H84.0.01.6C-03

GREISINGER

EN

Water-Proof Oxygen Meter for Dissolved Oxygen
With Integrated Temperature and Pressure Measuring

As of version 1.0 **Operating Manual**

GMH 5630

CE

☞ Please carefully read these instructions before use!

☞ Please consider the safety instructions!

☞ Please keep for future reference!

Made in Germany

WEEE-Reg.-Nr. DE 93889386

GHM MESSTECHNIK

GHM Messtechnik GmbH • Standort Greisinger
Hans-Sachs-Str. 26 • D-93128 Regenstauf
☎ +49 (0) 9402 / 9383-0 🖷 +49 (0) 9402 / 9383-33 info@greisinger.de

Contents

1 GENERAL NOTE 3
2 SAFETY 3
2.1 INTENDED USE 3
2.2 SAFETY SIGNS AND SYMBOLS 3
2.3 SAFETY GUIDELINES 3
3 PRODUCT DESCRIPTION 4
3.1 SCOPE OF SUPPLY 4
3.2 OPERATION AND MAINTENANCE ADVICE 4
4 START OF OPERATION 4
5 OPERATION 5
5.1 DISPLAY ELEMENTS 5
5.2 PUSHBUTTONS 5
5.3 CONNECTIONS 6
5.4 POP-UP CLIP 6
6 CONFIGURATION 7
7 THE OXYGEN SENSOR 8
7.1 DESIGN OF SENSOR GWO 5610 8
7.2 FIRST START OF OPERATION OF SENSOR GWO 5610 / FILLING 9
7.3 SENSOR MAINTENANCE OF GWO 5610 10
8 DISSOLVED OXYGEN MEASURING - PLEASE NOTE 10
8.1 AMBIENT PRESSURE AND MEASURING DEPTH OF THE SENSOR 10
8.2 CORRECTION OF SALINITY ('SAL') 10
9 CALIBRATION OF THE SENSOR 11
9.1 HOW TO CALIBRATE 11
9.2 EVALUATION OF SENSOR STATE (ELEC) 11
9.3 CALIBRATION INTERVAL (C.int) 11
10 UNIVERSAL OUTPUT 12
10.1 INTERFACE 12
11 ADJUSTMENT OF TEMPERATURE INPUT 13
12 INSPECTION OF THE ACCURACY / ADJUSTMENT SERVICES 13
13 REPLACING BATTERIES 13
14 ERROR AND SYSTEM MESSAGES 14
15 RESHIPMENT AND DISPOSAL 15
15.1 RESHIPMENT 15
15.2 DISPOSAL INSTRUCTIONS 15
16 SPECIFICATION 15

1 General Note

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

Mounting, start-up, operating, maintenance and removing from operation must be done by qualified, specially trained staff that have carefully read and understood this manual before starting any work.

The manufacturer will assume no liability or warranty in case of usage for other purpose than the intended one, ignoring this manual, operating by unqualified staff as well as unauthorized modifications to the device. The manufacturer is not liable for any costs or damages incurred at the user or third parties because of the usage or application of this device, in particular in case of improper use of the device, misuse or malfunction of the connection or of the device.

The manufacturer is not liable for misprints.

2 Safety

2.1 Intended Use

The instrument is measuring dissolved oxygen in water.
The measuring is performed by means of a suitable oxygen sensor (included in supply in standard instrument) connected to the 7-pole bayonet socket, the sensor measures at the membrane at the tip of the sensor.
Due to the properties of the sensor, it has to be calibrated regularly (e.g. at fresh air = 20.95%) to get precise values. If the sensor is used up, this will be detected during the calibration, the sensor has to be regenerated or replaced before continuing with measuring.

The safety requirements (see below) have to be observed.
The device must be used only according to its intended purpose and under suitable conditions.
Use the device carefully and according to its technical data (do not throw it, strike it, …)
Protect the device from dirt.

