

Operating Manual

Hand-held Measuring Device

GMH 3610

for Dissolved Oxygen and Temperature



How to Operate and Maintain Device:

a) First Usage:

If the electrode was disconnected from the device, pull off the protection flask and expose the electrode at least 2 - 3 hours to the air before the first calibration or measuring.

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

c) Treat device and sensor carefully. Use only in accordance with above specification. (do not throw, hit against etc.).

Protect plug and socket from soiling.

Make sure to use sensors that are suitable for the GMH device. Unsuitable measuring probes may lead to the destruction of the measuring device and/or the measuring probes.

d) When connecting the electrode 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 sensor do not pull at the cable but at the plug

e) Mains operation:

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

Do not apply overvoltage!! Cheap 12V-power supplies often have excessive no-load voltage. We, therefore, recommend using regulated voltage power supply units. Trouble-free operation is guaranteed by our power supply GNG10/3000. Prior to connecting the plug power supply to the mains make sure that the operating voltage stated at the power supply is identical to the mains voltage.



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 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.

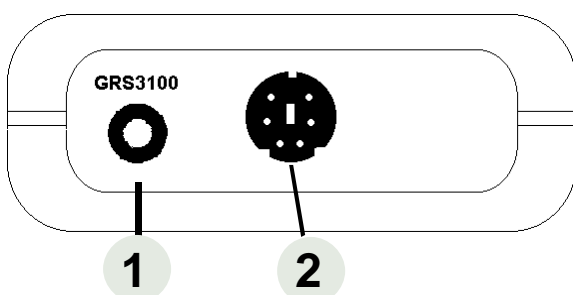
Operator safety may be risk if:

- 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. **This device has not been designed for monitoring life-saving equipment. If this device is used to monitor such systems the manufacturer shall assume no liability for damages whatsoever.**

Connections

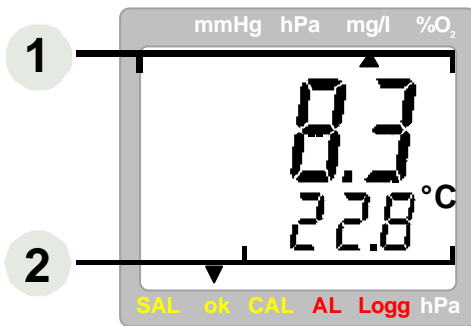


1 Interface: Connection for electrically isolated interface adapter (accessories: GRS 3100 or GRS3105)

2 Connection for oxygen sensor with integrated temperature probe

The **mains socket** is located at the left-hand side of the measuring instrument.


Displays



1 Main display

measuring value displayed:

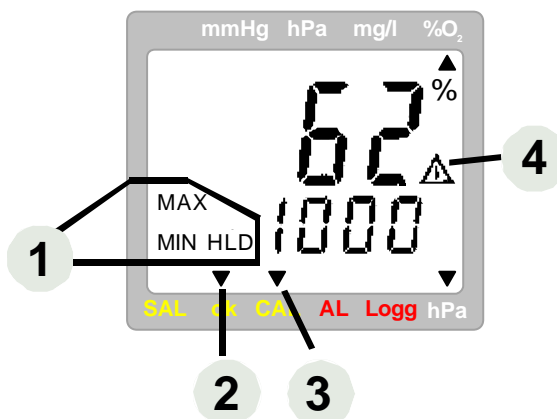
- Oxygen saturation in % (%O₂)
- Oxygen concentration (mg/l)

Use  -key to change main display.

2 Secondary display

-Temperature value of electrode (°C or °F)

Special Display Elements:



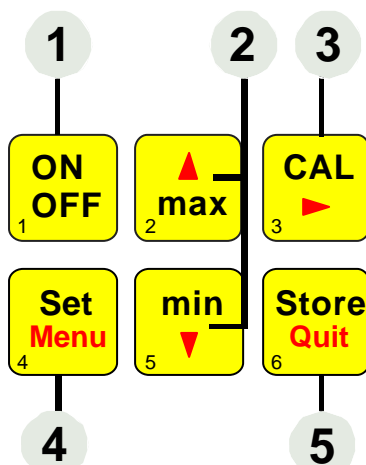
1 Min/Max/Hold: indicates if min., max. or hold values are displayed in the main and secondary display.

