H86.0.1X.6C-01

GREISINGER

Member of GHM GROUP

Operating manual

pH-Meter waterproof

as of version 1.0

G 1500

CE

☞ Please carefully read these instructions before use!

☞ Please consider the safety instructions!

☞ Please keep for future reference!

Made in Germany

WEEE-Reg.-Nr. DE 93889386

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1 General note

Read through this document attentively and make yourself familiar to the operation of the device before you use it. Keep this document in a ready-to-hand way in order to be able to look up in the case of doubt.

2 Safety

2.1 Intended Use

The device is designed for measuring the pH value by means of suitable electrodes.

It is equipped with a BNC connector for connecting different pH electrodes. The choice of a suitable electrode allows the device to be used in diverse applications.

Personnel which starts up, operates and maintains the device has to have sufficient knowledge of the measuring procedure and the meaning of the resulting measured values, this manual delivers a valuable help for this. The instructions of the manual have to be understood, regarded and followed.

The manufacturer will assume no liability or warranty in case of usage for other purpose than the intended one, ignoring this manual, operating by unqualified staff as well as unauthorized modifications to the device.

2.2 Safety signs and symbols

Warnings are labeled in this document with the followings signs:

Caution! This symbol warns of imminent danger, death, serious injuries and significant damage to property at non-observance.

Attention! This symbol warns of possible dangers or dangerous situations which can provoke damage to the device or environment at non-observance.

Note! This symbol point out processes which can indirectly influence operation, possibly cause incorrect measurement or provoke unforeseen reactions at non-observance.

2.3 Safety guidelines

This device has been designed and tested in accordance with the safety regulations for electronic devices.
However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using the device.

1. Trouble-free operation and reliability of the device can only be guaranteed if the device is not subjected to any other climatic conditions than those stated under (chapter 13 Specification).

2. 

If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting.
Operator safety may be a risk if:
- there is visible damage to the device
- the device is not working as specified
- the device has been stored under unsuitable conditions for a longer time.

In case of doubt, please return device to manufacturer for repair or maintenance.

3. 

Do not use these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury or material damage.
Failure to comply with these instructions could result in death or serious injury and material damage.

4. 

This device must not be used at potentially explosive areas! The usage of this device at potentially explosive areas increases danger of deflagration, explosion or fire due to sparking.

5. 

The electrodes contain 3 mol/l KCl or 1 mol/l KNO_3.

First aid measures

In case of contact with skin:	wash off with plenty of water
In case of contact with eyes:	rinse with plenty of water while holding the eyelid open and consult an eye doctor, if necessary.
If swallowed:	drink plenty of water. In case of nausea, consult a doctor.

6. 

This device is not constructed for use in medical applications.

7. 

Electrodes for measuring the pH value (including those with a plastic shaft) consist partly of glass, which can cause injuries if broken.
Especially when used for measuring foods there is a danger of damage to the electrode.
Therefore, always observe the following:
   - Check the electrode for damage before and after every measurement.
   - When measuring foods, always use small samples for the measurement and discard afterwards.

3 Product description

3.1 Scope of delivery

The scope of supply includes:

- Device with 2 batteries type AA
- Electrode for measuring the pH value (not **G 1500-GL**)
- Operating Manual
- Calibration protocol

3.2 Operating and Maintenance

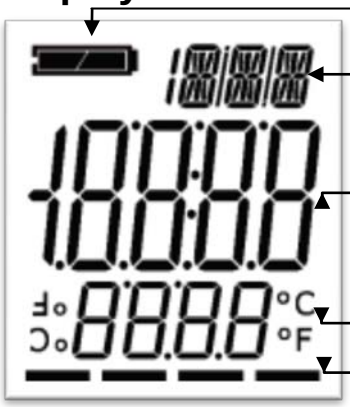
1. Battery operation:
   If the battery has been used up and needs to be replaced, the empty frame of the battery symbol starts blinking. The device will, however, continue operating correctly for a certain time.
   The battery has been completely used up, if ´bAt´ is shown in the main display.
   Battery replacement: (see chapter 10 Replacing batteries).

The battery has to be removed, when storing device above 50°C.
We recommend taking out the batteries if device is not used for a longer period of time.