2.2 Safety signs and symbols

Warnings are labeled in this document with the followings signs:

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

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

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

2.3 Safety guidelines

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

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

2. 

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

3. When connecting the device to other devices the connection has to be designed most thoroughly as internal connections in third-party devices (e.g. connection GND with protective earth) may lead to undesired voltage potentials that can lead to malfunctions or destroying of the instrument and the connected devices.

4. 

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. 

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

3 Product Description

3.1 Scope of supply

The scope of supply includes:

- Handheld instrument GMH 5630 with 2 AAA-Batteries
- Oxygen sensor GWO 5610
- Operating manual
- Short form manual

3.2 Operation and maintenance advice

1. Battery operation:
   If ‘bAt’ is shown in the lower display the battery has been used up and needs to be replaced. However, the device will 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. Battery change: p.r.t. chapter 13

   The battery has to be taken out, when storing device above 50°C. We recommend taking out battery if device is not used for a longer period of time.
   After recommissioning the real-time clock has to be set again.

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

3. USB or mains operation:
   When connecting a mains cable or USB interface cable, please take care to connect only allowed components.

   The output voltage of a connected power supply unit has to be between 4.5 and 5.5 V DC. Don’t apply overvoltage!

   We recommend operation with interface cable USB 5100. Then device is supplied by the USB interface of the connected PC or USB power supply adapter.

4 Start of Operation

In the case, the sensor was delivered ‘dry’, it has to be filled prior to operation. Please refer to chapter 7.2 First Start of Operation of Sensor GWO 5610 / Filling)

Connect sensor, switch instrument on with .

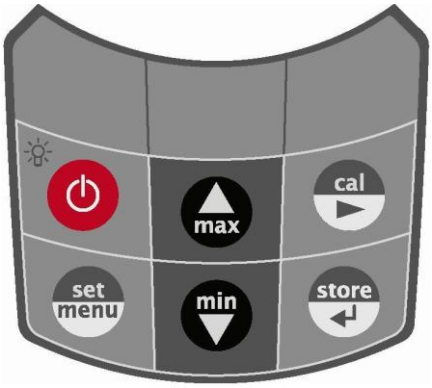
After the segment test  the instrument shows “Corr“ shortly, if it was user adjusted.
The device starts measurement afterwards.

5 Operation

5.1 Display elements

1	**Main display**: *Display of the current oxygen level, please refer to chapter6, ch2)* (choice via set menu -key)
2	**Secondary display**: sensor temperature, absolute pressure or depth (alternating, please refer to chapter 6 Lcd2))
3	**Main display units**
4	State of battery or sensor, if cal was pressed
5	Shows, if minimum/maximum/ memorized measuring value is in display
6	**OK**: Signals, if oxygen and temperature is stable
7	**CAL:** Signals, if automatic calibration is in progress
8	**SAL:** Signals, if salinity correction is activated
9	Not used
10	Secondary display units

5.2 Pushbuttons



On / off key, backlight

press shortly: activate backlight or switch on instrument
press longer: switch off instrument

Set / Menu:

press shortly: Change oxygen display unit
press for 2 sec. (menu): invoke configuration menu

+

min / max:

press shortly: min. or max. value is displayed
press for 2 sec: the corresponding value is deleted

Configuration (please refer to chapter 6):

enter values, or change settings

Store/Enter:

Measuring:

with Auto-Hold off: hold and save current measuring value ('HLD' is displayed)
with Auto-Hold on: start new measuring, It is finished , when "HLD' shows in display please refer to chapter 6

Configuration (please refer to chapter 6):

confirm settings, return to measuring

cal:

press shortly: display of sensor state rating
press for 2 sec: start sensor calibration

