

Operating Manual
Hand-held Measuring Device
GMH 3630
for Dissolved Oxygen, Temperature
and
Abs. Atmospheric Pressure



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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: 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.
- 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 supply 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 supplies. Trouble-free operation is guaranteed by our power supply GNG10/3000. Prior to connecting the plug power supply with the mains make sure that the operating voltage stated at the power supply is identical to the mains voltage.



Safety Requirements:

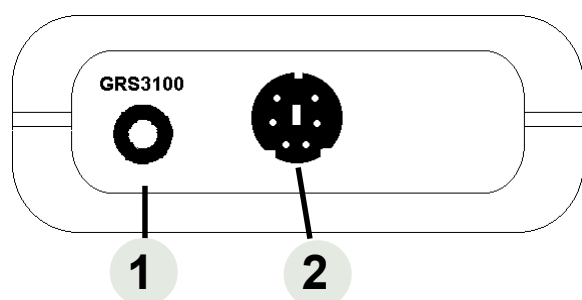
This device has been designed and tested in accordance with the safety regulations for electronic devices. However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using the device.

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 only serves as supervision by the monitoring of essential or other for the customer important systems. It must not be used instead of compulsory approval monitoring devices an it is not planed for that purpose. If this device is used for the monitoring of such systems on its own, the manufacturer will not assume liability for damages whatsoever.**

Connections

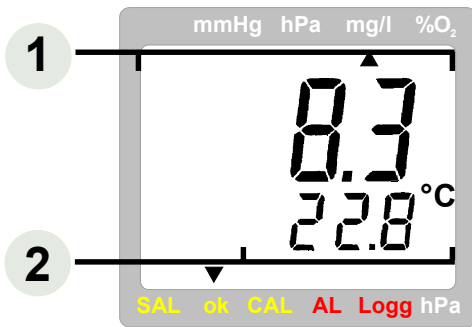


1 Interface: Connection for electrically isolated interface adapter (accessories: GRS 3100 or GRS3105)

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 values displayed:

- oxygen saturation in % (%O₂)
- oxygen concentration (mg/l)
- partial oxygen pressure (mmHg or hPa)

Use  -key to change main display.

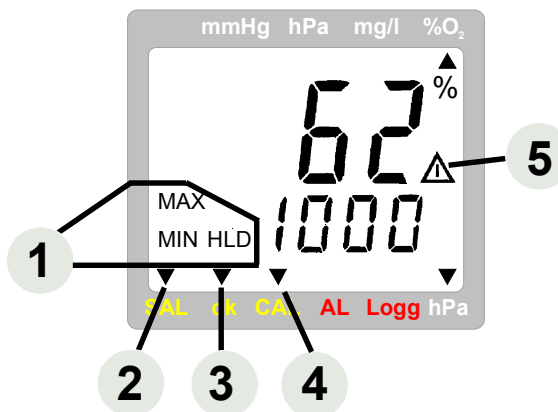
2 Secondary display

measuring values displayed:

- electrode temperature (°C or °F)
- abs. atmospheric pressure in the unit (hPa)

The secondary display can be determined by means of the configuration system (p.r.t. '**Configuration**')

Special Display Elements:



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

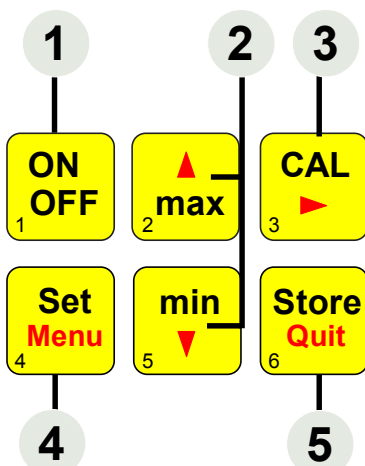
2 Sal-arrow: indicates active salinity correction factor

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

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

5 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: show state of electrode
- press for 2 sec: start oxygen calibration

4 Set/Menu:

- press for a short time(Set) changing of main menu
- 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 " \uparrow " (key 2) or " \downarrow " (key 5).