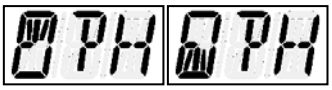
2. Treat device and probes carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plug and socket from soiling.
3. The pH electrode should be kept moist to prevent the membrane from drying out. We recommend storage in 3 mol/l KCl (our type: **KCL 3 M,** with the exception of **GE 103**). Extended storage in distilled or deionised water will result in depletion of the reference electrolytes.
4. The electrode should be stored in a dry area at a temperature between 10 °C and 30 °C. Below -5 °C the electrolytes can freeze, which will destroy the electrode.
5. The pH electrode that is included (not **G 1500-GL**) should be inserted at an angle of 90°±45° from the horizontal. This also applies to many other electrodes. For more information, consult the respective operating manual.

4 Operation

4.1 Display elements



Display “segment test“



Display “unstable“

1 **Battery symbol:** Rating of battery state

2 **Unit display:** Measured value units with stability indicator (~ is displayed until the measurement is stable, inner segments rotate) or display for “min/max/hold”

3 **Main display:** Current pH Value or value “min/max/hold”

4 **Auxiliary display:** Corresponding temperature value (to the value shown on the main display) with unit

5 no function

4.2 Pushbuttons

Overhead-display

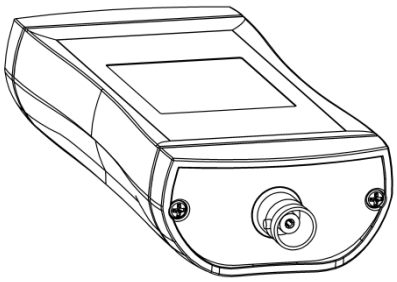
Key on/off, backlight
press shortly: switch on device
switch on/off backlight
press long: switch off device
In the menu:
press long: discard changes, device is switched off

Function key:
press shortly: hold and freeze measured value
press long: invoke menu
In the display “The saved value”:
press shortly: return to the measured value display
In the menu:
press shortly: select next parameter
press long: save settings, exit menu

Keys up/down:
press shortly: indicated value “min. or max”
press long: reset the “min-, / max-”value (to current measuring value)
In the menu:
change the selected current parameter

Turn display (”Overhead-display“)
press both keys until display is turned (orientation will be saved)

4.3 Connections



BNC socket:
connection for electrode

Usage of BNC plug:

Lock/ unlock with turnable ring at cable socket

ATTENTION

Protect contacts from soiling and moisture!
The connections are only waterproofed when a plug declared as waterproof is connected.

5 Start operation

Be sure that suitable batteries are inserted (see chapter 10 Replacing batteries).
Turn device on via key “on/off”.
After segment test the device displays some information about his configuration in the “auxiliary display”:

PoFF If “auto-power-off” is active - after the set time the instrument is switched off if no key is pressed (see chapter 7 Configuration).

CAL If there is no valid calibration >CAL< flashes on the unit display.

The device must be calibrated to the electrode prior to starting the measurement. (see chapter 8 Calibration of the pH measurement)
If the electrode is replaced, the device must be recalibrated.

After that the device is ready for measuring.

6 Basics of the measurement

6.1 pH measurement

The pH value describes the acidic or alkaline behaviour of an aqueous solution. pH values below 7 are acidic (smaller values indicate higher acidity), and values above 7 are alkaline; pH 7 = neutral.

To determine the pH value of a solution, it should always be recorded together with the measuring temperature, for example: pH 5.87; 23.0 °C.
The reason: Most liquids change their pH value with the temperature.

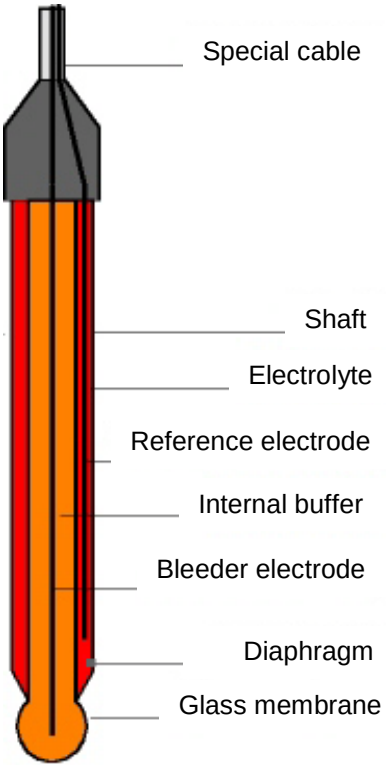
The pH measurement is very precise, but also sensitive. The measured signals are very weak (high-ohmic), especially when measured in weak or low-ion media. Therefore, always take measures to

- avoid interference (electrostatic charges, etc.)
- keep plug contacts clean and dry
- prevent electrodes (except special waterproof versions) from extended immersion above the shaft
- calibrate the electrode at sufficient intervals (see below). The frequency of calibration can range from every hour to several weeks, depending on the electrode and the application.
- use a suitable electrode. See chapter 6.2.5

6.2 pH electrodes

6.2.1 Design

Generally, single-rod measuring chains are used, which means that all necessary components are integrated in a single electrode (including the reference electrode).



