

Measuring device for pH / Redox temperature

as of version V2.6

Operating Manual

GMH 3530



GMH 3530
 Digital pH-/mV-/Thermometer



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1 Designated Use

This device is designed for the measurement of pH and redox potentials. Therefore a suitable electrode is needed. The electrode is connected via BNC-socket.

Please note: You need different types of electrodes for pH and redox measurement.

Additionally a temperature probe can be connected (Pt100, with suitable MINI-DIN plug).

This enables the automatic temperature compensation (ATC) for pH measurements.

The temperature of the measured solution can also be displayed. .

2 General Note

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

3 Operating and Maintenance Advice:

a) When to replace battery:

If Δ and 'bAt' are shown in the lower display the battery has been used up and needs to be replaced. The device will, however, operate correctly for a certain time.

If 'bAt' is shown in the upper display the voltage is too low to operate the device; the battery has been completely used up.

Please note: The battery has to be taken out, when storing device above 50°C.

We recommend to take out battery if device is not used for a longer period of time.

b) Treat device and sensor carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plug and socket from soiling.

c) When connecting the temperature probe the connector may not lock to the jack correctly. In such a case hold the connector not at the case but at the buckling protection of the cable during the plug in. Don't connect electrode canted! If plug is entered correctly, it will slide in smoothly.

To disconnect temperature probe do not pull at the cable but at the plug.

If plug is entered incorrectly the connecting pins of the plug can be damaged. => Plug can no longer be used and connecting cable needs to be replaced.

d) Mains operation:

When using a power supply device please note that operating voltage has to be 10.5 to 12 V DC.

Do not apply overvoltage!! Cheap 12V-power supply devices often have excessive no-load voltage. We, therefore, recommend using regulated voltage power supply devices. Trouble-free operation is guaranteed by our power supply devices. Trouble-free operation is guaranteed by our power supply, GNG10/3000.

Prior to connecting the plug power supply device with the mains supply make sure that the operating voltage stated at the power supply device is identical to the mains voltage.

e) Display values for damaged electrode cable or if no pH or redox-electrode has been connected

If no electrode is connected or the connection cable is damaged the display will nevertheless show mV, pH or rH values. Please note that these values can never be correct measuring results!

4 Safety Requirements:

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 "Specification".
2. If the device is transported from a cold to a warm environment condensation may cause in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
3. If device is to be connected to other devices (e.g. via serial interface) the circuitry has to be designed most carefully. Internal connection in third party devices (e.g. connection GND and earth) may result in not-permissible voltages impairing or destroying the device or another device connected.

Warning: If device is operated with a defective mains power supply (short circuit from mains voltage to output voltage) this may result in hazardous voltages at the device (e.g. sensor socket, serial interface).

4. 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:

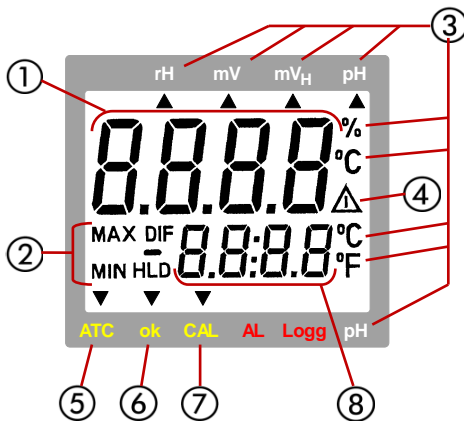
- there is visible damage to the device
- the device is not working as specified
- the device has been stored under unsuitable conditions for a longer time.

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

5. **Warning:** 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.

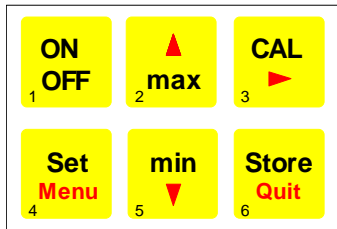
5 Display and control elements

5.1 Display elements



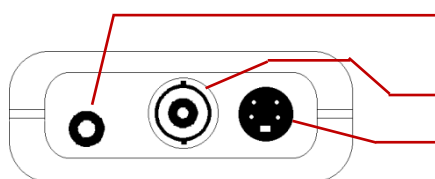
- ① **Main display:** pH-value, redox-value (mV, mV_H), rH value or user prompt
- ② Display elements to show minimum/maximum/memorized measuring value
- ③ Display of **measuring units**
- ④ **Warning signal** (low battery or recalibration prompt)
- ⑤ **ATC-arrow:** indicates if temperature sensor has been connected, i.e. if **automatic temperature compensation** is active, when operating in the pH, mV_H or rH mode.
- ⑥ **ok-arrow:** indicates that measuring value has been stable for a longer period of time
- ⑦ **CAL-arrow:** indicates that device is being calibrated at the moment, when operating in the **pH** mode.
- ⑧ **Secondary display:** measuring value, temperature or user prompt

