HENNLICH IPARTECHNIKA KFT

6000 Kecskemét-Kadafalva, Heliport Reptér – www.hennlich.hu

The all-rounder:

pH-, redox-, temperature- and conductivity measurement
all in one device!

Precision meter PM 2000

Automatic sensor recognition

Sturdy anodized aluminium housing

Illuminated display:
8 digits x 14 segments

Easy handling by clear user guidance system

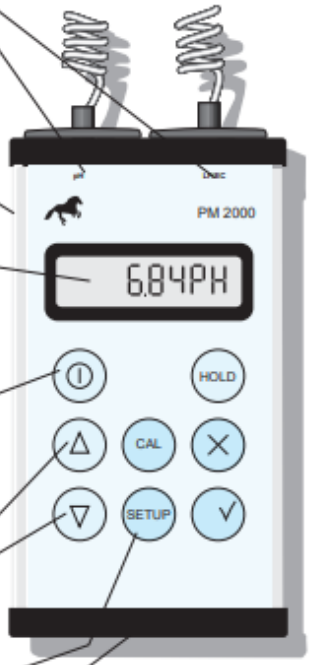
ON
Device switches off after 15 min.

Kind of measurement
pH / mV / °C / µS / mS

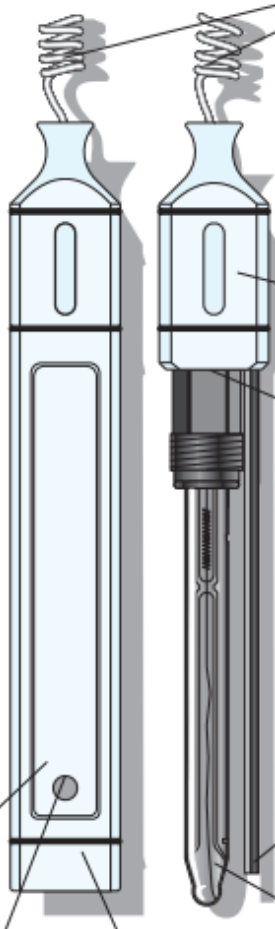
Automatic pH calibration with **CAL**

3 Lithium batteries AA

degree of protection: IP63



sensor spiral cable



pH / redox amplifier
with
temperature probe
Art.No.: 2000 0030

thread AS7

Temperature measurement
Pt 1000 sensor

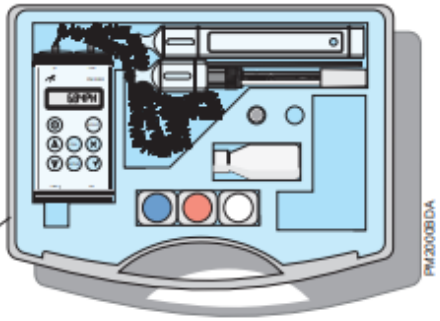
pH-measurement
Combination pH electrode
pH 62 / Inlab 412 or
combination redox electrode
Rx 110

