second buffer solution with **<▲> <▼>**.
10	Immerse the pH electrode in the second buffer solution.
11	Press the **<RUN/ENTER>** key. The second pH value appears on the display.
12	Set the measured value to the nominal pH value of the buffer solution (at the current temperature) with **<▲> <▼>**.
13	When the measured value is stable, press the **<RUN/ENTER>** key. The value of the slope (mV/pH) appears on the display. The probe symbol shows the evaluation of the current calibration.



14	Press the **<RUN/ENTER>** key. The value of the asymmetry (mV) appears on the display.



15	To return to the measuring mode: Press the **<M>** key.

4.4 Saving

The measuring instrument has an internal data memory. It can store up to 800 data records.
A complete data record consists of:

- Storage location
- Date/time
- Measured value
- Temperature
- Temperature measuring procedure
- ID number

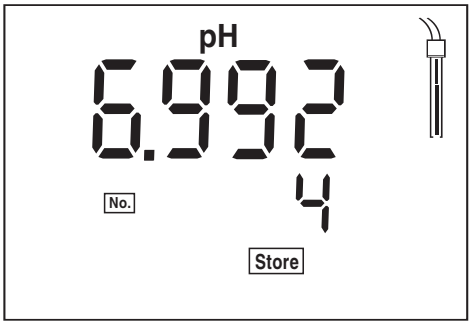
You can transmit measured values (data records) to the data storage in two ways:

- Save manually
- Switch on AutoStore (Int 1).

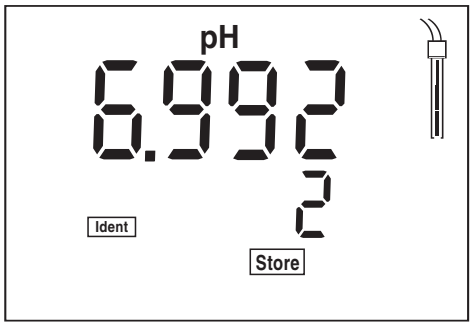
4.4.1 Saving manually

You can transmit a measured value to the data storage as follows:

1	Press the **<STO>** key. The current number (location number *No.*) of the next free storage location appears under the current measured value on the display.



2	Confirm with **<RUN/ENTER>**. The display switches to entering the ID number.



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

Message StoFull This message appears when all of the 800 storage locations are occupied.

You have the following options:

Saving the current measured value. The oldest measured value (storage location 1) will be overwritten by this	Press **<RUN/ENTER>**.
Returning to the measuring mode without saving	press any key
Outputting the data storage	see section 4.4.3
Clearing the memory	see section 4.4.4

4.4.2 Saving automatically

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

Setting the save interval

The default setting for the save interval (Int 1) is OFF.
By this, the AutoStore function is switched off.
To switch the function on, set an interval (5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min):

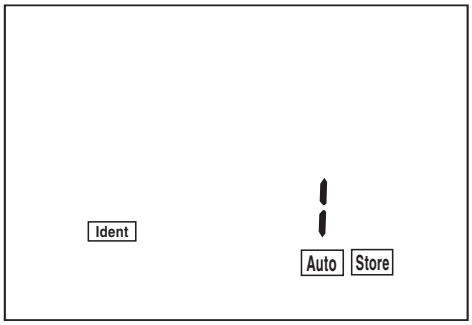
1	Press the **<RUN/ENTER>** key and hold it down.
2	Press the **<STO>** key. *Int 1* appears on the display.



3	Set the required interval between the saving procedures with **<▲>** **<▼>**.
4	Confirm with **<RUN/ENTER>**. The number of free memory locations appears on the display.



5	As soon as all of the 800 storage locations are occupied, *AutoStore* is terminated (Int 1 = OFF). If there are not enough storage locations available for your measurements: – Output and backup the data storage (see page 36) and – clear the memory (see page 41).
6	Confirm with **<RUN/ENTER>**. The prompt for the ID number appears on the display.