5.3 Connections

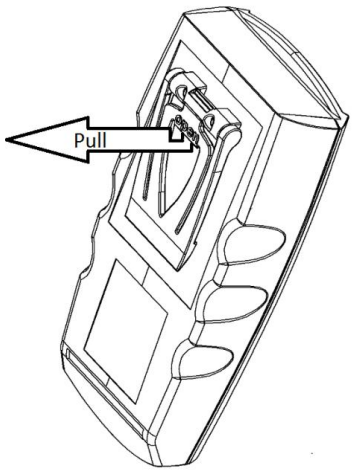
Universal output: interface, supply, analog output (see chapter 10)

7-pole bayonet socket: connection for sensor and temperature probe

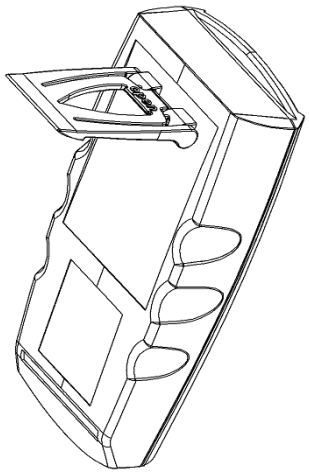
5.4 Pop-up clip

Handling:

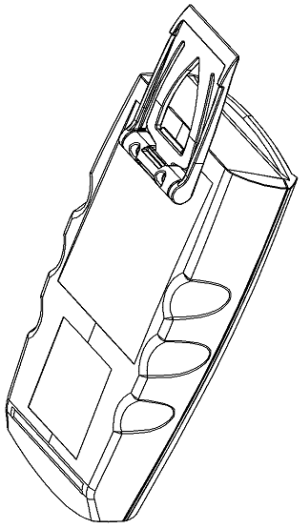
- Pull at label “open” in order to swing open the pop-up clip.
- Pull at label “open” again to swing open the pop-up clip further.



Pop-up clip closed



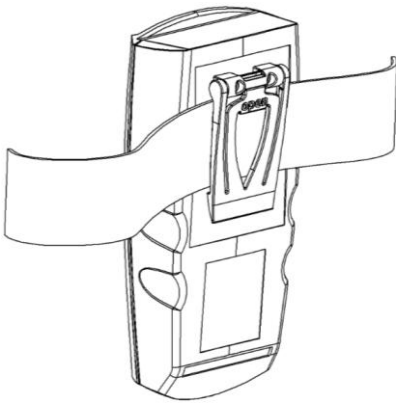
Pop-up clip at position 90°



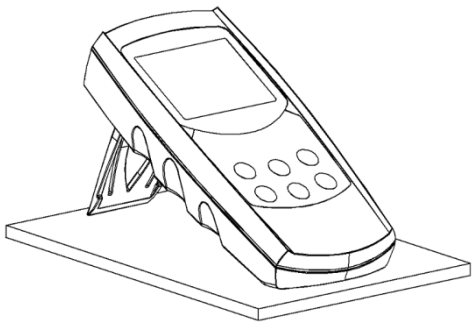
Pop-up clip at position 180°

Function:

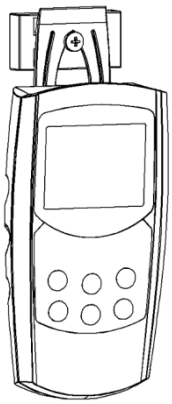
- The device with a closed pop-up clip can be plainly laid onto a table or attached to a belt, etc.
- The device with pop-up clip at position 90° can be set up on a table, etc.
- The device with pop-up clip at position 180° can be suspended from a screw or the magnetic holder GMH 1300.



Device attached to a belt



Device set up on a table



Device suspended from magnetic holder GMH 1300

6 Configuration

Some menu points depend on current device settings (e.g. some points are locked if logger memory contains data sets).

To change device's settings, press **"menu"** (set menu) for 2 seconds. This will activate the configuration menu (main display: "SEt"). Pressing **"menu"** (set menu) changes between the menus points, pressing (cal) jumps to the referring parameters, which can be selected with key (cal).