Low-polarisation graphite

Conductivity measurement
Art.No.: 2000 0241

Conductivity cell
useable up to 100°C for short time
material: ABS

Temperature measurement
Pt 1000 sensor



Complete in case

QUICK GUIDE PM 2000

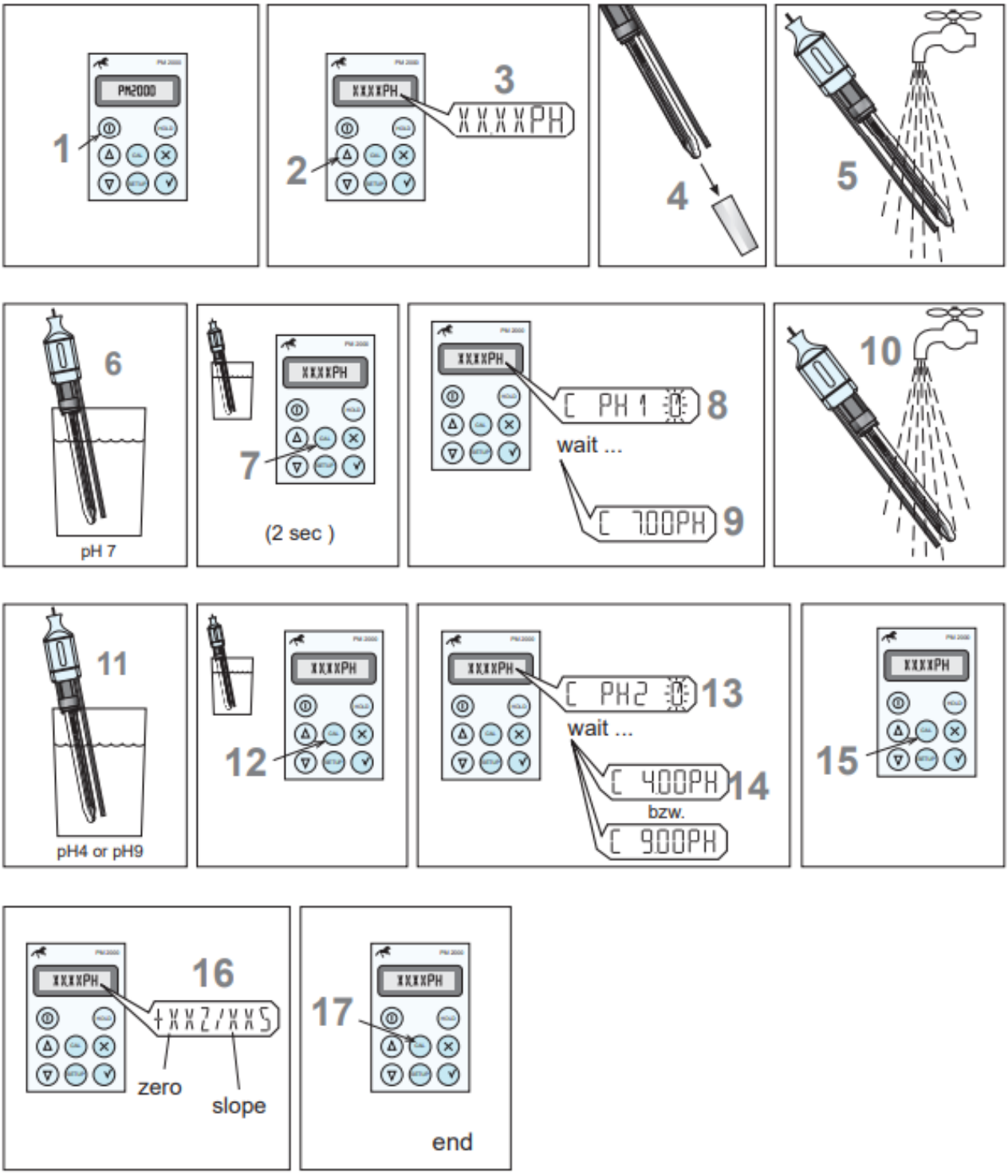
⏻	Switch on	(1 sec. sensor indication and 1 sec. "CONTR").
✕ 2 sec.	Switch off	(the instrument also switches off automatically 15 min after the last key press)
△ ▽	Adjust contrast	(one of the keys must be pressed during the indication "CONTR")
△ ▽	Select operating mode e.g.	→pH - ►REDOX - ►EC - ►TEMP -
HOLD 2 sec.	hold the indication	(indication is flashing)
	switch illumination on/off	(turns off automatically after 5 minutes)
CAL 2 sec.	pH calibration when the display shows "PH"	

SETUP 2 sec.

TC-XXX	Set conductivity compensation method and temperature coefficient.	✓ △ ▽ ✓
RT XX°C	Adjust conductivity reference temperature.	✓ △ ▽ ✓
CC X.XXXX	Adjust cell constant.	✓ △ ▽ ✓
PH/XX	Switch redox range on/off. Determine offset voltage of redox electrode. This requires a redox reference solution.	✓ △ ▽ ✓
TEMP XX	Select temperature probe for temperature indication	✓ △ ▽ ✓
ENGLISH	Select menu language.	✓ △ ▽ ✓
MANUFAC	Indication of serial and version number	✓

✓ Enter ✕ Cancel

QUICK GUIDE - pH CALIBRATION



NOTE: If the indication "ǂXXZ/XXS" flashes, there is a fault.
(see also notes on faults/error messages).

Remove the fault and repead the calibration!