2 ok-arrow: indicates that oxygen and temperature values have been stable for a longer period of time

3 CAL-arrow: indicates that an automatic oxygen calibration is carried out

4 Warning triangle: indicates a low battery

Pushbuttons



1 On/off key

2 min/max when taking measurements:

- press for a short time: min. or max. meas. value will be displayed
- press for 1 sec.: the value shown will be deleted

up/down when configuring:

- entering of values/changing of settings.

3 CAL:

- press for a short time: evaluation of electrode condition
- press for 2 sec: start oxygen calibration

4 Set/Menu:

- press for a short time (Set) changing of main display
- press for 2 sec. (Menu): configuration will be activated

5 Store/Quit:

- measuring: holds current meas. value ('HLD' in display)

Set/Menu: acknowledge setting, return to measuring.

Configuration

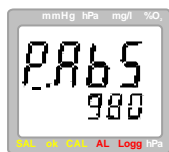
For configuration of the device press "Set"-key (key 4) for 2 seconds.

Choose between the individual values that can be set by pressing the "Set"-key (key 4) again.

The individual values are changed by pressing the keys "▲" (key 2) or "▼" (key 5).

Use key "Store" (key 6) to leave configuration and to store settings.

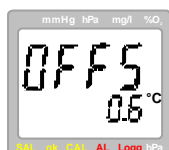
'Pressure Abs.': Entering of Atmospheric Pressure



500 .. 1100 hPa abs.

The oxygen values calculated refer to the atmospheric pressure set.

'Offset': Zero Point Displacement When Temperature is Measured



-3.0°C .. 3.0°C

and/or

-5.4°F .. 5.4°F:

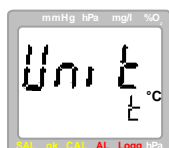
off.

The zero point of the measurement will be displaced by the value set to compensate for sensor and measuring device deviations.

Zero displacement not activated. (=0.0°, factory setting)

temperature displayed = temperature measured - offset

'Unit t': Selection of Temperature Unit °C /°F



°C: All temperature values in degrees Celsius

°F: All temperature values in degrees Fahrenheit

'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 via the serial interface.

off: automatic power-off function deactivated (continuous operation, e.g. in case of mains connection)

'Address': Selection of Base Address



01, 11, 21, ..., 91: Base address for interface communication.

Channel 1 will be addressed by the base address set, channels 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 will be connected via one interface make sure to configure the base addresses accordingly.

Note Regarding Zero Displacement ('Offset') Temperature

A zero displacement can be carried out for temperature measurements:

temperature displayed = temperature measured - offset

Standard: 'off' = 0.0°, i.e. no zero displacement. The zero displacement is used to compensate for sensor deviations. Any value but 'off' will be displayed when unit is switched on.

Electrode state 'ELEC'

By shortly pressing the 'CAL'-key and at the end of each calibration the state of the electrode will be displayed in steps of 10 percent.

100% ELEC: Electrode and measuring instrument are ready for operation without any limitations.

10..90% ELEC: The signal of the electrode is already weak, the precision of the measurement is still given.

Oxygen Measurements

Please observe the following points when measuring dissolved oxygen:

- **For measuring remove the protective flask.**
- **Do not disconnect electrode from device.** If electrode has been disconnected, wait 2 - 3 hours till the final electrode signal has settled, before carrying out measurements or a calibration.
- **Electrode needs to be calibrated** (p.r.t. 'How to calibrate oxygen electrode')
- **The temperatures of the electrode and of the liquid to be measured have to be identical** (if necessary, wait till temperatures match)
- **The measured liquid has to stream along the electrode membrane with at least 30 cm/sec** for measurements to be sufficiently accurate: either stir continuously or use agitator.

The GMH3610 calculates the oxygen concentration [mg/l] and the oxygen saturation [%] from the electrode signal and the temperature. According to DIN38408-C22 all measurements refer to steam saturated air.

Absolute atmospheric pressure

The absolute atmospheric pressure set mainly influences oxygen saturation measurements [%]; it may, however, also have an effect on the automatic oxygen calibration. Therefore, make it a rule to always check the atmospheric air pressure prior to conducting measurement/calibrations.

Please note that pressure conditions are different in bathymetry; when carrying out the measurements the absolute atmospheric pressure has to be compensated by the additional pressure in the water (10 m correspond to: absolute atmospheric pressure+1000 hPa). At a depth where the absolute pressure exceeds 2000 hPa (>~10m) the oxygen saturation [%] has to be calculated accordingly; measuring results for oxygen concentration [mg/l] will not be influenced.