7	Set the required ID number with **<▲> <▼>**.
8	Confirm with **<RUN/ENTER>**. The instrument switches to the pH measuring mode and starts the measuring and saving process. *AutoStore* flashes on the display.

Note
The AutoStore function is interrupted if you start other functions, e.g. output the data storage.
After the function is finished, the AutoStore function is continued. By this, however, temporal gaps in the recording of the measured values will occur.

Switching off AutoStore

Switch AutoStore off by:

- setting the save interval (Int 1) to OFF, or
- switching the measuring instrument off and then on again.

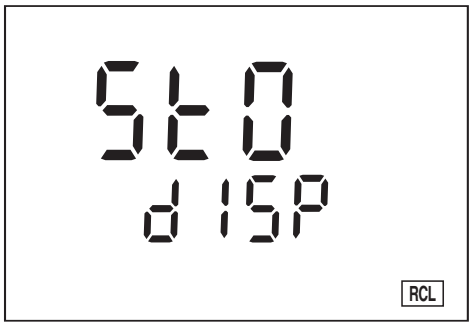
4.4.3 Outputting the data storage

You can output the contents of the data storage:

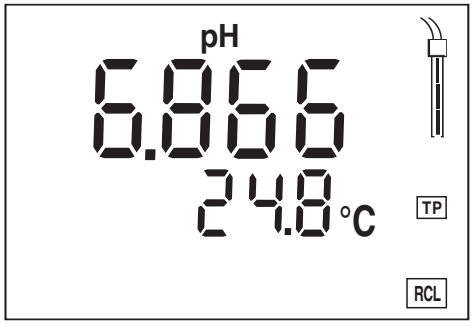
- Stored data on the display
- Calibration data on the display
- Stored data on the serial interface (only pH 3400i)
- Calibration protocol to the interface (only pH 3400i)

Outputting stored data on the display

1	Press the **<RCL>** key repeatedly until *StO dISP* appears on the display.



2	Press the **<RUN/ENTER>** key. A measured value appears on the display. The storage location of the data record is displayed for approx. 2 s, then the respective temperature appears.



You can perform the following activities:

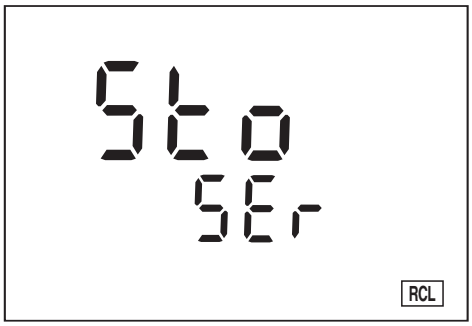
Display further elements of the data record (ID number, date, time, storage location)	Press **<RUN/ENTER>**
Advance one data record (storage location)	Press **<▲>**
Go back one data record (storage location)	Press **<▼>**

Note
If you want to search for a certain element (e.g. date), proceed as follows:

1	Using **<RUN/ENTER>**, select the element (e.g. date).
2	Press **<▲>** or **<▼>** repeatedly until the required date appears on the display. After approx. 2 s the temperature of the displayed measured value appears.

Outputting stored data to the interface (only pH 3400i)

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



2	Press the **<RUN/ENTER>** key. The complete storage content is transmitted to the interface; during the data transmission the numbers of the currently transmitted storage locations run through. After the data transmission, the measuring instrument automatically switches to the pH measuring mode.

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

After the instrument number, the printout contains the complete storage contents in ascending order of the storage location numbers.