QUICK GUIDE - pH CALIBRATION

- Switch on (1 sec. sensor indication and 1 sec. " CONTR").

- Select pH-range (indication: " XXXXPH ").

- Remove protection cap of pH electrode.

- Rinse the electrode (if possible in destillated water).

- Immerse pH-electrode in buffer solution (calibration possible with pH7 / pH4 or with pH7 / pH9).

CAL

2 sec.

- Calibration is started " PH 1 0" wait... " C 7.00PH".

- Rinse the electrode.

- Immerse electrode in second buffer solution.

CAL

- " C PH2 0" wait... " C 4.00PH".

CAL

- Zero point and steepness " ±XX.X/XX.X " are indicated.

ATTENTION: - If indication " ±XX.X/XX.X " is flashing, there must be a fault (see also notes on faults/error messages)
Clear fault and repeat calibration.

CAL

- Back to measurement indication.

WORKING WITH THE INSTRUMENT

SWITCH ON THE INSTRUMENT:

Press (I).

The instrument type is indicated for approx. 1 sec. (e.g. "PH-EC").

Indication "CONTR" appears for approx. 1 sec.

ADJUSTING THE CONTRAST:

If the display indicates ".CONTR.". , you can adjust the contrast of the display by pressing the keys (△) and (▽)

Enter the new contrast setting by (√) or retain the last setting by (×).

SWITCHING DISPLAY ILLUMINATION ON / OFF:

Press (HOLD) for at least 2 seconds to switch display illumination on / off. Display illumination automatically switches off after 5 minutes.

ADJUSTING THE MEASURING RANGE:

By the keys (△) (▽).

HOLD THE CURRENT MEASUREMENT ON THE DISPLAY:

Press (HOLD)

The indication is flashing; the measured value is held.

Press (HOLD) to release the measurement.

SWITCHING OFF:

The instrument switches off approx. 15 min after the last key has been operated; or press (×) 2 sec.

MEASUREMENT

TEMPERATURE:

- Select temperature range by △ or ▽ (indication: "XXX.X °C").
- Depending on selected temperature probe, immerse the probe in the medium and move it gently. (Standard sensor pH measuring amplifier)
- If the pH electrode has to be screwed off for temperature measurement, connections of preamplifier and of pH-electrode must be protected against dirty, by putting on the protection caps.
- Read the measurement.

CONDUCTIVITY:

- Select conductivity range by △ or ▽ (indication "XXX.X µS").
- Immerse conductivity cell in the medium. By moving gently possible air bubbles remaining in the contact space of conductivity cell are removed.
- For measurement, the sensor can not get up on the bottom of the vessel.
- If the indication is zero, select a smaller range with ▽
- If the reading is "1 . mS" or "1 . µS", select a larger range by △.
- If a measurement is not credible, you should check the setting of the temperature coefficient in SETUP.
  Changing the temperature coefficient is only possible in SETUP.
  Also check the cell type set in SETUP.

Warning:

Conductivity cell is only operatable in watersoluble mediums, otherwise measuring contacts will be affected and therefore results will be wrong!

MEASUREMENT

REDOX:

- For measurement of redox-voltage you have to exchange pH-electrode against a redox electrode (redox combination electrode).
- Select redox range by △ or ▽ (indication: "XXXXmV")
- Remove protection cap of redox electrode.
- Immerse the electrode in the medium and move it gently.
- Read the measurement.
- Rinse the redox electrode.
- Slide the protection cap back on the electrode.
- If the reading is implausible, you can test the zero-point with redox-solution in SETUP.

pH:

- Select pH range by △ or ▽ (indication: "XX.XPH").
- Remove protection cap of pH electrode.
- Electrode in the liquid to be measured dive and move mountains.
- Attention, the pH electrode is very sensitive to scratches. If your measuring vessel made of glass, please note this.
- Read the measurement.
- pH electrode cleaning by rinsing.
- Slide the protection cap back on the electrode.
- If the reading is not credible, re-calibrate the electrode.

The pH value can be measured only in water and in water-soluble fluids.

The measurement of pH in oil, fat, solvent etc. can be measured only by using the extraction.

SETUP CONDUCTIVITY ADJUSTMENTS

CALLING UP SETUP:

2 sec.

ADJUSTING LINEAR TEMPERATURE COEFFICIENT

Here you can set the temperature coefficient for conductivity between 0.0% and 3.9%.