How to Calibrate the Oxygen Electrode

If the electrode was dry for one or more days it has to be 'watered' for at least 30 minutes before carrying out a new calibration.

Due to its ageing the electrode has to be calibrated regularly. The unit is equipped with a simple calibration function, which automatically sets the electrode according to the oxygen content of the air (20.95%, 1-point calibration). We recommend to calibrate electrode once a week.

How to carry out the calibration

Remove protective flask prior to calibration and wipe diaphragm with a soft piece of cloth. You can choose between two modes of calibration for which the electrode has to be prepared accordingly. We recommend to calibrate for each set of measuring.

Air calibration without accessories

The electrode will be exposed to **ambient air**. To protect it from draughts, wrap electrode in a towel or cleenex. (before calibration, expose electrode at least 15 minutes to the ambient air, to let adjust the temperature and to dry membrane)

Depending on the rel. atmospheric humidity [%] and the temperature [°C] a small calibration error cannot be avoided and will have to be accepted. The cooler the air the smaller the deviation. Recommended temperature < 25°C.

For error compensation please refer to the opposite table.

Note: A correctly calibrated electrode shows 106 - 108% at air.

	20%	40%	60%	80%	100
5 °C	1,007	1,005	1,003	1,002	1,00
10 °C	1,01	1,007	1,005	1,002	1,00
15 °C	1,014	1,01	1,007	1,003	1,00
20 °C	1,019	1,014	1,009	1,005	1,00
25 °C	1,026	1,019	1,013	1,006	1,00
30 °C	1,035	1,026	1,017	1,009	1,00
35 °C	1,047	1,035	1,023	1,012	1,00
40 °C	1,063	1,047	1,031	1,016	1,00

*Deviations wehn carrying out an air calib.
without accessories,
O2-saturation=display value*correction factor*

Air calibration for highly accurate measurements

The electrode is exposed to **air with a relative atmospheric humidity of 100%**.

Proceed as follows: Put some distilled water in a bottle. Close bottle and generate a water steam saturation (100% rel. atmospheric humidity) in the remaining air by shaking it vigorously for approx. 3 minutes. Both water and air temperatures should be identical. Open bottle and insert electrode so that the diaphragm is in the air chamber.

Attention: By no means must the diaphragm get wet or be immersed in water. The bottle neck opening should only be slightly larger than the electrode diameter; make sure to avoid over pressure in the container.

Note: A correctly calibrated electrode shows 106 - 108% at air.

To start calibration: Press "CAL"-key (key 3) for 2 sec.

'CAL Air' will be displayed; the calibration will be completed automatically as soon as the measuring values for oxygen and temperature are stable. As soon as the calibration has been completed the electrode condition will be displayed briefly. ('Elec', evaluation in 10%-steps).



In case of **error messages** during calibration please refer to the chapter '**Fault messages**' at the end of this manual. If the calibration process cannot be completed after some time, at least one of the measuring values (partial oxygen pressure, temperature) is still unstable. Check measuring set-up!

The Oxygen Electrode

The oxygen electrode is an active electrode consisting of a silver cathode and a lead anode with the electrolyte being calcium hydroxide (KOH). In case of oxygen being present it will be reduced at the silver cathode, i.e. the electrode supplies a current. No oxygen means no current either. The oxygen measurements use up both the silver cathode as well as the lead anode. The electrode is subject to ageing. We, therefore, recommend to maintain the electrode every 8 weeks (p.r.t. "Electrode maintenance").



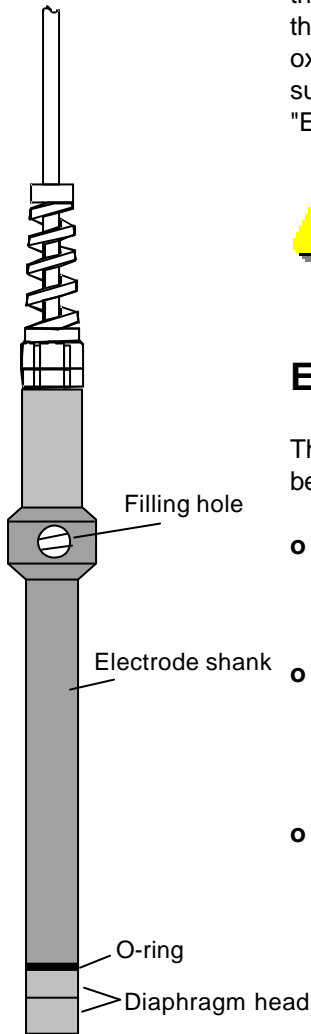
Please note: Make it a rule to always store the electrode in a humid environment.