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

'Resolution': Selection of Display Resolution of Oxygen Measurements



Hi: high resolution, measuring ranges limited



Lo: low resolution, maximum measuring ranges

Auto: automatic selection of resolutions, maximum measuring ranges

'Salinity': Selection of Salinity Correction [‰]

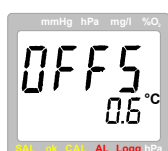


0 .. 70.0‰ Oxygen values will be corrected



off: Salinity correction deactivated (=0.0°)

'Offset': Zero Point Displacement When Temperature is Measured



-3.0°C .. 3.0°C

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

or



-5.4°F .. 5.4°F:

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

temperature displayed = temperature measured - offset

'CAL': Calibration in Air or Water



Air:

Electrode calibration in air (at 100% relative humidity) (factory setting)



AQUA:

Electrode calibration in water (oxygen saturation 100%)

'CAL': Choice of Calibration Mode



1-Pt:

standard 1-point calibration (factory setting)



2-Pt:

2-point calibration with the calibration equipment GKS3600, for highly accurate measings in the upper measuring range, too (>25 mg/l)

'Lcd.2': Measuring Value Displayed in The Secondary Display



t, °C:

Permanent temperature display



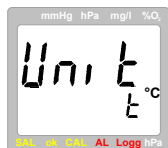
P.Abs, hPa:

Permanent display of absolute atmospheric pressure

both, °C, hPa:

Both the temperature and the abs. atmospheric pressure will be displayed (display changing at intervals)

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



°C:

All temperature values in degrees Celsius



°F:

All temperature values in degrees Fahrenheit

'Unit P O2': Selection of Unit for Partial Oxygen Pressure hPa / mmHg



hPa:

Partial oxygen pressure in hPascal



mmHg:

Partial oxygen pressure in mm mercury column

'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 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, 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.

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 at monthly intervals (p.r.t. "Electrode maintenance").



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

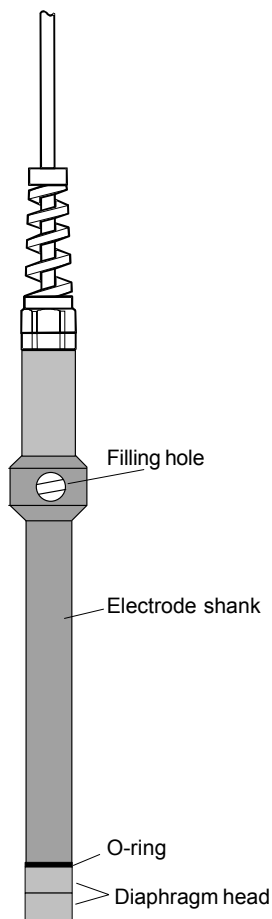
- in the storage flask filled with water
- in another container filled with water

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.



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.

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 electrode measurement is sensitive against shocks! By stirring of the electrode in the measured liquid be careful that the electrode does not hit the container. A vibration of the electrode has a effect to the measured value.

The GMH3630 calculates the oxygen concentration [mg/l], the oxygen saturation [%] and the oxygen partial pressure [hPa] 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 is measured inside the instrument - not in the electrode. The absolute atmospheric pressure mainly influences oxygen saturation measurements [%]; also has 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 at the electrode are different in bathymetry; therefore, the oxygen concentration needs to be corrected accordingly. Measuring results for partial oxygen pressure and oxygen concentration [mg/l] will not be affected.

Correction of salinity ('SAL')

The higher the salinity (salt content) the lower the solubility of oxygen in water, i.e. although the partial oxygen pressure is the same, the quantity of oxygen dissolved in water (mg/l) is lower. Therefore, determination of the oxygen concentration requires entering the salinity of the medium (p.r.t. 'Configuration'). The correction of salinity is based on media on a water basis, whose chemical content is similar to sea water. Any corrections are based on the 'International Oceanographic Tables' (IOT).

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 device is equipped with two simple calibration functions: Standard 1-point calibration, sufficient for the most applications and special 2-point calibration, if high accuracy is needed in the upper measuring range (>25mg/l). We recommend to calibrate the electrode before each measuring series.

How to carry out the 1-point calibration

The 1-point calibration adjusts the electrode to the oxygen content of the atmosphere (20.95%). Remove protective flask prior to calibration and wipe diaphragm with a soft piece of cloth. You can choose between three 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.

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.