Step	Key	Indication	Note
1	SETUP 2 sec.	SETUP	Calling up setup
		TC-NAT	
2	✓	TC-NAT	Indication flashes
3	△ or ▽	TC-LIN	Switching method
4	✓	TC XX%o	Entering method
5	△ or ▽	TC 1X%o	Predecimal place
6	✓(✕ = cancel)	TC 1X%o	Entering figure
7	△ or ▽	TC 12%o	First decimal place
8	✓(✕ = cancel)	TC-LIN	Entering figure
9	✕		Escaping setup

SETTING TEMPERATURE COMPENSATION FOR NATURAL WATERS

Step	Key	Indication	Note
1	SETUP 2 sec.	SETUP	Calling up setup
		TC-LIN	
2	✓	TC-LIN	Indication flashes
3	△ or ▽	TC-NAT	Switching method
4	✓(✕ = cancel)	TC-NAT	Entering method
5	✕		Escaping setup

SETUP CONDUCTIVITY ADJUSTMENTS

SETTING REFERENCE TEMPERATURE FOR CONDUCTIVITY MEASUREMENT:

- The reference temperature for temperature compensation can be switched between 20°C and 25°C.

Step	Key	Indication	Note
1	SETUP 2sec.	SETUP	Calling up setup
		TC-XXX	
2	▽	RT XX°C	
3	✓	RT XX°C	Indication flashes
4	△ or ▽	RT XX°C	Changing ref. temp.
5	✓ (✗ = cancel)	RT XX°C	Entering ref. temp.
6	✗		Escaping setup

SETTING CELL CONSTANT :

Cell constant adjustable from 0,8000 to 1,6999 .

Schritt	Key	Indication	Note
1	SETUP 2sec.	SETUP	Calling up setup
		TC-XXX	
2	▽ ▽ ...	CC XXXXX	Current cell constant
3	✓	CC XXXXX	First digit begins blinking
4	△ or ▽	CC 1XXXX	Enter first digit
5	✓ (✗ = cancel)	CC 1.2726	Enter all other digits
6	✗		Escaping setup

SETUP

SELECTING TEMPERATURE PROBE FOR TEMPERATURE INDICATION

TEMP PH - For temperature measurement, the temperature sensor of the pH-amplifier used

TEMP EC - For temperature measurement, the temperature sensor uses conductivity cell

Step	Key	Indication	Note
1	SETUP 2sec.	SETUP	Calling up setup
		TC-XXX	
2	△ ...	TEMP PH	
3	✓	TEMP PH	Selecting source
4	△ or ▽	TEMP EC	
5	✓ (✕ = cancel)	TEMP EC	Entering
6	✕		Escaping setup

INDICATION OF THE SERIAL NUMBER

MANUFAC - here the instrument serial and version number are indicated.

Step	Key	Indication	Note
1	SETUP 2sec.	SETUP	Calling up setup
		TC-XXX	
2	△	MANUFAC	
3	✓	No.XXXXXX	Serial number
4	✓ (✕ = cancel)	V 1.03	Version number
5	✓ (✕ = cancel)	MANUFAC	
6	✕		Escaping setup

SETUP REDOX

SETTING OFFSET POTENTIAL OF REDOX ELECTRODE

To determine the offset of your redox electrode:

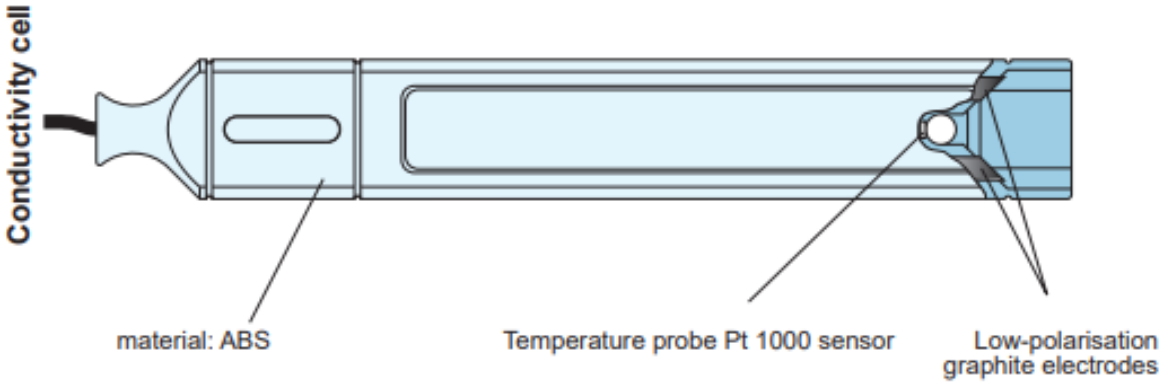
- Remove protection cap of your redox electrode and rinse the electrode.
- Immerse electrode in redox reference solution.