5.2 Pushbuttons



- ON OFF** 1: On/off key
- max** 2: **min/max when taking measurements:**
press shortly: min. or max. meas. value so far will be displayed
+
press for 2 sec.: the min. or max. value will be deleted
Configuration: to enter values, or change settings
- CAL** 3: **CAL:** for 'pH' mode only:
press shortly: display state of electrode condition and calibration data
press for 2 sec: start pH-calibration
- Set Menu** 4: **Set/Menu:**
press (Set) shortly: for 'pH' and 'mV_H': manual temperature input if no temperature probe is connected additionally for 'rH': manual input of pH value.
press (Menu) for 2 sec: configuration will be activated
- Store Quit** 6: **Store/Quit:**
measuring: holds and memorizes current meas. value ('HLD' in display)
Configuration: enter setting, return to measuring

5.3 Connections



- interface:** connection for galv. Isolated interface adapter (accessory: GRS 3100, GRS3105 or USB3100)
- BNC-socket:** connection for pH- or redox-electrode
- Mini-DIN-socket:** connection for Pt100-temperature probe (4-wire connection; 2-wire also possible, but may result in additional measuring faults due to cable)

The mains socket is located at the left side of the instrument

6 Configuration

To configure the device press **Set Menu**-key for 2 seconds.

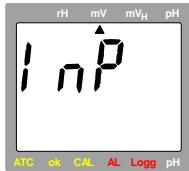
Press the **Set Menu**-key again to choose between the individual values that can be set.

The individual values are changed by pressing the keys **max** or **min**.

Use **Store/Quit** to leave configuration menu and save your settings.

'Input': Selection of Measuring Function pH / Redox mV / Redox mV_H / rH / thEr

The current measuring function can be identified by an arrow at the top of the display:



pH: pH-measurements with pH-electrode

mV: redox measurements with redox-electrode

mV_H: redox measurement with redox-electrode (with standard 3 mol/l KCL electrolyte).

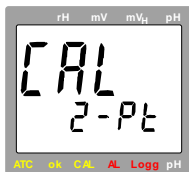
The value shown is corrected to the standard hydrogen system (0 - 50°C: acc. to DIN 38404).

Temperature probe (ATC) or manual temperature input required.

rH: rH-measurement: the rH value is calculated from the measured values of pH, redox and temperature. You may also enter pH and temperature values manually.

thEr: Pt100 thermometer: the current temperature is displayed in the main display, the secondary display either shows the min. or max. value or is used for the hold-function.

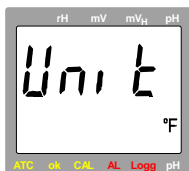
'CAL': Selection of Number of Calibration Points (for pH measurements only)



2-Pt: the pH-electrode will be calibrated at 2 points (one calibration point in neutral range and one calibration point in acid or basic range)

3-Pt: the pH-electrode will be calibrated at 3 points (one calibration point in neutral, acid and basic range)

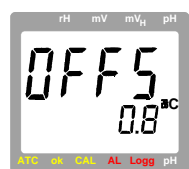
'Unit': Selection of Temperature Unit °C / °F



°C All temperature values in degree Celsius

°F: All temperature values in degree Fahrenheit

'Offset': Zero Shift of Temperature



-10.0°C ... 10.0°C

or

-18.0°F ... 18.0°F

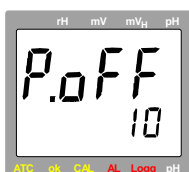
The zero point of the temperature measurement will be displaced by this value to compensate for deviations in the sensor and measuring device:

temperature displayed = temperature measured - offset

off: Zero shift has been deactivated (=0.0°)

Note: If the temperature offset is set, this is displayed when the device is turned on.