Sample printout:

```
Device No.: 12345678

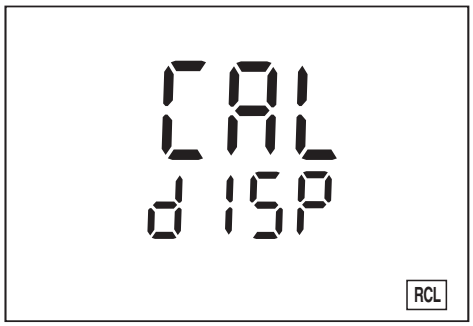
No.    1:
 09.03.99        17:10
pH 10.01         25    °C
Tman          AR
Ident :  1

No.    2:
 09.03.99        17:11
pH 10.01         24.7  °C
Tauto          AR
Ident :  1

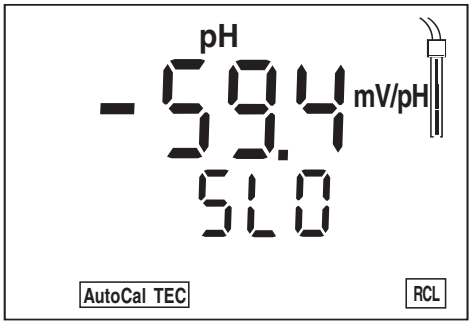
No.    3:
 09.03.99        17:12
  305 mV
Tauto
Ident :  13
...
```

Outputting the calibration data on the display

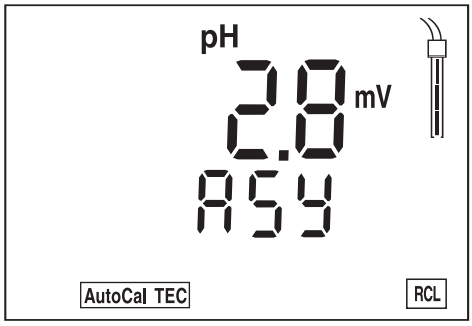
1	Press the **<RCL>** key repeatedly until *CAL dISP* appears on the display.



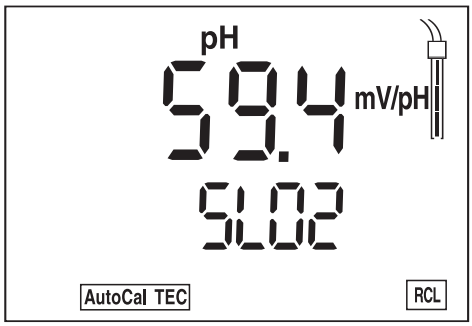
2	Press the **<RUN/ENTER>** key. The slope (mV/pH) in the calibration range I and the calibration procedure of the last calibration appear on the display:



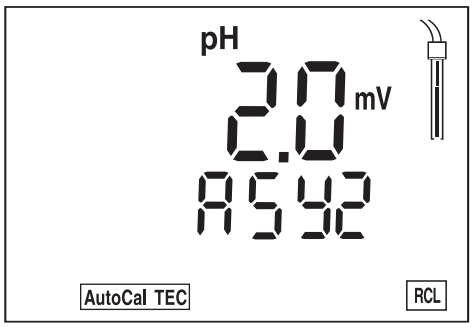
3	Press **<RUN/ENTER>** to display the value of the asymmetry (mV) in the calibration range I.



4	In two-point calibration: Using **<M>** or **<RUN/ENTER>**, you can switch back to the pH measuring mode. In three-point calibration: Press **<RUN/ENTER>** to display the slope [mV/pH] in the calibration range II *(SLO2)*.



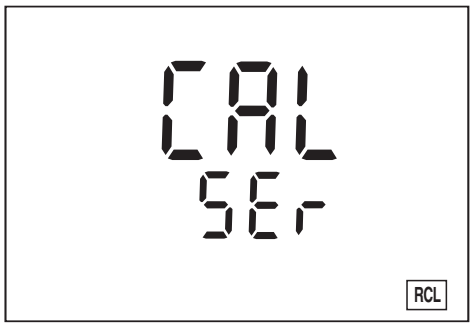
5	Press **<RUN/ENTER>** to display the value of the asymmetry (mV) in the calibration range II *(ASY2)*.



6	Using **<M>** or **<RUN/ENTER>**, you can switch back to the pH measuring mode.

Outputting the calibration protocol on the interface (only pH 3400i)

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



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

Note
You will find a sample calibration protocol in PRINTING THE CALIBRATION RECORD (3400I), page 19.