Calibration in air saturated water (configuration: 'Cal AQUA')

This mode of calibration is more difficult than the ones already described. As water is easily oversaturated it quickly results in calibration errors. In order to generate air saturated water, pure water (25-30°C) is poured into another container from a height of 50 cm. This process is repeated 20 times. In order for an oversaturation to be able to evaporate wait approx. 5 min. before carrying out the calibration (do not forget to stir).

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 state 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!

	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

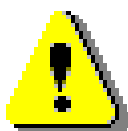
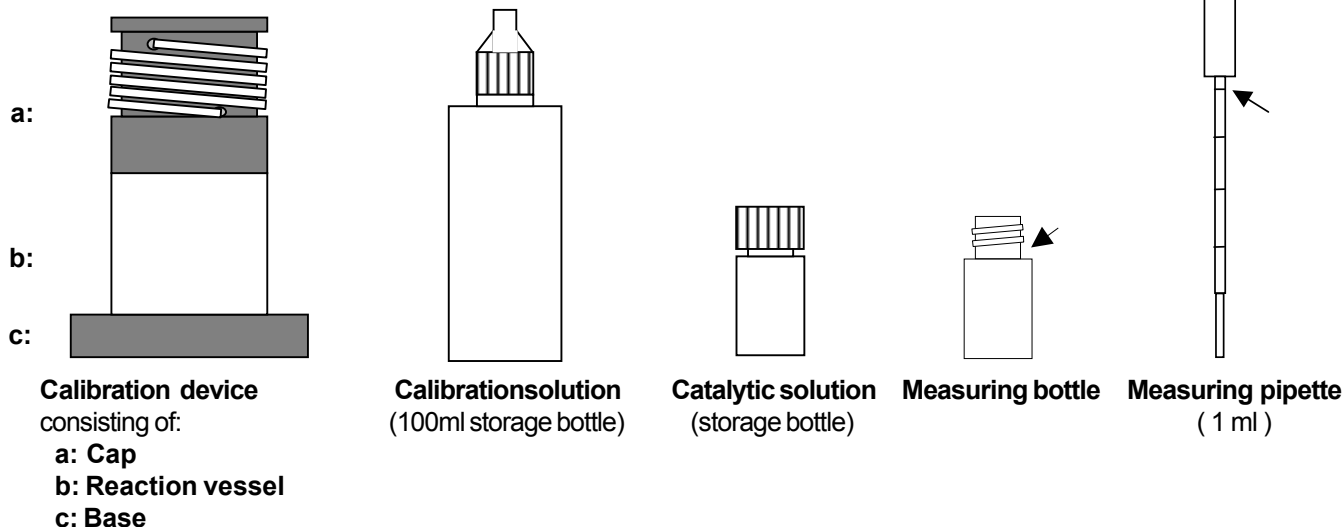
Deviations wehn carrying out an air calib. without accessories,

*O2-saturation= display value*corr. factor*

How to carry out a 2-point calibration

When carrying out a 2-point calibration the electrode will, first of all, be adjusted to the oxygen content of the air (20.95%). Then, the electrode will be adjusted to approx. 100 % using the calibration device GKS3600 to use it for high measuring areas.

Components required for calibration (part of GKS3600):



! Attention ! Both catalytic and calibration solution are caustic and must not be accessible to children. Protect calibration solution from direct sun. Do not swallow solution; make sure the solution does not come into contact with your eyes or skin. Please also refer to the safety advices on the bottles!

2. How to carry out calibration

Prior to starting the calibration, remove protective flask and dry up membrane using a soft piece of cloth. Be sure that "CAL 2.Pt" was chosen in the configuration.

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

Calibration point 1

- Carry out an air calibration or a calibration in air saturated water the way it is described in chapter "How to carry out a - point calibration".
- If the calibration of the first point was carried out successfully, the device will ask you to work on the 2nd calibration point by displaying "CAL Pt. 2".
- If electrode was calibrated in water (CAL AQUA), use soft piece of cloth to dry it.