'Power.off': Selection of Power-off Delay



1...120: Power-off delay in minutes. Device will be automatically switched off as soon as this time has elapsed if no key is pressed/no interface communication takes place.

off: Automatic power-off function deactivated (continuous operation, e.g. for mains operation)

'Address': Selection of Base Address



01, 11, 21, ..., 91:


Base address for interface communication. Channel 1 will be addressed by the base address set, channel 2 and 3 will have the following addresses.
(Example: base address 21 - channel 1 = 21, channel 2 = 22, channel 3 = 23)

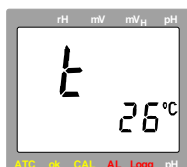
Using the interface converter GRS3105 it is possible to connect several devices to a single interface. As a precondition the base addresses of all devices must not be identical. In case several devices are connected via one interface make sure to configure the base addresses accordingly.

7 Manual Setting of Temperature when operating device without temperature probe

When operating in pH, mV_H or rH mode, the device requires the temperature of the liquid being measured. We recommend using a temperature probe (which will be automatically detected); the measured temperature will be used to calculate the measuring values (ATC: automatic temperature compensation).

If no temperature probe is connected, temperature may be entered manually:

To do so press the -key shortly.




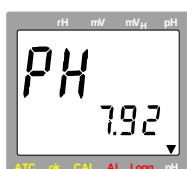
0 ... 105 °C:

Input of temperature of liquid

Use the -key to acknowledge input; device returns to measuring mode.

8 Manual Setting of pH-Value for measuring function rH

Running the GMH 3530 in the rH-measuring mode requires both temperature and pH value. Press  shortly again to switch over to the pH-value entering mode:



0.0 ... 14.00 pH:

Input of pH-value

Use -key to acknowledge input and to return to measurement.

9 Calibration of 'pH'-Measurement

The electrode data of pH-electrodes are subject to a lot of fluctuation due to ageing and manufacturing tolerances. Therefore it is necessary to check the calibration with buffer solutions before measurements take place. If deviations are too large, a recalibration is necessary.

Buffer solutions are liquids with an accurate pH-value. The following buffers can be used for calibration:

- Standard-series (4.01pH, 7.00pH and 10.01pH)
- DIN-series (1.68pH(A), 4.01pH(C), 6.87pH(D), 9.18pH(F) and 12.45pH(G))
- Any buffer (neutral buffer ranging from 6.5 ... 7.5pH)



Service life of a buffer solution is limited and will be further reduced unless the electrodes are properly rinsed and dried when changing over the solutions. This may even result in incorrect calibration! We recommend to use new buffer solution for calibration, as far as possible, and to rinse with non-ionising or distilled water.

9.1 How to prepare calibration solutions of standard series

- Fill 2 plastic bottles with 100 ml distilled water each.
- Open pH 7 capsule (green) carefully (turn one half of the capsule while pulling and make sure not to spill any solution); put content (including both capsule parts) into one of the bottles.
- Put content of pH 4 capsule (orange) (or pH 10, blue) and both capsule parts into the second bottle.

The capsule shell will colour the liquid in the respective colour: **orange = pH4.01; green = pH7.00; blue = pH10.01**
 Make sure to prepare buffer solutions in time as they can only be used after at least 3 hours. Shake well before use.

9.2 Note: Automatic temperature compensation during calibration

Both the signal of the pH-electrode and the pH-buffer are depending on temperature. If a temperature probe is connected, the temperature influence of the electrode is compensated automatically during measuring as well as during calibration. Otherwise enter actual buffer temperature as accurate as possible (see below). When working with the standard or DIN-buffer series, the influences of buffer temperature are also compensated. If buffers are entered manually, make sure to enter the pH-values of the buffers at the relevant temperature to ensure optimum calibration of the device.

9.3 How to carry out calibration


Please note: the calibration can only be carried out at a temperature range of 0 - 60°C !

If you have not yet done so set device to measuring mode 'pH' (see configuration). Make sure that either the 2 or 3 point calibration (whichever is required) has been activated in the configuration.


Carefully remove electrode safety cap (Attention! Contains 3 mol KCl!).