4.4.4 Clearing the memory

With this function, you can delete stored data records. 800 storage locations will then be available again.

Note
The *Clear memory* function only appears when there are data records stored in the memory. Otherwise, the measuring instrument automatically switches to the measuring mode.

Proceed as follows to clear all data records:

1	Switch off the measuring instrument.
2	Press the **<STO>** key and hold it down.
3	Press the **<ON/OFF>** key. The display test appears briefly on the display. Subsequently, *Sto clr* appears.



4	Confirm the clearing process with **<RUN/ENTER>**. Pressing any other key prevents the clearing, the data records will remain stored.

Note
The calibration data remain stored and can be called up.

4.5 Transmitting data (only pH 3400i)

You have the following possibilities of transmitting data:

- One of the following options:
  - With the *AutoStore* function (page 34), measured values are periodically saved internally (save interval Int 1) and output on the interface.
  - With the *Data transmission interval* function (Int 2), measured values are periodically output on the interface (see below).
- With the *Output data storage* function (page 36), calibration data or saved measured values are output on the interface.
- Via the analog recorder output (page 44), measured values are output as voltage values.
- With the KOM pilot communication kit (accessory), data can be transmitted bidirectionally (page 45).



Note
If you connect a recorder (analog output), the output on the digital interface is switched off.

4.5.1 Data transmission interval (Int 2, pH 3400i)

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

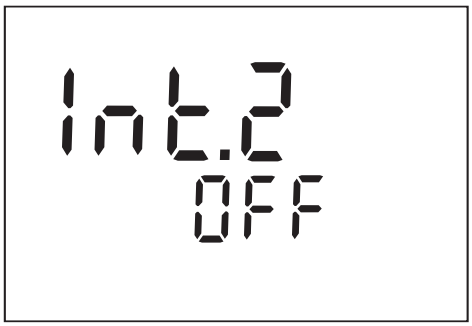


Note
When the *AutoStore* function is active, the data transmission is performed according to the setting of the save interval (Int 1). Set the save interval (Int 1) to OFF to activate the *Data transmission* interval (Int 2).

Setting the Data transmission interval

The default setting for the interval is OFF.
To start the data transmission, set an interval (5 s, 10 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min):

1	Press the **<RUN/ENTER>** key and hold it down.
2	Press the **<RCL>** key. *Int 2* appears on the display.

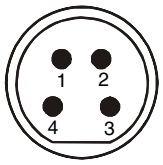


3	Set the required interval between the saving procedures with **<▲>** **<▼>**.
4	Confirm with **<RUN/ENTER>**. The measuring instrument automatically switches to the pHmeasuring mode.

4.5.2 Recorder (analog output, pH 3400i)

You can transmit data to a recorder via the analog output. Connect the analog output to the recorder via the AK323 interface cable.
The data output automatically switches to *Recorder output.*

Socket assignment



RS 232
REC

1 free
2 Plug coding
3 Ground
4 Analog output
(internal resistance < 5 Ohm)

Note
The analog output is activated automatically in the cable by connecting 2 and 3.

At the analog output, there is a low-impedance electrode signal (corresponding to 50 ... 62 mV/pH).

4.5.3 PC/external printer (RS 232 interface, pH 3400i)

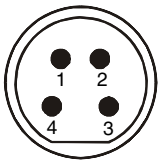
Via the RS 232 interface, you can transmit the data to a PC or an external printer.
Use the AK340/B (PC) or AK325/S (ext. printer) cable to connect the interface to the instruments.
The data output automatically switches to the *RS 232* interface.

Warning
The RS 232 interface is not galvanically isolated.
When connecting an earthed PC/printer, measurements cannot be performed in earthed media as incorrect values would result.