Calibration point 2

- Top up measuring bottle till calibration solution reaches the beginning of the thread (indicated by arrow in figure above).
- Remove cap (a:) from the reaction vessel (b:) and empty out the contents of the measuring bottle into the reaction vessel (b:), place reaction vessel securely on its base (c:).
- Take out 1 ml (see arrow) of the catalytic solution using the measuring pipette and drop it into the reaction vessel (b:); the reaction will start now.
- Put cap (a:) into reaction vessel (b.) and wait 2-3 minutes, then place the electrode into the cutout on the cap.
- Leave calibration equipment and electrode like this (do not squeeze reaction bottle as this will lead to incorrect measuring results). The measuring device automatically identifies the start of the reaction and counts backwards a max. of 360 seconds at 2 second intervals. If the measuring value has stabilized within this time, calibration of the 2nd calibration point will be completed. Electrode evaluation (10 to 100%) will be displayed for approx. 1 sec., then the device will switch over to measuring mode.

The two-point calibration has now been completed.

- Remove electrode from cap and wait for approx. 10 minutes. If you start measuring immediately after calibration has been completed the measuring value obtained is too high by approx. 0.4 mg/l.
- Drain reaction vessel (put used calibration solution into sewage) and rinse with water.



In case there are any **error messages** during calibration please refer to the **error code** at the end of this manual. If the device cannot leave the calibration mode for an extended period of time, at least one of the measuring values has not stabilized (partial oxygen pressure, temperature, air pressure). Please check your measuring set-up.

Electrode state 'ELEC'

By shortly pressing the 'CAL'-key and at the end of each calibration the electrode state resulting of the last successful calibration carried out 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.

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, USB3100 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: partial oxygen pressure
 - channel 4: temperature
 - channel 5: 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.

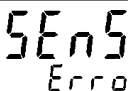

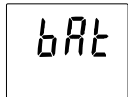
In case you want to develop your own software we offer a **GMH3000-development package** including

- 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	Oxygen partial pressure	Temperature	Atmosph. pressure abs.		
Channel 1	Channel 2	Channel 3	Channel 3	Channel 4	DLL-Code	Name/Function
x	x	x	x	x	0	Read nominal value
x	x	x	x	x	3	Read system status
x	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		x			175	Delete max. value
x	x	x	x	x	176	Read min. measuring range
x	x	x	x	x	177	Read max. measuring range
x	x	x	x	x	178	Read unit for measuring range
x	x	x	x	x	179	Read decimal point for measuring range
x	x	x	x	x	180	Read measuring type
			x		194	Set display unit
x	x	x	x	x	199	Read meas. type in display
x	x	x	x	x	200	Read min. display range
x	x	x	x	x	201	Read max. display range
x	x	x	x	x	202	Read unit of display
x	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
Er.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.2	Wrong atmospheric pressure	atmospheric pressure has to be between 500 and 1100 hPa
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.5	Second calibration point is not within the allowable range	air bubbles in the diaphragm head? check calibration environment (p.r.t.'How to calibrate oxygen electr.')
Cal Err.6	Second calibration point is not within the allowable range	air bubbles in diaphragm head? electrode needs maintenance or has to be replaced
Cal Err.6	timeout: no stable measuring value	check calibration environment (p.r.t.'How to calibrate oxygen electr.')

Specification

Measuring ranges	high resolution	low resolution and/or resolution 'Auto' (=Auto Range)
Partial oxygen pressure	0.0...570.0 hPa 0.0...427.5 mmHg	0...1200 hPa 0...900 mmHg
Oxygen concentration	0.00...25.00 mg/l	0.0...70.0 mg/l
Oxygen saturation	0.0...250.0 %	0...600 %
Electrode temperature	0.0..50.0 °C	
abs. atmospheric pressure	500..1100 hPa	
Accuracy in the device (at nominal temperature)		
Oxygen meas. ranges	±1.5% ±0.2mg/l (0...25mg/l) ±2.5% ±0.3mg/l (25... 70mg/l - after 2-point calibration)	
Electrode temperature	±0.1°C ±1Digit	
abs. atmospheric pressure	±0.5% FS ±1Digit	
Nominal temperature	20°C	
Operating temperature	0 to +50 °C	
Relative humidity	0 to +95 %RH (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 or USB interface of a PC via electrically isolated interface adapter GRS3100, GRS3105 or USB3100.	
Power supply	9V-battery, type IEC 6F22 (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 ±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 (2004/108/EG). Additional fault: <1%	

Disposal instruction:

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.