The diaphragm, which establishes a connection between the electrolyte and the liquid to be measured, can be designed in different ways. Clogging / soiling of the diaphragm is a frequent cause of a malfunctioning or sluggish electrode. Always handle the glass membrane with extreme care. This is where the “source layer” is formed, which is crucial for the measurement. To maintain this layer, the electrode must always be kept moist (see below).

6.2.2 pH electrode GE 114 WD

The electrode included in the scope of delivery of the G 1500 is a robust, low-maintenance gel electrode with an epoxy shaft (Ø 12 mm x 120 mm), Pellon diaphragm and waterproof BNC connector.
Area of use: pH 0 - 14 (temperature range 0 - 60°C, conductivity >200µS/cm)

The electrode is suitable for universal use (e.g. drinking water, surface water, swimming pools, aquariums, slightly dirty waste water).

A storage bottle is included with the pH electrode. Before conducting a measurement, remove the electrode from the bottle (by loosening the screw cap) and rinse with tap water.

Fig. with/without storage bottle

6.2.3 Care and maintenance

The **GAK 1400** maintenance and calibration set contains the products needed for calibration, care and maintenance of your electrode: 5 buffer capsules (**GPH 4,0**, **GPH 7,0**, **GPH 10,0**), 3 wide-mouth bottles **GPF 100**, storage solution **KCL 3 M**, cleaning solution **GRL 100**

Crystallisation of the 3 mol/l KCl solution (potassium chloride) is unavoidable! Crystallised potassium chloride on the protective cap and shaft can easily be removed with a fingernail or cloth and is therefore not a defect or grounds for complaint.

Dirty electrodes must be cleaned. Suitable cleaners for the pH glass membrane are listed in the table below.

Impurities	**Cleaners**
General residue	Mild detergent
Inorganic coatings	Commercially available liquid glass cleaners
Metal compounds	1 mol/l HCl solution or **GRL 100**
Oil, grease	Special cleaner or solvent (*
Biological coatings with protein	1% pepsin enzyme in 0.1 molar HCl solution (**GRL 100**)
Resin lignins	Acetone (*
Extremely resistant residues	Hydrogen peroxide, sodium hypochloride (*

Normal cleaning: Immerse for at least 5 minutes in **GRL 100** pepsin cleaning solution, then rinse with clean water

*) Check the material of the pH probe (plastic shafts, for example, cannot be cleaned with solvent). If in doubt, contact the manufacturer to inquire about suitable cleaners for the existing electrode.
This is also important in the case of aggressive substances or other substances that are not primarily water-based!

6.2.4 Further information

pH electrodes are wearing parts that must be replaced after exposure to chemical and mechanical influences if compliance with the required values is no longer possible even after careful cleaning and possibly regeneration, or if the signal is very sluggish. When using the electrodes, be aware that various substances in aqueous solutions can corrode glass and that chemicals can produce a chemical reaction with the KCl solution in the electrode, which can result in blockage of the diaphragm.

Examples:

- In solutions that contain proteins, such as for measurements in medical and biological applications, KCl can cause denaturation of the protein.
- Coagulated paints
- Solutions that contain high concentrations of silver ions

Substances that accumulate on the glass membrane or the diaphragm affect the measurement and must be removed regularly. This can be achieved for example with automatic cleaning systems.

Electrodes normally have a life of at least 8-10 months, which can usually be increased to more than 2 years with proper care. The actual life will vary depending on the particular application.

