GREISINGER
Member of GHM GROUP

English

Operating Manual

pH electrodes

GE xxx

Companies / Brands of the GHM

Members of GHM GROUP:

GREISINGER
HONSBERG
Martens
DeltaOHM
VAL.CO

www.greisinger.de

Keep for later use.

Index

1 General Note

Read this document carefully and get used to the operation of the product before you use it. Keep this document within easy reach near the product for consulting in case of doubt.

2 Safety

2.1 Intended Use

The pH electrodes must be used only according to its intended purpose and under suitable conditions. The electrodes must be operated with suitable measuring devices and be calibrated before first use and afterwards in regular intervals.

The safety requirements (see below) have to be observed.

The life-time and accuracy of the electrodes depends on adequate selection as well as on proper handling. Please consider therefore the chapters “Choose the right electrode”, “Measuring and storing” and “Maintenance”.

Use the device carefully and according to its technical data (do not throw it, strike it, etc.). Protect the device from dirt.

To be sure that there´s no risk arising due to misinterpretation of measured values, the operator must have further knowledge in case of doubt - the user is liable for any harm/damage resulting from misinterpretation due to insufficient knowledge.

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 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.

2.3 Safety signs and symbols

The following signs in this document highlight warnings:

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

This symbol indicates danger for living tissue as well as a variety of materials, which can be damaged or destroyed when coming into contact with this chemical. Caustic effect, protective equipment required!

This Symbol indicates dangers to all living beings that may result in death or acute or chronic health hazards when inhaled, swallowed, or absorbed through the skin of this chemical.

This Symbol indicates irritant substances that can cause inflammation on short-term, prolonged or repeated contact with the skin or mucous membranes.

Attention! This symbol warns of possible dangers or dangerous situations that 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.

This symbol instructs the use of eye protection which protects the eyes from harmful influences when working with powerful light, UV radiation, laser, chemicals, dust, splinters or weather influences.

This symbol instructs the use of protective gloves which offer protection from mechanical, thermal, chemical, biological or electrical hazards.

2.4 Foreseeable misuse

The fault-free function and operational safety of the product can only be guaranteed if generally applicable safety precautions and the device-specific safety instructions for this document are observed.

If these notices are disregarded, personal injury or death, as well as property damage can occur.

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

This device is not suitable for medical applications.

The device is not suitable for direct contact with food products.

Take samples and dispose them correctly after the measurement.

2.5 Safety instructions

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.

The electrodes contain 3 molar KCL (GE103: 1mol/l KNO_3), which is acidly.

First-Aid-provisions:

- Contact with eyes: rinse opened eye with sufficient water, contact oculist
- Contact with skin: clean with sufficient water
- Swallowing: drink much water. If feeling sick, contact doctor

The electrodes contain glass parts that can cause injuries when broken.
There is an elevated risk of injury in conjunction with measurements in food.

- Inspect the electrode before and after measurement!
- Always measures in samples for measurements in foods. Discard these samples after the measurement!

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.

Do not use this product 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

When interacting with chemicals at least the following points must be ensured:

1. Obey all notes on the container of chemicals.
2. Obey all notes in the safety specification sheet of chemicals.
3. Consider any statutory provisions guidelines and guidelines of chemicals when disposing!
   This is also for accidentally spilled chemicals, dried residues, soiled rags or similar.
4. Always wear suitable protective clothing (e.g. protection goggles, safety gloves, face mask, etc.)!
5. Never eat, drink or smoke in the operational area of chemicals!
6. In case of problems instantly consult skilled personnel.

Suitable clean-up possibilities (eye wash, etc.) must exist within spitting distance!

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 specification

3 Basics

3.1 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.