Step	Key	Indication	Note
1	SETUP 2sec.	SETUP	Calling up setup
		TC-XXX	
2	▽ ▽ ...	PH/---	
3	✓	PH/---	
4	△ or ▽	PH/RX	
5	✓	0 mV	Enter the redox potential of the redox reference solution
6	△ or ▽	mV	
7	✓ (✕ = cancel)	20 mV	
8	△ or ▽	2 mV	
9	✓ (✕ = cancel)	210 mV	
10	△ or ▽	216 mV	
11	✓ (✕ = cancel)	216 0	Offset is measured
		N XX mV	Dertermined offset
12	✓	PH/RX	
13	✕		Escaping setup

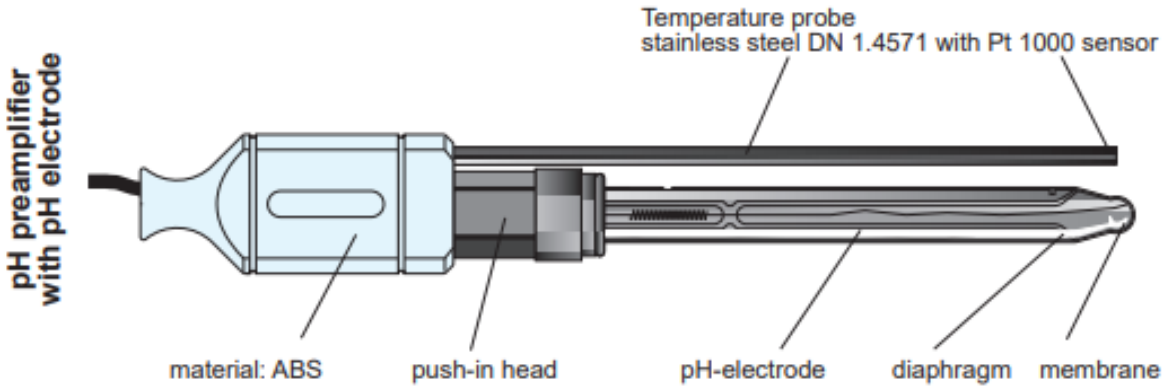
ATTENTION: - In future, determined offset will be considered automatically at each redox measurement and correct result will be indicated.

- If the message "FAIL 6" is indicated the divergence of zero offset of redox electrode is too high > (+-50mV) and can not be compensated automatically. In this case the offset is reset to zero.

PROBE DESCRIPTION



Warning: Conductivity cell is only operatable in watersoluble mediums, otherwise measuring contacts will be affected and therefore results will be wrong!



MAINTENANCE NOTES

pH electrodes:

Cleaning:

Any contamination deposited on the glass membrane has to be removed.
If careful wiping with a moist soft tissue does not prove successful, various chemical cleaning methods can be used depending on the type of contamination.

Experience has shown that the following agents can be used for cleaning glass electrodes:

With fat and oil contamination: cleaner containing detergents, domestic detergent cleaners.
With lime deposits and metal hydroxide coatings: dilute hydrochloric acid (10%).
With deposits containing sulfides (e.g. wastewater treatment): a cleaner mixture of dilute hydrochloric acid (10%) and thiourea (saturated).
With media containing proteins (measurements on foodstuffs): a cleaner mixture of dilute hydrochloric acid (10%) and pepsin (saturated).
As regenerating solution for very sluggish pH electrodes: a fluoric acid mixture consisting of nitric acid (10%) and ammonium fluoride (50 g/l).