6.2.5 Choosing a pH electrode

The **GE 114 WD** (or other universal electrodes, such as **GE 100**) can be used for most applications. However, some areas of application require special electrodes:

1. Measurements in low-ion media (rainwater, aquarium water, de-ionised water): **GE 104 BNC** (from 20 µS/cm).
4. Soil analyses
   Glass electrodes with more than one diaphragm (**GE 101 BNC**). Use an insertion mandrel!
5. Electroplating, certain paints and lacquers: **GE 151 BNC** glass electrode
6. Cheese, fruit, meat
   Needle electrode (**GE 101 BNC** or **GE 120 BNC**). For measurements in cheese, milk and all products that contain proteins, the electrode must be cleaned with a special cleaner (pepsin solution - **GRL 100**)
7. Waste water: Glass electrode with ground diaphragm **GE 173 BNC**

7 Configuration

Some menu points depend on current device settings.

invoke menu	next parameter	change parameter	confirm settings	discard changes
		 press shortly: single step hold key: fast change		

Press the “function key” long, until the menu is invoked and the first parameter is displayed (auxiliary display shows “SEt.t“).

Press the “function key” shortly to select the next parameter. The parameter can be changed by pressing the keys “up/down”. After the last parameter or by pressing the “function key” long the settings will be confirmed and the menu exits. In order to discard changes switch off the instrument. When the device is switched on again it will start with the former configuration

When the value "YES" is selected for the parameter "Init" and confirmed by pressing the "function key", the device will be reset to the factory settings.

If no key is pressed for more than two minutes the configuration will be aborted (display: "C.End"). Within the parameter „PH.oF" and „PH.SL" this timeout is not activated. All changes will be discarded!

At every menu item you can save the changes and close the menu by pressing and holding the function key (> 1s).

Param.	Werte	Bedeutung		
	/			
SEt.t	**Setting the temperature**			
	-5 … 150 (*	Set the temperature used for temperature compensation in °C (* or 23 … 302 °F		
PH.oF	**Setting the zero point**			
	Display current measure-ment value	Set the zero point for calibration of the pH measurement (see chapter 8 Calibration of the pH measurement) Note: if no calibration is necessary, do not change the parameter by pressing the Up/Down keys – continue with function key		
PH.SL	**Setting the gradient**			
	Display current measure-ment value	Set the gradient for calibration of the pH measurement (see chapter 8 Calibration of the pH measurement) Note: if no calibration is necessary, do not change the parameter by pressing the Up/Down keys – continue with function key		
PoFF	**Auto-power-off function**			
	oFF	No auto-power-off		
	15, 30, 60, 120, 240	Automatically turn of device, when no key is pressed during the selected value (in minutes)		
Li tE	**Backlight**			
	oFF	Backlight disabled		
	15, 30, 60, 120, 240	Automatically turn of backlight, when no key is pressed during the selected value (in seconds)		
	on	Backlight will not be turned off automatically		
Unit	**Temperature unit**			
	°C	Display temperature in °C		
	°F	Display temperature in °F		
Init	**Restore factory settings**			
	no	Keep current configuration		
	YES	Load factory settings (display: "Init donE")		

During menu exit, the changes are stored ("Stor") – if necessary the device will be restarted automatically.

8 Calibration of the pH measurement

Equipment needed:

- Reference: Buffer solution(s) (e.g. **GPH** …, **PHL** …, **GAK 1400**)
- Distilled or deionised water for rinsing the electrode
- Measuring device for determining the temperature of the buffer solution(s), if necessary

8.1 General information

To achieve a precise measurement, observe the following points:

- If possible, the calibration range should overlap the measuring range. To achieve this, it is recommended to use buffer solutions for measurements as follows: below pH 7: pH 7.0 and pH 4.0
  above pH 7: pH 7.0 and pH 10.0
- Calibration should be conducted at the same temperature used for the measurement in the medium. To equalize the temperatures of the buffer solution(s) and electrode, they should be stored together for a while in a place that is protected against draught.
- Measure the temperature of the buffer solution(s) with a thermometer (e.g. **G 1710**). The exact value of the buffer solution(s) is temperature dependent and can be determined based on the tables provided.
- Always use fresh buffer solutions

We recommend that you always conduct a 2-point calibration.

Calibration is possible only in a temperature range of 0..60 °C.

8.2 Preparations

Connect the pH electrode to the device and switch on the device (the current measured value appears on the display).
If possible, do not hold the measuring device in your hand during the measurement (see chapter 6 Basics of the measurement
pH measurement). Carefully remove the protective cap from the electrode (Caution!! The cap contains 3 mol/l KCl).

Rinse the electrode with distilled or deionised water.

8.3 Conducting a 1-point calibration

Invoke the menu by pressing and holding the function key as described in chapter 7.