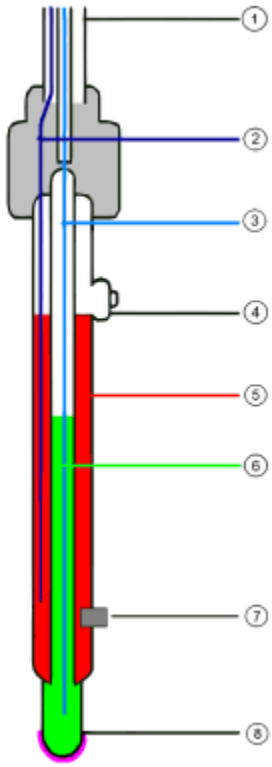
The pH measurement is very precise, but also sensitive. The measured signals are very weak (high-ohmic), especially when measured in weak or low-ion media. Therefore, always take measures to

To determine the pH value of a solution, it should always be recorded together with the measuring temperature, the reason is that most liquids change their pH value with the temperature.

- 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.

3.2 Design of electrode

In most cases so-called combination electrodes are used. That means that all needed elements are integrated in a single electrode (including reference electrode).
Sometimes even a temperature sensor is integrated. (The picture shows an electrode without temperature sensor)



1. Coaxial cable
2. Reference electrode
3. Measuring electrode
4. Refill opening
5. Electrolyte
6. Internal buffer
7. Diaphragm
8. Glass membrane / source layer

The diaphragm, which establishes a connection between the electrolyte and the liquid to be measured, can be designed in different ways. Clogging or soiling of the diaphragm is a frequent cause of a malfunctioning or sluggish electrode.

Always handle the glass membrane with extreme care. The so-called source layer forms there. This is crucial for the measurement and must always be kept moist.

3.3 Further information

A pH electrode is a wear part. If the signal is very slow or the required values are no longer observed after careful cleaning and possible regeneration, the electrode must be replaced. 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.

3.4 Service life

The service life of electrodes is normally at least 8 to 10 months. When cared for properly, this can usually increase to more than 2 years. The actual life will vary depending on the particular application.

Extreme pH values and high temperatures accelerate the aging process.

4 Operating and Maintenance

4.1 Measuring and storing

The pH-electrodes have been tested and have been subordinated strict quality controls in all manufacturing-steps
To keep the optimum efficiency and accuracy for a long time take care of the following points:

- Remove the **storing protection-cap** and rinse the shaft and pH-glass-diaphragm with distilled water.
- **Important!** The pH-glass-diaphragm has to be kept wet. When not in use the electrode must be stored in 3 mol/l KCl solution. (GE 103 in 1 mol/l KNO_3). If the pH-glass-diaphragm dried out, the performance and the responsiveness are affected. To re-moisten the electrode store it in 3 mol/l KCl solution for 24 hours (GE 103 1 mol/l KNO_3).
  A longer storage of a combination-electrode or a reference-electrode in distillated water will deplete them of KCl. Please refill KCl-electrolyte (saturated or 3 mol) in time
- **Do not touch the glass-diaphragm!** Damages on the surface and attrition affect the performance negatively and might even destroy the electrode.
- Before usage perform a visual check of the pH-electrode. If there are air-bubbles in the pH-glass-diaphragm or the outer reference-electrode you can get them out by shaking the electrode downward.

- For electrodes with liquid electrolytes: For continuous flow of electrolyte the **cap sleeve made of rubber**, that covers the **refill opening**, has to be removed before measurements. The opening has to be closed for storage in order to prevent running down.
- The level of the electrolyte should be over the level of the measured medium. This ensures stable measuring values and reduces pollution of the diaphragm and reference electrolyte.
- Take care that the diaphragm fully contacts the media you want to measure.
  Minimum depth for e.g. GE 100 20 mm, maximum 80 mm
- Keep cable and plug of the electrode always clean and dry. Otherwise the electric insulation will be lost and consequently measuring errors or other subsequent errors might occur.
- The **calibration (adjustment)** of the measurement chain (single-rod or measurement and reference electrode) has to be performed according to the device manufacturer. The “asymmetry” is adjusted with help of an buffer solution with a value at the chain’s zero point (e.g. pH 7.0). The “slope” is adjusted with help of a second buffer solution, whose pH value should match the expected measuring range (e.g. pH 4.0; pH 10.0; pH 12.0), but at least 2 pH units different from the first value.
- The electrode has to be stored in dry rooms at temperatures between 10°C to 30°C. Below –5°C the electrode might be damaged because of freezing of the electrolyte. We recommend to store the electrode vertically with the cable to the upper side.
- The pH-electrode should be arranged vertically upwards with the connecting cable.
  A slight angle of inclination does not impair the measurement

4.2 Calibration

The electrodes have to be calibrated (adjusted) in regular intervals. The length of the intervals depends on the accuracy requirements, the application and the electrode.