For cleaning dirty diaphragms it is possible to use the same methods as for glass electrodes. Diaphragms blocked by precipitated silver chloride (through prolonged contact with low-ion water) or silver sulfide (measurement in sulfide-containing media) which have a brown or black colouration; can possibly be made operatable again by treatment with 28% ammonia solution or a special diaphragm cleaning solution. At severe dirtying there is the possibility to file the surface of the diaphragm (only of the diaphragm) with a fine nail file. (Only possible on glass electrodes).

Warning! **Observe protective precautions handling solutions containing acid. Always rinse all parts in deionised water after cleaning.**

Short-term / long-term storage:

-Short-term storage of electrodes (not suitable for pH-120)

In principle all electrodes should be stored in a 3 mol/l potassium chloride solution; for correct operation of the glass electrode the presence of the water-containing film on the surface of the membrane glass is an essential requirement.

- Long-term storage of electrodes:

All electrodes which are not being used for longer periods are best stored in dry areas at 10 - 30°C, i.e. the protection cap contains no liquid. Before use, the electrodes must be soaked for 24 hours in a 3 mol/l potassium chloride solution (formation of the membrane layer).
Electrodes are only determinated storable.
It is recommendable not to exceed storage period of 6 months.

For gel-filled electrodes it is essential to store them in 3 mol/l potassium chloride solution. Refill the protection cap every 3 - 4 weeks.

Important: **At temperatures below -5°C the electrodes may fracture through freezing of the internal buffer and the internal electrolyte. Ensure that packaging is protected against frost when shipping.**

Conductivity cell:

Occasional cleaning of the electrode surface with a commercially available cleaning detergent (with a small tooth brush) is recommended. Otherwise the conductivity cell requires no maintenance.

Warning: **Conductivity cell is only operatable in watersoluble mediums, otherwise measuring contacts will be affected and therefore results will be wrong!**

MAINTENANCE NOTES

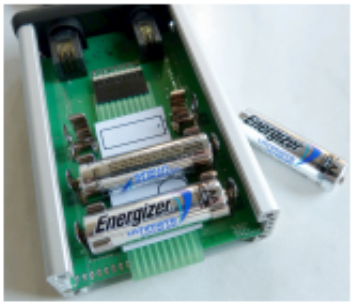
Replace batteries:

Replace the batteries when the display shows "LO BAT" appears.

The exchange should take place in a dry and clean environment.

Unscrew the plastic cover soil.

Pull back.



Replace batteries.

CAUTION:

NOTE POLARITY.

Reversed using batteries can destroy the device.

In order to ensure the accuracy of the measurements, only lithium AA batteries are used.

Assemble in reverse order it again.

Case back is marked with the note "keyboard".
(Please note in the soil)

Please note:
Empty batteries out of the bin. Please ensure the set up
Collection points.

NOTES ON FAULTS

If there should be any faults during operation or calibration, please check the following items:

Fault	Fault elimination
Instrument cannot be switched on.	- Batteries empty
Temperature measurement:	
Reading not credible?	- Temperature probe not immersed deeply enough in the medium ? (at least 3 cm) - (on pH-EC only) It is important to note which probe has been selected for temperature measurement in SETUP.
pH measurement:	
Reading not credible; time for stable measurement is too long.	- Has the instrument been calibrated ? - pH membrane dirty ? - Diaphragm dirty ? - pH electrode used?
Conductivity measurement:	
Reading not credible.	- Are measurement contacts clean ? - Is temperature coefficient adjusted correctly ? - Is reference temperature adjusted correctly ? - Is the correct cell constant adjusted?

ERROR MESSAGES

Message	Explanation	Fault elimination
LoBAT	- Batteries empty	- Change batteries
FAIL 6	- Offset of redox electrode is too high, can no longer be compensated automatically.	- Is electrode clean ? - Is redox reference solution too old or exhausted?
	Zero Point (+ - 50 mV) or slope (53 .. 59 mV) the pH electrode are outside the predefined parameters	- Have membrane and diaphragm been cleaned ? - Are buffer solutions too old or exhausted ? - Is temperature probe immersed in buffer solution ? - Exchange electrode
----PH	- Not a valid pH calibration available. It is measured with "0 Z 58S.	- Carry out pH calibration.