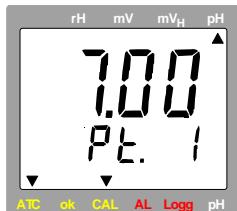
Rinse electrode with distilled water and dry.

How to start calibration: press  -key for 2 sec.

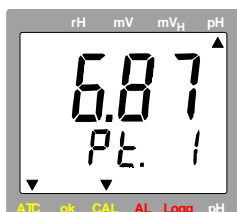
The display will prompt you to measure the first calibration solution. Use  -key to abort calibration. In such a case the last calibration before this one remains valid.

1. Selection of calibration solution

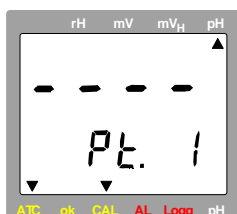
Use  -key to switch over between the various series:



Standard-series (values at 25°C: 4.01pH, 7.00pH, 10.01pH)
 neutral calibration solution 7.00pH



DIN-series (values at 25 °C: 1.68 pH (A), 4.01 pH (C), 6.87 pH (D), 9.18 pH (F), 12.45 pH (G))
 neutral calibration solution 6.87pH



manual buffer setting

If other buffers are used than those provided in the standard or DIN series select manual buffer setting now:



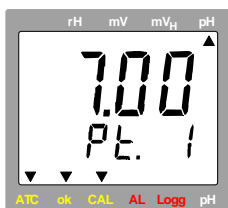
6.50 ... 7.50 pH: Setting range for neutral calibration solution



(please note, see above:
 'Automatic temperature compensation during calibration')

Note: The calibration procedure with buffers of standard series and with a temperature sensor used is indicated by a green background.

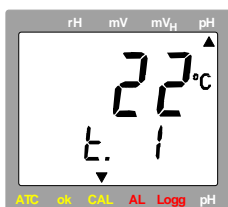
2. Calibration point 1: 'Pt. 1'



Place electrode and temperature probe (if any) in the neutral solution stirring gently.

The measuring value is stable as soon as the display stops blinking and the 'ok'-arrow is displayed in the left-hand corner of the display. Use -key to take over meas. value.

The next calibration step will be displayed.



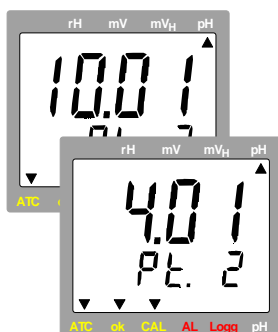
no temperature sensor: manual input of temperature of solution 1

Use or -key to enter the temperature of the buffer solution.

Use to take over the value and to display the next calibration step.

3. Rinse electrode in distilled or non-ionised water, dry electrode

4. Calibration point 2: 'Pt. 2'

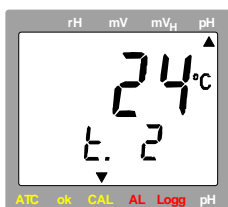


Place electrode and temperature probe (if any) in the buffer solution you want to use for the next calibration point (e.g. for standard series: 4.01pH or 10.01pH).

In case of manual buffer selection use and -keys to enter pH-value of the solution. If solutions of the Standard and DIN-series are used, their pH-value will be automatically detected.

The measuring value is stable as soon as the display stops blinking and the 'ok'-arrow is displayed in the left-hand corner of the display. Use -key to take over meas. value.

If no temperature probe is used the next calibration step will be displayed, otherwise a 2-point calibration would be completed and the state of the electrode will be displayed.



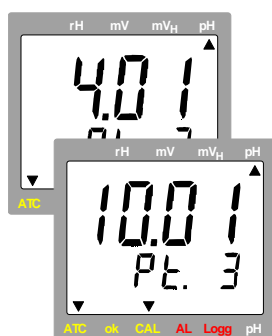
no temperature probe: manual input of temperature for solution 2

Use or -keys to enter the buffer solution temperature.

Use to take over value and to display electrode state.

5. Rinse electrode in distilled or non-ionised water, dry electrode

6. Calibration point 3: 'Pt. 3' (for 3-point calibration only)



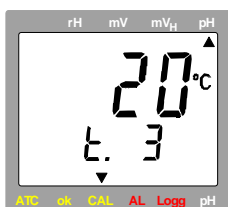
Place electrode and temperature probe (if any) in the buffer solution you want to use for the third calibration point (e.g. 10.01pH).