If asymmetry or slope cannot be adjusted any longer, it’s a sign that

a) the electrode is exhausted and has to be exchanged, or

b) the electrode is polluted and has to be cleansed (see below), or

c) the buffer solution is exhausted (prepare new solution). Prepared buffer solution have a limited life time (about 1 month) when using/calibrating it thoroughly (no procrastination of buffer solution residua from one solution to an other one through cleaning and drying the electrode not enough)

Buffer-capsules have no lifetime limitations, therefor we recommend keeping a sufficient number of them in stock.pH 12 buffer capsules (white) have to be stored in an exsiccator or stored together with drying agent.

As an alternative to the buffer capsules the PHL buffer solutions are available. They are stored in practical 250 ml dosage bottles and are ready-to-use (keep the best-before at the buffer solutions in mind).

The electrolyte (mostly 3 mol/l KCl) should be always available for refilling, too. (e.g. contained in working and calibration set GAK 1400).

4.3 Care and maintenance

- For electrodes with liquid electrolyte: Check level of reference electrolyte and, if necessary, refill 3 mol/l KCl solution with help of an syringe or pipette.
- Normal cleaning takes place with the GRL 100 pepsin cleaning solution into which the electrode is immersed for 5 - 10 minutes before being rinsed off with clean water.

Crystallisation of the 3 mol/l KCL solution 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. The suitable cleaning agents for the pH glass membrane are listed in the table below.
- Mechanical cleansing should be avoided as this might damage the electrode permanently. Therefore a chemical cleansing is preferable.

Impurities	**Cleaners**
General residue	Mild detergent
Inorganic coatings	common fluids for glass cleaning
Metal compounds	1 mol/l HCl solution or GRL 100 pepsin cleaning solution
Oil and grease	Special cleaner or solvent
Biological coatings with protein	1% pepsin enzyme in 0.1 molar GRL 100 HCl solution
Biological coatings with protein	Acetone
Extremely resistant residues	Hydrogen peroxide or sodium hypochloride

The material of the pH probe must always be protected. Plastic shafts must not be cleaned in solvents, etc. 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!

The GAK 1400 working and calibration set includes all necessary products for calibration, care and maintenance of the electrode.

5 Choose the right electrode

	GE 014	GE 100	GE 101	GE 103	GE 104	GE 106	GE 107	GE 108	GE 109	GE 114	GE 117	GE 120	GE 125	GE 126	GE 135	GE 151	GE 170	GE 171	GE 173
Sewage														X					X
Aquarium water	X	X			X	X	X	X	X	X	X			X		X			X
Soil testings			X																
Emulsions			X		X														X
On-site measurements							X	X	X	X	X		X		X				
Fish farming	X	X			X	X	X	X	X	X	X		X	X	X	X			
Photo laboratory				X															
Galvanic baths				X												X			X
Beverages													X		X	X			X
Low-ion media (Rain water, some aquariums, VE water)					X	X													X
Cosmetics					X														
Food sample			X									X							
Sea water	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X
Process chemistry																X	X	X	X
Online measurements																	X	X	X
Swimming pool water	X	X				X		X		X	X		X	X	X	X			X
Suspensions			X		X														X
Drinking water	X	X			X	X		X		X	X		X	X	X	X		X	X
Water-based lacquers					X														X

For most applications, the GE 114 or the GE 100 can be used.
Some different applications requires a special electrode.

GE 100 is a universal electrode with two ceramic diaphragms and liquid.