Enter the temperature of the buffer solution under “SEt.t” and confirm by pressing the function key.

Place the electrode in the buffer solution (e.g. pH 7).

For a 1-point calibration, you can use any buffer solution; for a 2-point calibration you must use a buffer solution with a value between pH 6.75 and pH 7.25.

Wait until the display value is stable. Press the Up/Down key to set the display value to the value of the buffer solution.

For a 2-point calibration, press the function key briefly to switch to the second calibration point. To conduct a 1-point calibration, confirm the entered value by pressing and holding the function key.

Rinse the electrode with distilled or deionised water.

8.4 Conducting a 2-point calibration

Conduct the offset equalization with a buffer solution (value between pH 6.75 and pH 7.25) as described in 8.3 “Conducting a 1-point calibration”.

As the temperature in the device under “SEt.t” enter the temperature of the solution used for equalization of the gradient (2nd point, not pH 7).

Place the electrode in the buffer solution (e.g. pH 4, pH 10). The buffer solution must have a value below pH 6 and above pH 8.

A gradient correction with buffer solutions between pH 6 and pH 8 is not possible. An attempt to change the values will result in “CAL Err.2 / CAL Err.3” and the change will be ignored.

Wait until the display value is stable. Press the Up/Down key to set the display value to the value of the buffer solution.

Confirm the configured value by pressing the function key.

8.5 Completion of the calibration

After successful completion of a 2-point calibration the assessment of the electrode condition is displayed briefly in percent.
A low value can be the result of the age of the electrode, contaminated or old buffer solutions or impurities on the BNC connector.

If the calibration is not completed successfully an error message (CAL Err.) is displayed (see chapter 11.2 Error messages for calibration).

Confirm the error message by pressing the function key – the device will restart and the standard values for zero point and gradient are restored.

In the unit display >CAL< flashes to indicate the missing calibration.

If the calibration was carried out unattended, switch off the device by pressing and holding the On/Off button in order to use the values of the previously active calibration after restarting the device.

Display the electrode assessment of the currently active calibration:
Invoke the menu by pressing and holding the function key as described in chapter 7. Press the function key to access the parameter “PK.OF”. Close the menu by pressing and holding the function key (Do not change values) – the electrode assessment in percent is displayed (“----” if no valid data is available).

9 Accuracy check / adjustment service

You can send the device to the manufacturer for adjustment and inspection.
Calibration certificate - DKD certificate - official certifications:
If the measuring instrument is supposed to receive a calibration certificate, it has to be sent to the manufacturer (declare test points, e. g. pH 4; pH 10).
If the device is certificated together with a suitable sensor very high overall accuracies are possible.
Basic settings can only be checked and – if necessary – corrected by the manufacturer.
A calibration protocol is enclosed to the device ex works. This documents the precision reached by the production process.

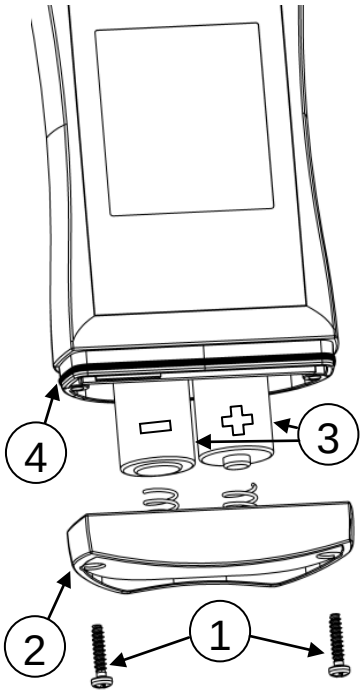
10 Replacing batteries

Before changing batteries, please read the following instruction and follow it step by step. Not following the instruction may cause harm to the instrument or the protection against ingress of water and dust may be lost!
Avoid unnecessary opening of the instrument!

Do not use different types or batteries with different state of charge. We recommend using new and high quality alkaline batteries.
The use of damaged or unsuitable batteries could lead to further heating, whereby the batteries can burst or in the worst case exploding.

Required tools: 1x Phillips screwdriver PH 1

- Unscrew the two screws (1) and remove the cover (2).
- Exchange the two batteries (type: AA) (3) carefully. Ensure correct polarity – the correct position of the batteries is drafted on the circuit board. The batteries must slide in without force.
- Check: O-ring seal (4) undamaged, clean and in the intended cavity? To make the assembly easier and prevent damage, a dry O-ring can be greased with suitable grease.
- Put on the cover (2) straightly. The device is starting automatically.
  Note: the O-ring (4) has to been in the cavity, when pushing on the cover (2),
- Tighten the screws (1).