In case of manual buffer selection use and to enter pH-value of the solution. If solutions from the Standard and DIN-series are used their pH-value will be automatically detected.

The measuring value is stable as soon as the display stops blinking and the 'ok'-arrow is displayed in the left-hand corner of the display. Use -key to take over meas. value.

Please note: both, a basic and acid calibration point have to be selected to carry out a 3-point calibration.

If no temperature probe is used the next calibration step will be displayed, otherwise a 2-point calibration would be completed and the state of the electrode will be displayed.



no temperature probe: manual input of temperature for solution 3

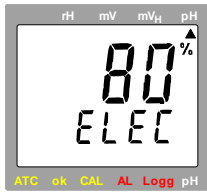
Use or -keys to enter the buffer solution temperature.

Use to take over value and to display electrode state.

☆: There is no temperature input if an external temperature sensor is used.

10 Indication of Electrode State (for pH-measurements only)

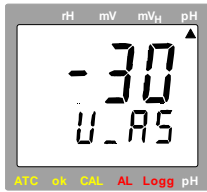
The electrode state calculated on basis of the last successful calibration will be displayed 3 seconds by pressing the **CAL**-key. The state will also be displayed automatically after calibration.



- 100%: optimum electrode state
- 30...90%: satisfactory electrode state
- <30%: electrode considerably aged or soiled. Please replace electrode if there is no improvement after it has been cleaned and calibrated acc. to paragraph 'pH electrode'

For the percent evaluation both asymmetry and slope will be taken into account, the lower result will then be used to calculate the electrode state.

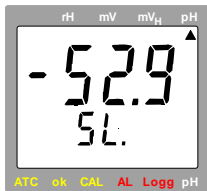
Use **CAL**-key to display electrode characteristics:



Electrode asymmetry at 25°C [mV]

max. permissible range: ±60mV, optimum: 0mV
Soiling of the electrode has a negative effect on the electrode asymmetry.

After pressing the **CAL**-key once again shortly:



Slope of electrode at 25°C [mV/pH]

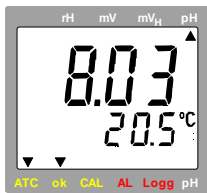
permissible range: -62...-45mV/pH, optimum: -59,2mV/pH
In case of 2-point calibration the slope will be stated for the entire measuring range. For 3-point calibration the slope for the acid measuring range will be displayed (SL.1) first. By pressing the **CAL**-key once again the slope for the basic range (SL.2) will be displayed

11 How to Perform a rH-Measurement

The rH-value of a liquid will be calculated from the measurements of the pH-value, the redox value, and the temperature of a liquid. To determine the rH-value of your solution, proceed as follows:

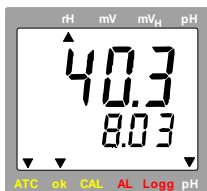
Please note: Make sure that pH- and redox electrodes are in a perfect condition during measuring and that they are cleaned and dried carefully before placing them in the solution.

First put pH- and redox electrode and the temperature sensor in the solution, stirring it carefully.



1. How to measure pH-value:

Connect the pH-electrode and the temperature sensor to the GMH 3530. Then set GMH3530 to pH-measuring mode and calibrate electrode, if necessary, (p.r.t. configuration and calibration during measuring mode pH). Then take measurements of the pH-value of the solution and press the **Store Out**-key to memorize measurement. Do not switch off the GMH3530 before the rH-measurement has been completed as otherwise the pH-value could be deleted and will have to be entered manually.



2. How to establish rH-value:

Put redox electrode and temperature sensor in the solution, stirring it carefully. Connect redox-electrode and configurate the GMH3530 to rH-measuring. The main display shows the rH-value of the solution, the secondary display switches over between the pH-value measured before and the temperature.

Please note: The measuring values for pH and temperature (if no temperature probe is connected) can also be entered manually. Press **Set Menu** for a short time and use **max** and **min** to enter temperature value. After pressing **Set Menu** shortly the pH-value can be changed. (also refer to manual temperature settings).