GE 101 is preferably used for small sample amounts. It comprises a glass electrode with two ceramic diaphragms and liquid electrolyte.

GE 104 is preferably used for measurements in low-ionic media, such as rainwater, aquarium water and deionized water.

GE 114 is a universally applicable, durable and low-maintenance gel electrode with Pellon diaphragm. It can be used for measurements in drinking water, swimming pools, aquaria and slightly contaminated waste water.

GE 117 is a temperature-compensated gel electrode with two ceramic diaphragms and PH 13.5 cable screw coupling.

GE 120 is an insertion electrode and is preferably used for measurements in cheese, fruit and meat. For measurements in products containing proteins, the electrode must be cleaned with a special cleaner. For this purpose, we recommend the GRL 100 pepsin cleaning solution.

GE 125 is a waterproof, universally applicable, durable and low-maintenance gel electrode with ceramic diaphragm. It can be immersed above the shaft for an extended time.

GE 126 is a extremely low-maintenance and long-term stable gel electrode with ceramic diaphragm.

GE 135 is a waterproof, universally applicable, durable and low-maintenance gel electrode with ceramic diaphragm. It can be immersed above the shaft for an extended time.

GE 151 is a glass electrode and is preferably used in galvanic applications for paints and lacquers.

GE 173 is an alkaline-resistant glass electrode with ground diaphragm and gel electrolyte for chemical and waste water applications.

6 Reshipment and disposal

6.1 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.

6.2 Disposal

The device must not be disposed of with household waste. Return it to us, freight prepaid. We will then arrange for the proper and environmentally-friendly disposal.

Private end users in Germany have the possibility of dropping off the product at the municipal collection centre.

7 Manufacturer / distributer

GHM GROUP – Greisinger
GHM Messtechnik GmbH
Hans-Sachs-Str. 26
93128 Regenstauf
Germany
+49 9402 9383-0 | info@greisinger.de | www.greisinger.de
WEEE-Reg.-Nr.: DE 93889386