11 Fault and System Messages

11.1 Error messages for measurement

	Description	What to do?
No display or confused characters, Device does not react on key press	Battery empty	Replace battery (see chapter 10 Replacing batteries)
	System error	Open battery cover, wait briefly, close again (see chapter 10 Replacing batteries)
	Device defective	Return to manufacturer for repair
Err.1	Measured value above allowable range	Check: temperature not within sensor range? -> measuring value to high!
	defective electrode	Return to manufacturer for repair
Err.2	Measured value below allowable range	Check: temperature not within sensor range? -> measuring value to low!
	defective electrode	Return to manufacturer for repair
SYS Err	System error	Switch off the device and switch on again, check batteries - when the error remains return to manufacturer for repair
bAt Lo	battery is ultimately exhausted	(See chapter 10 Replacing batteries)

11.2 Error messages for calibration

	Description	What to do?
>CAL< (flashes in unit display)	An error occurred during the last calibration	Conduct a calibration (see chapter 8 Calibration of the pH measurement)
CAL Err.1	Neutral buffer not allowed	
	Incorrect buffer solution	Always use the neutral buffer as the first solution! (Exception: 1-point calibration)
	Buffer solution is contaminated	Use fresh buffer solution
	Electrode is defective	Clean the electrode and repeat calibration. If error occurs again -> replace electrode
CAL Err.2	Slope is too low	
	Buffer solution(s) contaminated	Use fresh buffer solutions
	Electrode is defective	Replace electrode
CAL Err.3	Slope is too high	
	Buffer solution(s) contaminated	Use fresh buffer solutions
	Electrode is defective	Replace electrode
CAL Err.4	Incorrect calibration temperature	Calibration is possible only between 0..60°C

12 Reshipment and disposal

12.1 Reshipment

All devices returned to the manufacturer have to be free of any residual of measuring media and other hazardous substances.
Measuring residuals at housing or sensor may be a risk for persons or environment

Use an adequate transport package for reshipment, especially for fully functional devices. Please make sure that the device is protected in the package by enough packing materials.
Add the completed reshipment form of the GHM website http://www.ghm-messtechnik.de/downloads/ghm-formulare.html.

12.2 Disposal

Dispense exhausted batteries at destined gathering places The device must not be disposed in the unsorted municipal waste! Send the device directly to us (sufficiently stamped), considering the above if it should be disposed. We will dispose the device appropriate and environmentally sound.
Private user can return the device at the municipal collection points for small electrical appliances.

13 Specification

Measuring range pH		0,00 … 14,00 pH
Temperature compensation		-5 … 150 °C (bzw. 23 … 302 °F)
Accuracy	pH (device)	± 0,02 pH ± 1 Digit
Input resistance pH		approx. 10^{12} Ohm
Measuring cycle		Approx. 2 measuring per second.
Anschlüsse	pH	BNC Anschluss für pH-Elektrode
Display		3-lines segment-LCD, additional symbols, illuminated (white, lighting time adjustable)
Additional functions		Min/max/hold
pH calibration		Manual 1- or 2-point calibration
Housing		Break-proof ABS-housing
	Protection class	IP65 / IP67 (only with waterproof characterized probes at connected state).
	dimensions L*B*H [mm] and weight	108 * 54 * 28 mm without BNC connector 130 g inc. battery without electrode 190 g inc. battery and electrode
Working conditions		-20 to 50 °C; 0 to 95 % r.F. (shortly 100 % r.F.)
Storage temperature		-20 to 70 °C
Power supply		2*AA-batteries (scope of delivery)
	Power consumption/ Battery life	Approx. 0.7 mA, with lighting approx. 2.5 mA Life time > 3000 hours for alkaline batteries (without backlight).
	Battery indicator	4 state battery status display Exchange notice if battery is low: "bAt"
Auto-Power-Off-Function		If activated, the device is switched off automatically
Directives and standards		The instruments confirm to following European directives: 2014/30/EU EMV directives 2011/65/EU RoHS Applied harmonized standards: EN 61326-1:2013 emissions level: class A emi immunity according to table 2 additional error: < 0.5 % FS EN 50581:2012 The device is for the mobile application or for the stationary operation in the course of specified working conditions without further restrictions construed.