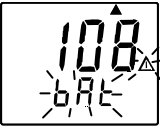
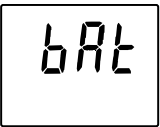
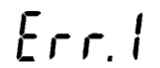
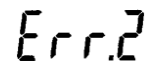


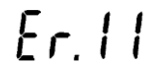

12 Error And System Messages

Error or system messages

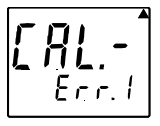
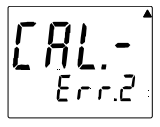
Description / Reason


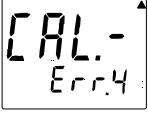
Remedy

General:

	Low battery voltage device will only continue operation for a short time	replace battery
	Low battery voltage - If mains operation: wrong voltage	replace battery replace power supply, if fault continues to exist: device damaged
keine Anzeige bzw. wirre Zeichen	- Battery voltage too low	replace battery
	- If mains op.: power supply defective or wrong voltage/polarity	check/replace mains supply
	- System error	disconnect battery or power supply, wait for a short time, re-connect
	Values exceeding measuring range	Check: are there any values exceeding the measuring range specified? -> meas. device not suitable
	Electrode/sensor/cable defective	-> replace electrode/probe
	Values below measuring range	check: are there any values below the measur- ing range specified? -> meas. device not suitable
	Electrode/sensor/cable defective	-> replace electrode/probe
	System fault	switch on again: if fault continues to exist, de- vice is damaged -> return to manufacturer for repair
for 'Ther.'- measurement only: 	- No temperature probe connected - Temperature sensor defective	connect temperature sensor - > replace temperature probe
	Value could not be calculated	temperature out of compensating range (0...105°C), or out of measuring range (Err.1 or Err.2)
pH-measurement only:: 	Last calibration not valid, existing calibration data are maintained.	repeat calibration process (to deactivate this warning: press Cal-key while switching device ON/OFF)

pH-calibration:

	Neutral buffer not permissible: - Electrode defective - Wrong buffer solution - Buffer solution defective	clean electrode and calibrate again if fault occurs again -> replace electrode always use neutral buffer as first solution! use new buffer solution
	Slope is too low: - Electrode defective - Buffer solution defective	replace electrode use new buffer solution

	<p>Slope is too high</p> <ul style="list-style-type: none"> - Electrode defective - Buffer solution defective 	<p>replace electrode use new buffer solution</p>
	<p>Incorrect calibration temperature</p>	<p>calibration can only be done at 0..60°C</p>

13 The pH-electrode

pH-electrodes are wear parts which need to be replaced, depending on the chemical or mechanical stress they are subjected to, if the values required can no longer be kept even after thorough cleaning and recovery. Please take into account that there are several materials which attack glass when they are in water solutions; other chemicals may react with the KCl-solution in the electrode thus causing blockings in the diaphragm.

Examples:

- with solutions containing protein, like they are used on the medical and biological sector, KCl may result in the denaturation of the protein.
- coagulated varnish
- solutions with a relatively high concentration of silver ions

Problems may also occur when taking measurements in low-ion media containing solvent. Some of the problems occurring when taking measurements in such media can be counteracted by using a double-chamber electrode (**Type GE 103**) with suitable bridging electrolyte (type depending on application).

Any material depositing on the measuring membrane or the diaphragm will influence the measurements and have to be removed at regular intervals. This can be done by means of automatic cleaning equipment.

13.1 Various applications require special electrodes

1. **Measurements in low-ion media** (rain water, aquarium water, VE-waters)
Type GE 104 (special faceted electrode as of 50µS/cm) or GE 106 (as of 100µS/cm).
2. **Sea water aquariums**
Standard pH combined electrodes with 3mol KCl (**type GE 100**).
3. **Photographic laboratories**
Use double-chamber electrodes, with bridging electrolyte (1 molar potassium-nitrate solution); potassium-nitrate solution has to be exchanged if necessary, make sure to fill water cap for storage of electrode with potassium-nitrate solution (**type GE 103**).
4. **Pools**
Standard pH-electrode with 3mol KCl (**type GE 100**).
5. **Soil checks**
Glass electrode with several diaphragms (**type GE 101**). Use insertion mandrel!
6. **Cheese, fruit, meat**
Insertion electrode (**type GE 101**). When taking measurements in cheese, milk and other high-protein products use special cleaning agent to clean electrode. (**pepsin solution - GRL 100**).