- in the storage flask filled with water
- in another container filled with water

If electrode has not been used for some time, clean diaphragm with soft cloth and remove deposits, if any (algae, bacteria etc.).

Electrode design

The electrode housing is made of PVC. With the exception of the electrode shaft all parts need to be maintained regularly and be replaced if necessary.



- o **Protective flask:** The protective flask is used to moisten the diaphragm. The service life of the electrode will be prolonged. The protective flask contains water.
Attention! Use water only; never use calcium chloride (KCl); this is only required for storage of pH-electrode.
- o **Diaphragm head:** the diaphragm head is covered with a teflon diaphragm. It will be filled with KOH electrolyte and screwed onto the electrode shaft (no air bubbles). Damages in the diaphragm, large air bubbles or air bubble rings in the diaphragm head will result in erroneous measurements. This may also be the reason for errors in the calibration. The diaphragm head is a spare part and can be ordered individually.
- o **Filling hole:** If the electrode is used at high temperatures or if it has been stored without its protective flask for a longer period of time, some electrolyte will be lost due to pervaporation. During maintenance make it a rule to unscrew diaphragm head, remove locking screws and top up electrolyte using a syringe. Replace and tighten locking screws. Normally some electrolyte can be observed penetrating at the silver cathode.



Attention when working with electrolyte! The electrolyte is a corroding agent! (strong caustic solution, KOH)

Electrode Maintenance

If it can no longer be calibrated, electrode needs maintenance.

Attention! The electrolyte is a corroding agent.

To maintain electrode please proceed as follows:

1. Unscrew diaphragm head and wipe clean of electrolyte solution using a paper cloth. Do not touch electrolyte. If your skin has come into contact with electrolyte, rinse thoroughly with clear water.
2. Clean silver cathode with sanding paper (grain size 240). Do not polish silver cathode, surface should stay rough. Remove all dust.
3. Remove filling screw and top up lost electrolyte (e.g. using disposable syringe))
4. Replace and tighten filling screw.
5. Top up diaphragm head with electrolyte avoiding air bubbles and place on table (cover table with absorbent paper first).
6. Keep electrode in a vertical position and replace diaphragm head on the electrode from the bottom. Electrolyte will be forced out of the diaphragm head and spill over (put on disposable gloves or use paper towel to touch diaphragm head).
7. Wipe up excess electrolyte with paper cloth.
8. Check cathode for air bubbles.

If there are large air bubbles, remove diaphragm head again and repeat process as of point 5.

If O-ring has been damaged, it has to be replaced.

When maintenance has been completed replace protective flask. Re-connect electrode to measuring device and wait for at least one hour till electrode can be calibrated.

The Serial Interface

All measuring and setting data of the device can be read and/or changed by means of the serial interface and a suitable electrically isolated interface adapter (GRS3100 or GRS3105). In order to avoid transmission errors, there are several security checks implemented.

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

- EBS9M** 9-channel software to display the measuring values
 - channel 1: oxygen saturation
 - channel 2: oxygen concentration
 - channel 3: temperature
 - channel 4: absolute atmospheric pressure
- EASYCONTROL**: Universal multi-channel software (EASYBUS-, RS485-, and/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 32 bit Windows functions library ('GMH3000.DLL') with documentation that can be used by the most programming languages.
- Programming examples Visual Basic 4.0, Testpoint (Keithley Windows measuring software)

The following interface functions will be supported:

Oxygen saturation	Oxygen concentration	Temperature	Atmosph. pressure abs.		
Channel 1	Channel 2	Channel 3	Channel 4	DLL-Code	Name/Function
x	x	x	x	0	Read nominal value
			x	1	Set nominal value
x	x	x	x	3	Read system status
x	x	x	x	6	Read min. value
x	x	x	x	7	Read max. value
x				12	Read ID no.
x				174	Delete min. value
x				175	Delete max. value
x	x	x	x	176	Read min. measuring range
x	x	x	x	177	Read max. measuring range
x	x	x	x	178	Read unit for measuring range
x	x	x	x	179	Read decimal point for measuring range
x	x	x	x	180	Read measuring type
		x		194	Set display unit
x	x	x	x	199	Read meas. type in display
x	x	x	x	200	Read min. display range
x	x	x	x	201	Read max. display range
x	x	x	x	202	Read unit of display
x	x	x	x	204	Read decimal point of display
x				208	Read channel count
x				210	Read electrode state
		x		216	Read offset correction
		x		217	Set offset correction
x				222	Read power-off delay
x				223	Set power-off delay
x				240	Reset device
x				254	Read programme identification

Fault and System Messages

Display	Description	Remedy
	No sensor	connect sensor sensor defective -> return sensor to manufacturer for repair
	Battery voltage too low, device will only continue operation for a short time	replace battery
	Battery voltage low In case of mains op.: wrong voltage	replace battery replace mains supply, if error continues to exist: unit damaged
No display or confused characters	- Battery voltage too low - If mains op.: power supply defective or wrong voltage/polarity - System error - Device defective	replace battery check/replace mains supply disconnect battery or power supply, wait for a short time, reconnect return to manufacturer for repair
Err.1	Values exceeding measuring range Electrode was disconnected Sensor/cable defective	check: are there any values exceeding the measuring range specified? -> meas. value too high Wait for final electrode signal being set -> replace
Err.2	Sensor/cable defective	-> replace
Err.7	Fault in the device	switch on again: if fault continues to exist, device is damaged -> return to manufacturer for repair
Err.9	No sensor and/or error in sensor	connect suitable sensor sensor defective -> return to manufacturer for repair
Err.11	Value could not be calculated	one of the measuring values required for calculation is missing sensor missing or damaged (overflow/underflow)

Error and System Messages During Oxygen Calibration

Display	Description	Cause/Remedy
Cal Err.1	Wrong temperature	temperature has to be between 5 and 40°C
Cal Err.3	Wrong current: too low	membrane dried up => store electrode in water for 2 hours regenerate or replace electrode check calibration environment (p.r.t.'How to calibrate oxygen electr.')
Cal Err.4	Wrong current: too high	check calibration environment (p.r.t.'How to calibrate oxygen electr.')
Cal Err.6	timeout: no stable measuring value	air bubbles in the diaphragm head? check calibration environment (p.r.t.'How to calibrate oxygen electr.')

Specification

Measuring ranges

Oxygen concentration	0.0 ... 25.0 mg/l
Oxygen saturation	0 ... 300 %
Electrode temperature	0.0 ... 50.0°C

Accuracy device (at nominal temperature)

Oxygen measuring ranges:	$\pm 1.5\%$ $\pm 0.2\text{mg/l}$
Electrode temperature	$\pm 0.1^\circ\text{C}$ ± 1 Digit

Atmospheric pressure compensation: infinitely variable: 500 .. 2000 hPa abs.

Nominal temperature 25°C

Operating temperature 0 to +50°C


Relative humidity 0 to +95%r.h. (non-condensing)

Storage temperature -20 to +70°C (Electrode: 0 to +60°C)

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. 155 g

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

Power supply 9V-battery, type IEC6F22 (included) as well as additional d.c.connector (dia of internal pin 1.9 mm) for external 10.5-12V direct voltage supply.  (suitable power supply: GNG10/3000)

Power consumption approx. 3.5 mA

Display 2 four-digit LCD-displays (12.4mm or 7mm high) for measuring values or for min., max., values, Hold-function etc. as well as additional arrows.

Pushbuttons 6 membrane keys altogether for on/off switch, selection of thermoelements, min. and max. value-memory, Hold-function etc.

Min-/max-value memory both the max. and the min. value for each measurement are memorized.

Hold function press button to memorize current measuring values

Power-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.

Electrode connection 6-pin screened mini-DIN-plug

Electrode oxygen electrode (active diaphragm type) with integrated NTC resistor

Response time: 95% in 10 sec., depending on temperature

Operation life: 3 years or more, depending on proper maintenance

Operating pressure: max. 3 bar.

Mounting dia 12,0 \pm 0,2 mm (also suitable for 1/2" glanding)

Length approx. 220 mm

Mounting length approx. 110 mm

Weight approx. 180 g

Cable length 4 m

Working temperature 0 to 40 °C

EMC:

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 (89/336/EEG). Additional fault: <1%