Technical Data:
subject to alterations

Ambient temperature:	0 - 50°C
Indication:	8 digits x 14 segments LCD - 7mm with switchable backlight
pH input impedance:	> 10^{12} Ohm
pH input current:	≤ 1 pA
Batteries:	3x1, 5V Lithium, min 90 hrs battery life, battery indicator, auto power off after 15 minutes.
Weight:	280g without probe
Housing:	aluminium (anodised silver)
Warranty :	1 year, exclusive consumption articles e.g. pH-electrodes
Dimensions:	L x W x D 128 x 82 x 31 mm

pH measurement

Measuring range:
0,00 to 14,00 pH

Automatic temperature compensation 0 to 100°C

Indication accuracy: ±0,01 pH

Automatic calibration with buffer
pH7.00 and pH4.00 or pH7.00 and pH9.00
(buffer value is stated and automatically recognized)

mV measurement (redox potential):

Voltage from -1000 mV to +1000 mV

(resolution 1mV)

Zero position for redox electrodes separately adjustable.

Temperature measurement

Range: -25,0°C to +150,0°C

Resolution: 0,1°C,
Accuracy: +- 1°C

Sensor: Pt 1000 Class B

Conductivity measurement

Measuring range:
0 - 99,99 µS / 999,9 µS / 9999 µS / 99,99 mS / 999,9 mS

Accuracy: up to 200mS: <2% or 8 digit
up to 500mS: <4% or 5 digit

The measuring frequency is automatically adapted
to conductivity (approx. 20 Hz to 110 kHz)

Temp. coeff. adjustable 0 - 3,9%
(standard setting 2,2%)
(natural waters)

Temperature measurement:

Range: 0°C to 100°C

Resolution: 0,1°C
accuracy: +-1°C

Sensor: Pt 1000 Class B

Dimensions of conductivity measuring cell:

W x D x L = 32 x 18 x 165mm

Combination pH electrodes

Dimensions: ø12mm x L=125mm

All round standard pH electrode with plastic stem
Combination pH electrode **pH 62**
1 - 12 pH, 0 - 60°C

Precision pH electrode with glass stem
Combination pH electrode **InLab 412**
0 - 14 pH, 0 - 100°C

Case:

Practical, handy case, well suited for field use.

This portable analysis device with battery supply is appropriate for each application. Be it in the laboratory, production, waste water treatment, in routine measurements in the field, every place where precise measurements are needed.

APPENDIX

General information:

What is pH?

pH is the abbreviation of "potentia hydrogenii", or concentration of hydrogen. PH is the logarithmic unit of hydrogen ion concentration. Its scale extends from 10^{-14} to 10^{0}.
For simplification the exponent is specified without sign. pH 7 therefore means a hydrogen ion concentration of 10^{-7} or 1 gramme hydrogen ions at 10^{7} gramme water.

What is the significance of pH?

A high concentration of hydrogen ions in water means acidic water; a low concentration means alkaline water. At a concentration of 10^{-7} = pH 7 the reaction is neutral.
pH values below 7 are characterising acidic liquids, those above pH 7 alkaline liquids. Because of the logarithmic scale unit, each whole number on the pH scale represents a 10-fold increase in acidity (degree of alkalinity). Today pH measurement is used in wide areas of industry, medicine, pharmaceutical industry and research.

How does an electronic pH meter work?

A glass measuring probe is immersed in the water to be examined. The probe is linked by a cable to a battery-operated measuring instrument. The electrical voltage generated by the probe depends on the pH. A high-sensitivity amplifier processes this measuring signal and passes it to the digital display. The accuracy of the instrument can be checked at any time by using two precisely adjusted calibration solutions (buffer solutions).

How long does a pH measurement take?

The time required by a pH electrode to provide a stable measurement extends from a few seconds to several minutes. It depends on the construction and on the age of the electrode, as well as on the consistency and the temperature of the solution tested.

What is redox potential and what is the purpose of redox measurement?

The concept "redox" is an abbreviation for the simultaneous reactions of reduction and oxidation. Oxidation is understood to be not only the absorption of oxygen but also quite generally the absorption of a positive charge or the loss of negative charges. Reduction is understood to be the reversal of these processes.

How is the redox potential measured?

This requires a platinum electrode and a pH meter with a mV range. The platinum electrode is immersed in water like a pH electrode and the result of the measurement is readable after some time.

What is conductivity?