Standard cleaning: apply 0,1 molar HCl-solution for at least 5 minutes or protein cleaning agent.

The average service life of an electrode is 8 to 10 months but may be increased to 2 years if electrode is well maintained and treated carefully. We regret not being able to give a more detailed information as this is highly dependent on the individual case of application.

14 The Redox-electrode



The device has been optimized for electrodes using silver/silver chloride as reference system and the electrolyte KCl, 3mol/l.

If other types are used, the measuring function mV_H will supply wrong measuring results.

How to treat electrode:

- Store electrode in dry environment at temperatures between 10°C and 30°C. If temperature falls below **-5°C** the electrolyte may freeze and the electrode be destroyed.
- The electrode is equipped with a protection cap and must always be kept wet. The protection cap contains a 3mol/l-KCl solution which needs to be topped up, if necessary. If combined electrodes and reference electrodes are kept within distilled water for a longer period of time this may lead to a loss of KCl.
- Remove air bubbles in the membrane ball by shaking (like fever thermometer).
- Check reference electrolyte level at regular intervals; if necessary, top up electrolyte level with 3 mol/l-KCl solution through filling hole (closed by means of a silicon ring) using a syringe or pipette.
- Rinse electrodes thoroughly with distilled water before measurement.
- Rinse again during the measuring process. Clean electrodes after use. We recommend a pepsin hydrochloric acid (GRL 100) to clean soiling by protein.
- The platinum cap (silvery) can be cleaned by any commercial cleaning powder (put some cleaning powder on a cloth and apply to platinum in rotary movements for a short time)
- In case the measuring function of the electrode is impaired or reacting extremely slow, please proceed as follows:
 - check reference electrode for air bubbles
 - check reference electrode by comparing meas. results to those obtained by another reference electrode
 - treat sensitive glass membrane with recovery solution (1 to 2 minutes at ambient temperature)
 - replace electrode

Our scope of supply includes all solutions for calibrating, topping up, cleaning and activating.

15 The serial interface

All measuring data and settings of the device can be read and changed by means of the serial interface and a suitable electrically isolated interface adapter (GRS3100, GRS3105 or USB3100).

In order to avoid faulty transmission, we have designed elaborate security measures for interface communication.

The following **standard software packages** are available for data transfer:

- **EBS9M** 9-channel software to display the measuring value (channel 1) and the temperature (ch. 2)
- **EASYCONTROL**: Universal multi-channel software (EASYBUS-, RS485-, or GMH3000- operation possible) for real-time recording and presentation of measuring data in the ACCESS®-data base format.

In case you want to develop your own software we offer a **GMH3000-development package** including:

- a universally applicable Windows functions library ('GMH3000.DLL') with documentation, can be used by all 'established' programming languages, suitable for:
Windows 95™, Windows 98™, Windows NT™, Windows 2000™, Windows XP™, Windows Vista™.
- Programming examples Visual Basic 4.0, Delphi 1.0, Testpoint

15.1 The following interface functions will be supported:

Operating mode								DLL-Code	Name / function
pH		mV		rH		Ther.			
Channel	1	2	1	2	1	2	1		
	x	x	x	x	x	x	x	0	Read nominal value
		x		x		x		1	Set nominal value
	x	x	x	x	x	x	x	3	Read system status
	x	x	x	x	x	x	x	6	Read min. value
	x	x	x	x	x	x	x	7	Read max. value
	x		x		x		x	12	Read ID no.
	x		x		x		x	174	Delete min. value
	x		x		x		x	175	Delete max. value
	x	x	x	x	x	x	x	176	Read min. measuring range
	x	x	x	x	x	x	x	177	Read max. measuring range
	x	x	x	x	x	x	x	178	Read unit for measuring range
	x	x	x	x	x	x	x	179	Read decimal pt. for measuring range
	x	x	x	x	x	x	x	180	Read measuring type
								194	Set display unit
	x	x	x	x	x	x	x	199	Read meas. type in display
	x	x	x	x	x	x	x	200	Read min. display range
	x	x	x	x	x	x	x	201	Read max. display range
	x	x	x	x	x	x	x	202	Read unit of display
	x	x	x	x	x	x	x	204	Read decimal point of display
	x		x		x		x	208	Read channel count
	x							210	Read electrode state
		x		x		x	x	216	Read offset correction
		x		x		x	x	217	Set offset correction
	x		x		x		x	222	Read power-off delay
	x		x		x		x	223	Set power-off delay
	x		x		x		x	240	Reset instrument
	x		x		x		x	248	Special device functions
	x		x		x		x	254	Read program version