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

Baud rate	selectable between: 1200, 2400, **4800**, 9600
Handshake	RTS/CTS + Xon/Xoff
Parity	none
Data bits	8
Stop bits	1

Socket assignment



RS 232
REC

1 CTS
2 RxD
3 Ground
4 TxD

4.5.4 Remote control (pH 3400i)

The measuring instrument can be remotely controlled from a PC. This requires the KOM pilot communication kit. It is available as an accessory.
The instrument is then controlled via commands that simulate keystrokes and request the current display contents.

Note
A more detailed description is provided within the scope of delivery of the communication kit.

4.6 Configuration

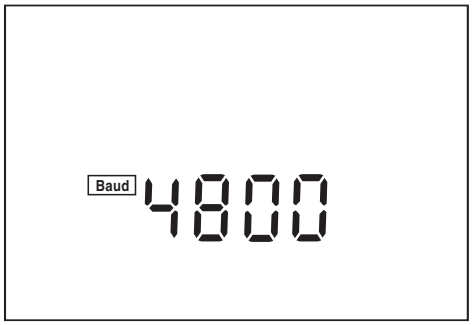
You can adapt the measuring instrument to your individual requirements. To do this, the following parameters can be changed (the status on delivery is marked in bold):

Baud rate	1200, 2400, **4800**, 9600
Display during the pH calibration	**Buffer nominal value**, or current electrode voltage
Calibration interval (Int 3)	1 ... **7** ... 999 d
Date/time	Any
pH resolution	**0.01** or 0.001

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

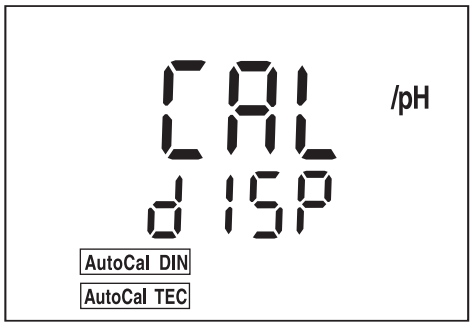
1	Switch off the measuring instrument.
2	Press the **<M>** key and hold it down.
3	Press the **<ON/OFF>** key. The display test appears briefly on the display. The measuring instrument then switches automatically to the setting of the baud rate.

Baud rate (pH 3400i)



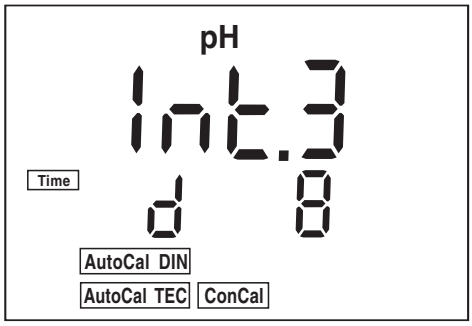
4	Select the required Baud rate with **<▲> <▼>**.
5	Confirm with **<RUN/ENTER>**. *CAL diSP* appears on the display.

Display during the pH calibration



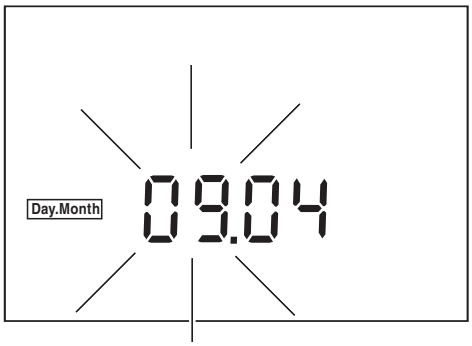
6	Select the required display during the pH calibration with **<▲> <▼>**. *mV*: Display of the current electrode voltage */pH*: Display of the buffer nominal value.
7	Confirm with **<RUN/ENTER>**. *Int 3* appears on the display.