8 Specification

Type	Description	Operating range	Pressure	Reference electrolyte	Connection	Cable	Notes	Diaphragm type /Membrane shape	Tube
GE 014-Cinch †)	low Cost pH-electrode	pH 2-12, 0..60°C > 200 µS/cm	pressureless	3mol/l KCl	Cinch	1 m		2x ceramic / sphere	plastic approx. Ø12x110 mm
GE 014-BNC †)					BNC				
GE 100-Cinch	standard pH-electrode	pH 0-14, 0..80°C > 100 µS/cm	pressureless	3mol/l KCl	Cinch	1 m		2x ceramic / sphere	tyril approx. Ø12x120 mm
GE 100-BNC					BNC-				
GE 101-Cinch	injection pH-electrode	pH 2-11, 0..60°C > 100 µS/cm	pressureless	3mol/l KCl	Cinch	1 m		2x ceramic / cone	glass approx. Ø12x120 mm
GE 101-BNC					BNC				
GE 103-Cinch †)	double chamber pH-electrode	pH 0-14, 0..80°C > 200 µS/cm	pressureless	3mol/l KCl 1mol/l KNO3	Cinch	1 m		2x ceramic / sphere	plastic approx. Ø12x120 mm
GE 103-BNC †)					BNC				
GE 104-Cinch	special grinding pH-electrode	pH 2-14, 0..80°C > 20 µS/cm	pressureless	3mol/l KCl	Cinch	1 m	moveable joint, easy-to-clean	grinding / cylinder	glass approx. Ø12x120 mm
GE 104-BNC					BNC				
GE 106-Cinch	pH-electrode for VE water	pH 0-14, 0..80°C > 100 µS/cm	pressureless	3mol/l KCl	Cinch	1 m		3x ceramic / sphere	tyril approx. Ø12x120 mm
GE 106-BNC					BNC				
GE 108-Cinch	standard pH-electrode, pressure resistant	pH 0-14, 0..80°C > 100 µS/cm	max 6 bar	3mol/l KCl (gel)	Cinch	2 m	pressure resistant up to 6 bar with PG13.5 thread	2x ceramic / cylinder	PSU approx. Ø12x120 mm
GE 108-BNC					BNC	2 m			
GE 108-S7					S7 connection	- *)			
GE 109-BNC	pH-electrode with int. Pt100 sensor	pH 0-14, 0..60°C > 100 µS/cm	max 6 bar	3mol/l KCl (gel)	BNC und MiniDIN	2 m	pressure resistant up to 6 bar	2x ceramic / cylinder	PSU approx. Ø12x120 mm
GE 114-BNC	low-cost pH-electrode	pH 0-14, 0..60°C > 200 µS/cm	pressureless	3mol/l KCl (gel)	BNC	1 m		1x pellon / sphere	epoxy approx. Ø12x120 mm
GE 117-BNC	pH-electrode with int. Pt1000 sensor	pH 0-14, 0..60°C > 100 µS/cm	max 6 bar	3mol/l KCl (gel)	BNC and 4mm banana	2 m	pressure resistant up to 6 bar with PG13.5 thread	2x ceramic / cylinder	PSU approx. Ø12x120 mm
GE 120-Cinch	injection pH-electrode	pH 0-14, 0..60°C > 200 µS/cm	pressureless	Ag/AgCl (gel)	Cinch	1 m	incl. screwable cutting blade	2x ceramic / cone	PVC approx. Ø22x110 mm injection tip approx. Ø13x60
GE 120-BNC					BNC				
GE 125-BNC	pH-electrode with int. Pt1000 sensor	pH 0-14, 0..70°C > 200 µS/cm	pressureless	3mol/l KCl (gel)	BNC and 4mm banana	2 m	water-proof IP 67 incl. BNC plug	1x ceramic / cylinder	epoxy approx. Ø12x120 mm
GE 126-BNC	extremely low-maintenance pH-electrode	pH 0-14, 0..80°C > 100 µS/cm	max 5.5 bar	Ag/AgCl (Gel)	BNC	5 m	with ½“ NPT thread	2x ceramic / sphere	ABS approx. Ø26.4x147 mm
GE 135-BNC	pH-electrode with int. Pt1000 sensor	pH 0-14, 0..80°C > 150 µS/cm	max 5 bar	Ag/AgCl (Gel)	BNC and 4mm banana	1 m	water-proof IP 67 incl. BNC plug	1x ceramic / cone	PC approx. Ø12x130 mm
GE 151-Cinch	pH-electrode for difficult measurement conditions	pH 0-14, 0..80°C > 100 µS/cm	pressureless	3mol/l KCl	Cinch	1 m	chemically resistant glass tube	1x ceramic / cylinder	glass approx.Ø12x120 mm
GE 151-BNC					BNC				
GE 170-S7 †)	pH-electrode for extreme conditions	pH 0-14, 0..130°C > 100 µS/cm	max 15 bar @ 25°C	3mol/l KCl (gel)	S7 connection	- *)	up to 130°C / 15 bar with PG13.5 thread	3x ceramic / sphere	glass approx. Ø12x120 mm
GE 171-S7	pH-electrode for extreme conditions	pH 0-14, 0..140°C > 100 µS/cm	max 10 bar	3mol/l KCl (gel)	S7 connection	- *)	can be sterilized and autoclaved with PG13.5 thread	2x ceramic / sphere	glass approx. Ø12x120 mm
GE 173-Cinch	special grinding pH-electrode	pH 0-14, 0..80°C > 50 µS/cm	max 6 bar	3mol/l KCl (gel)	Cinch	2 m	alkali resistant, pressure resistant up to 6 bar with PG13.5 thread	grinding / cylinder	glass approx. Ø12x120 mm
GE 173-BNC					BNC				
GE 173-S7					S7 connection	- *)			

†) *no longer available*

*) *Note: cable GEAK-2S7-BNC or GEAK-5S7-BNC is needed for connection S7 (additional adapter GAD 1 BNC is required for measurement devices with cinch plug)*