15.2 Functions for this device only (DLL-248)

Operating mode								Code		Function
pH		mV		rH		Ther.				
Channel	1	2	1	2	1	2	1	R	W	
Read/write										
	x	x		x	x		x	x	0 257	Operating mode (Choice between modes of operation)
	x								20 276	Uasymmetrie (pH-calibration)
	x								21 277	Slope 1 (acid range)
	x								22 278	Slope 2 (alkaline range)
						x	x		30 286	pH-value (for rH-calibration)

16 Specification:

Display ranges:

Temperature:	-100.0 ... +250.0°C or -148.0 ... +482.0°F
pH:	0.00 ... 14.00 pH
Redox (ORP):	-1999 ... +2000 mV; referring to hydrogen system: -1792 ... +2207 mV _H (bei 25°C) acc. to DIN 38404
rH:	rH 0.0 ... 70.0

Resolutions: 0.1°C or 0.1°F / 0.01 pH / 1 mV / 0.1 rH

Accuracy: (at nominal temperature, device ± 1 Digit)

Temperature:	$\pm 0.2^\circ\text{C}$ (-20..80°C), otherwise $\pm 0.4^\circ\text{C}$
pH:	± 0.01 pH (for electrode temperature 10..50°C)
Redox:	$\pm 0.1\%$ FS (mV or mV _H)
rH:	± 0.1 rH

Sensor connections:

pH, Redox, rH:	BNC-socket
Temperature:	4-pin screened Mini-DIN-plug for Pt100 4-wire (2-wire also possible)

Input resistance: 10¹² Ohm (pH, Redox)

Nominal temperature: 25°C


Working temperature: 0 to +50°C

Relative humidity: 0 to +95%RH (non-condensing)

Storage temperature: -20 to +70°C

Interface: Serial interface (3.5mm jack), serial interface can be connected to RS232 or USB interface of a PC via electrically isolated interface adapter GRS3100, GRS3105 or USB3100 (accessories).

Memory: Min-, Max-value- and Hold memory

Power supply: 9V-battery, type IEC 6F22 (included) or additional d.c.connector (internal pin \varnothing 1.9 mm) for external 10.5-12V direct voltage supply. 
(suitable power supply: GNG10/3000)

Power consumption: approx. 3 mA

Low battery warning:  and 'bAt'

Automatic-off-function: Device will be automatically switched off if no key is pressed/no interface communication takes place for the time of the power-off delay. The power-off delay can be set to values between 1 and 120 min.; it can be completely deactivated.

Housing dimensions: 142 x 71 x 26 mm (L x W x D), impact-resistant ABS plastic housing, membrane keyboard, transparent panel. Front side IP65, integrated pop-up clip for table top or suspended use.

Weight: approx. 165 g

Temp. compensation: Automatic temperature compensation (ATC) in the operating modes "pH", "mV_H" or "rH" if temperature probe is used. Compensation temp. range: 0 ... 105°C
If no temp. probe is used, temperature can be entered manually.

pH-calibration:

- 2-point or 3-pt. calibration with standard buffers, DIN-buffers, manually entered buffers
- autom. buffer detection, temperature dependence of standard or DIN buffers will be automatically compensated
- permissible electrode data: asymmetry: ± 55 mV
slope: -62...-45 mV/pH
- sensor evaluation according to calibration result (from 10 to 100%).

Rec. redox electrodes: Reference system: silver/silver chloride, electrolyte: KCl, 3 mol/l
(use only this type if changing values to hydrogen system "mV_H" and for rH measurements!)

EMV: The device corresponds to the essential protection ratings established in the Regulations of the Council for the Approximation of Legislation for the member countries regarding electromagnetic compatibility (2004/108/EG).
Additional fault: <1%

17 Disposal instruction:

Batteries must not be disposed in the regular domestic waste but at the designated collecting points. The device must not be disposed in the unsorted municipal waste! Send the device directly to us (sufficiently stamped), if it should be disposed. We will dispose the device appropriate and environmentally sound.