Calibration interval



8	Set the required interval in days with **<▲> <▼>**.
9	Confirm with **<RUN/ENTER>**.

Date and time



10	Set the date of the current day with **<▲> <▼>**.

11	Confirm with **<RUN/ENTER>**. The date (month) flashes in the display.
12	Set the current month with **<▲> <▼>**.
13	Confirm with **<RUN/ENTER>**. The year appears on the display.
14	Set the current year with **<▲> <▼>**.
15	Confirm with **<RUN/ENTER>**. The hours flash on the display.
16	Set the current time with **<▲> <▼>**.
17	Confirm with **<RUN/ENTER>**. The minutes flash on the display.
18	Set the current time with **<▲> <▼>**.
19	Confirm with **<RUN/ENTER>**. The measuring instrument automatically switches to the pH measuring mode.

Setting the resolution

1	Press the **<RUN/ENTER>** key and hold it down.
2	Press the **<M>** key. The measured values are displayed with a high resolution, e.g. pH = 4.012.
3	Press the **<RUN/ENTER>** and **<M>** keys once more. The measured values are displayed with a low resolution, e.g. pH = 4.01.

4.7 Reset

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

Measurement parameters

The following measured parameters *(*pH *Inl)* are reset to the default condition:

Measuring mode	pH
Asymmetry	0 mV
Slope	-59.16 mV/pH
Calibration procedures	AutoCal TEC
Temperature, manual	25 °C
Resolution (pH display)	0.01 (low resolution)
Display during the pH calibration	Buffer nominal value

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

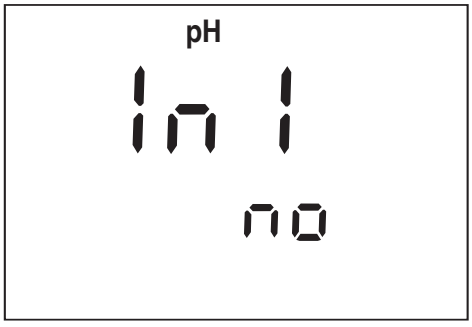
Configuration parameters

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

Baud rate	4800
Interval 1 (automatic save)	OFF
Interval 2 (for data transmission)	OFF

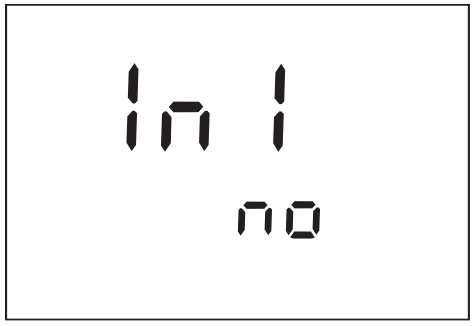
Resetting the measuring parameters

1	Press the **<RUN/ENTER>** key and hold it down.
2	Press the **<CAL>** key.



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

Resetting the configuration parameters



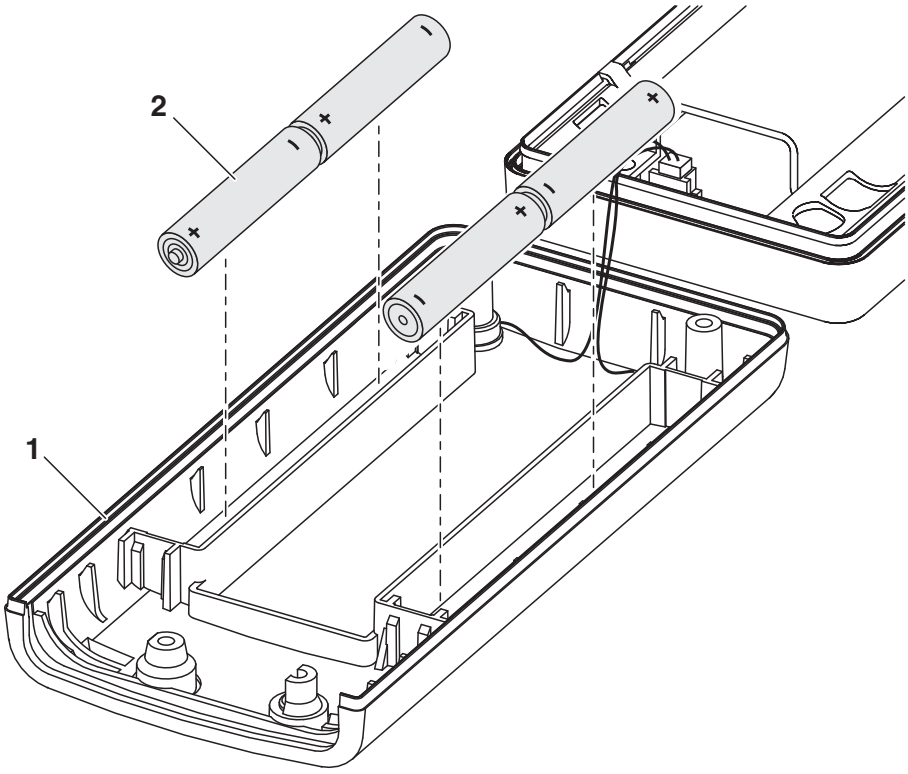
5	Using **<▲> <▼>**, switch between *no* and *YES*. *YES*: Resetting the configuration parameters *no*: Retaining settings.
6	Confirm with **<RUN/ENTER>**. The measuring instrument automatically switches to the pH measuring mode.