Conductivity generally is measured as specific conductivity. Liquids conduct an electric current through ions. The more ions, the higher the conductivity. Units: µS/cm (micro-Siemens per centimetre) or mS/cm (milli-Siemens per centimetre).

What is the significance of conductivity?

Most of the ions contained in water are parts of dissolved salts. For example, common salt (formula: NaCl) is divided into a positive sodium ion (Na^+) and a negative chlorine ion (Cl^-). Both ion types conduct the electrical current. Simplified, conductivity is a measurement for the quantity of dissolved salts in water.

Reference temperature list:

Specific conductivity (kappa) of KCl solutions of different concentrations at different temperatures, in S / cm.

Concen-tration	0°C	15°C	16°C	18°C	19°C	20°C	22°C	24°C	25°C
1,000n-KCl	0,065410	0,092520	0,094410	0,098220	0,100140	0,102070	0,105940	0,109640	0,111800
0,100n-KCl	0,007150	0,010480	0,010720	0,011190	0,011430	0,011670	0,012150	0,012640	0,012880
0,010n-KCl	0,000776	0,001147	0,001173	0,001225	0,001251	0,001278	0,001332	0,001386	0,001413

APPENDIX

pH and redox electrodes

General note:
People talk about electrodes, or combination electrodes. Most of the time they talk about combination electrodes, i.e. a combinated electrode in which the reference electrode is also the reference system.

1. Combination electrodes:

Electrodes for measuring electrochemical potentials always consist of a measuring electrode and a reference electrode. The measuring or indicator electrode provides the voltage in relation to the concentration. The voltage of the reference electrode however is constant and is not influenced by the medium.

Combination electrodes are constructions consisting of a glass electrode and a reference electrode. The reference electrode is arranged concentrically around the glass electrode.

1.1 Reference electrode system:

Reference electrode systems are predominantly constructed with a silver/silver oxide reference system. Reference systems with liquid electrolyte should always contain sufficient liquid; if necessary they are topped up with 3 mol potassium chloride solution. Reference electrodes with gel reference electrolyte can not be topped up. During measurement the filler opening should be open to ensure pressure equilibration. The liquid column inside the electrode should be a few centimetres higher than the level of the measured solution in order to produce a positive hydrostatic pressure which ensures a steady flow of KCl solution through the diaphragm out into the measured solution. The result is a continuous self-cleaning action of the diaphragm and besides it prevents, that eventually poison of electrode are diffusing inside the electrode, which would destroy the drawing off system.

1.2 Diaphragmas:

Reference electrodes are in contact with the measured solution through a diaphragm. This diaphragm must be porous and permeable for liquids. Among diaphragms one can distinguish between a ceramic diaphragm.

1.3 pH measurement of soil:

For pH measurement of soil, approx. 100 cm^3 soil is mixed thoroughly with 100 cm^3 distilled water. Immerse the combination pH electrode and move it slightly. The pH can be read when the indication no longer changes. Clean the pH electrode after use only by rinsing with ordinary water and shake off any water adhering to it. After use, please pull the soaking cap filled with KCl solution back over the electrode tip. The KCl solution should be renewed frequently.

APPENDIX

2. Plastic electrodes:

e.g. pH 60

Plastic electrodes represent a compromise design. Their advantage is that they are nearly unbreakable and have a closed, maintenance-free system which does not require refilling. Their disadvantage is larger errors, up to a few tenths pH, in case of measurements differing from ambient temperature.

The following measurement procedure has proved successfully:
Immerse the electrode in the medium, move it gently and take the measurement when the reading has become stable. If immersion period of electrode is exceeded (several minutes) the zero position begins to drift (this is due to the design).

3. Metal electrodes (redox electrodes):

The metal surface must be free of any form of contamination. Apart from mechanical cleaning processes (supersonic, grinding, polishing) it is also possible to use cleaning detergents listed under item 6; also chrome-sulfuric acid for removing fatty films.

4. Electrode mounting:

Electrodes must be arranged vertically from above or at an angle of up to 75° to the vertical. Horizontal electrodes or inverted electrodes are incapable of measurement. This requirement applies also during the calibration of electrodes.

Cable connection:

NOTE: On plug connectors it is important to ensure that they are kept absolutely clean and dry; otherwise there may be creepage currents which reduce the measurement signal or cause it to collapse completely.