5 Maintenance, cleaning, disposal

5.1 Maintenance

The measuring instrument is almost maintenance-free.
The only maintenance task is replacing the batteries.
LoBat indicates that the batteries should be changed. The batteries are then largely depleted.

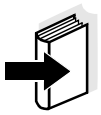
Replacing the batteries



1	Open the housing after the instrument has been switched off: – Undo the four screws on the underside of the instrument – Pull down the lower cover (1).
2	If necessary, take the four depleted batteries (2) out of the battery compartment.
3	Place four new batteries (type Mignon AA) in the battery compartment.
4	Close the lower cover (1).



Warning
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.



Note
For the maintenance of the electrodes, follow the corresponding operating manual.

5.2 Cleaning

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



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

5.3 Disposal

Packing

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

Batteries

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



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

Measuring instrument

Dispose of the measuring instrument as electronic waste at an appropriate collection point. It is illegal to dispose of the instrument in household refuse.

6 What to do if...

Error message OFL

Cause	Remedy
pH electrode:	
– Not connected	– Connect electrode
– Air bubble in front of the diaphragm	– Remove air bubble
– Air in the diaphragm	– Extract air or moisten diaphragm
– Cable broken	– Replace electrode
– Gel electrolyte dried out	– Replace electrode

Error message E3

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

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

No stable measured value

Cause	**Remedy**
pH electrode:	
– Diaphragm contaminated	– Clean diaphragm
– Membrane contaminated	– Clean membrane

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

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

LoBat display

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

Obviously incorrect measured values

Cause	Remedy
pH electrode:	
– pH electrode unsuitable	– Use suitable electrode
– Temperature difference between buffer and test sample too high	– Adjust temperature of buffers or test samples
– 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 the **<CAL>** and **<ON/OFF>** keys at the same time and release them again. The software version is displayed.

Display to

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

Probe symbol flashes

Cause	Remedy
– Calibration interval expired	– Recalibrate the measuring system

Message StoFull

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

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

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

7 Technical data

Dimensions and weight

Length [mm]	172
Width [mm]	80
Height [mm]	37
Weight [kg]	Approx. 0.3

Mechanical structure

Type of protection	IP 66

Electrical safety

Protective class	III

Test certificates

cETLus, CE

Ambient conditions

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

Measuring ranges and resolution

	Measuring range	Resolution
pH	- 2.000 ... + 19.999 - 2.00 ... + 19.99	0.001 0.01
U [mV]	- 999.9 ... + 999.9 - 1999 ... + 1999	0.1 1
T [°C]	- 5.0 ... + 105.0	0.1

Accuracy (± 1 digit)

pH(± 2 pH units from the calibration point)	± 0.003 at + 15 °C ... + 35 °C ± 0.01
U [mV]	± 0.2 at + 15 °C ... + 35 °C
T [°C]	NTC 30: ± 0.1 PT 1000: ± 0.5 at 0 °C ... 15 °C ± 0.1 at 15 °C ... 35 °C ± 1 at 35 °C ... 55 °C

pH temperature input:

Manually [°C]	- 20 ... + 130

Analog output (only pH 3400i)

Automatic switchover when the recorder is connected by the cable, AK 323.

Output signals	Corresponds to the electrode voltage, i.e. 50-62 mV/pH unit
Accuracy	± 0.1% of the measured value ± 4 mV
Internal resistance	< 5 Ohm (current limited to max. 0.2 mA output current)

Serial interface (only pH 3400i)

Automatic switchover when a PC or a printer is connected via the cable, AK 340/B or AK 325/S.

Type	RS 232, data output
Baud rate	Selectable 1200, 2400, 4800, 9600 baud
Data bits	8
Stop bit	2
Parity	None
Handshake	RTS/CTS + Xon/Xoff
Cable length	Max. 15m

Power supply

Batteries	4x1.5V alkali-manganese batteries, Type AA
Operational life	Approx. 3000 operating hours
Mains (only pH 3400i)	The following specifications apply to all plug-in power supplies: Connection max. Over-voltage category II Plug-in power supply unit (Euro, US , UK, Australian plug) FRIWO FW7555M/09, 15.1432 Friwo Part. No. 1822089 Input: 100 ... 240 V ~ / 50 ... 60 Hz / 400 mA Output: 9 V = / 1,5 A

Guidelines and norms used

EMC	E.C. guideline 89/336/EEC EN 61326-1:1997 EN 61000-3-2 A14:2000 EN 61000-3-3:1995 FCC Class A
Instrument safety	E.C. guideline 73/23/EEC EN 61010-1 A2:1995
Climatic class	VDI/VDE 3540
Type of protection	EN 60529:1991

FCC Class A Equipment Statement

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

8 Lists

This chapter provides additional information and orientation aids.

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

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

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

Abbreviations

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

S	Slope (internat. k)
SELV	Safety Extra Low Voltage
SLO	Slope setting on calibration
TP	Temperature measurement active (Temperature Probe)
U_{ASY}	Asymmetry

Glossary

Adjusting To manipulate a measuring system so that the relevant value (e. g. the displayed value) differs as little as possible from the correct value or a value that is regarded as correct, or that the difference remains within the tolerance.

Asymmetry Designation for the offset potential of a pH electrode. It is the measurable potential of a symmetrical electrode, the membrane of which is immersed in a solution with the pH of the nominal electrode zero point (WTW electrodes: pH = 7).

AutoRange Name of the automatic selection of the measuring range.

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

Calibration Comparing the value from a measuring system (e. g. the displayed value) to the correct value or a value that is regarded as correct. Often, this expression is also used when the measuring system is adjusted at the same time (see adjusting).

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

Electrode zero point The zero point of a pH electrode is the pH value at which the electromotive force of the pH electrode at a specified temperature is zero. Normally, this is at 25 °C.

Electromotive force of an electrode The electromotive force U of the electrode is the measurable electromotive force of an electrode in a solution. It equals the sum of all the galvanic voltages of the electrode. Its dependency on the pH results in the electrode function which is characterized by the parameters, slope and zero point.

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

Measured value The measured value is the special value of a measured parameter to be determined. It is given as a combination of the numerical value and unit (e. g. 3 m; 0.5 s; 5.2 A; 373.15 K).

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

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

MultiCal® WTW name stating that a measuring instrument provides several calibration procedures.

Offset potential The measurable potential of a symmetrical electrode, the membrane of which is immersed in a solution with the pH of the nominal electrode zero point. The asymmetry is part of the offset potential.

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).

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.

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

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

Slope The slope of a linear calibration function.

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

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

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