The parameter value can be changed with (max) or (min). Pressing **"menu"** (set menu) again jumps back to the main configuration menu and saves the settings.

Pressing **"enter"** (store) finishes the configuration.

Pressing "menu" and "store" at the same time for more than 2 seconds will reset the device to factory defaults.

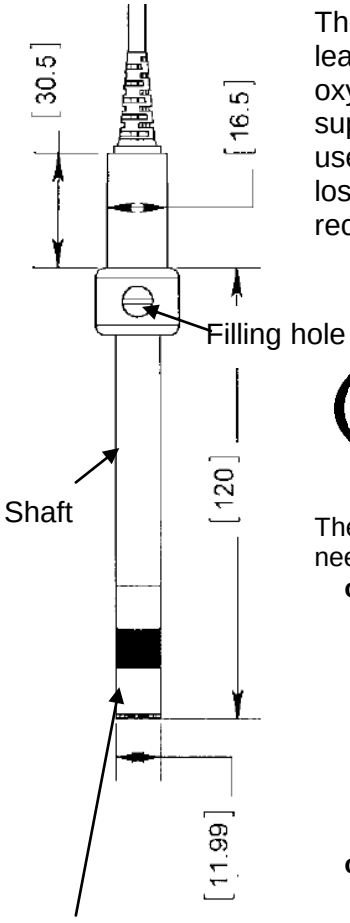
If no key is pressed for more than 2 minutes the configuration will be aborted. All changes will be discarded!

Menu	Parameter	Value	Description		
(set menu)	(cal)	(max) or (min)			see
SEt ConF	**Set Configuration: General configuration**				
	Unit Conc	Conc ppm	Display unit of O_2- concentration ppm (identical values like mg/l)		
		Conc mg/l	Display unit of O_2- concentration mg/l (identical values like ppm)		
	Ch 2	SAt %O_2	Main display shows O_2- concentration (mg/l or ppm) or O_2-Saturation in % *(ex works setting)*		
		P 02 hPa	Main display shows O_2- concentration or O_2-partial pressure in hPa		
		P 02 mmHg	Main display shows O_2- concentration or O_2- partial pressure in mmHg		
	rES	Hi	Best O_2 resolutions		
		Lo	Low O_2 resolution, calm value display (standard)		
	SAL	oFF	Salinity correction deactivated *(ex works setting)*		
		0.1 ... 70.0	Salinity correction activated, Unit ‰ = PSU, e.g. sea water ~35.0		
	Lcd.2	t	Second. display always temperature		
		P	Second. display always absolute pressure		
		P t	Second. display alternates between temperature and abs. pressure		
	Unit t	°C	All temperatures in degree Celsius (ex works setting)		
		°F	All temperatures in degree Fahrenheit		
	C.Int	1 ... 365	Calibration reminder period (in days)		
		oFF	No calibration reminder		
	Auto HLD	on	Auto measuring value identification Auto Hold (when logger = off)		
		oFF	Standard hold function on key press (when logger = off)		
	P.oFF	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. (ex works setting 20min)		
		oFF	Automatic power-off function deactivated (continuous operation)		
	LitE	oFF	Background Illumination deactivated		
		5...120	Turn off illumination after 5… 120s (factory settings: 10 s)		
		on	Illumination always on		
	Out	oFF	Interface off -> minimal power consumption		
		SEr	Serial interface activated (ex works setting)		
	Adr	01,11,21, ... 91	Base address for serial interface communication *(ex works setting 01)*		

	Set Corr: Input adjustment				
SEt Corr	OFFS °C or °F	-5.0 °C .. 5.0 °C or -9.0 °F .. 9.0 °F	The zero point of the temperature measuring is shifted for the entered value. This can be used to compensate sensor and instrument deviations		
		oFF	No zero adjustment for temperature measurement (=0.0°)		
	SCAL °C or °F	-5.00 ... 5.00 %	The slope of the temperature measurement is corrected by this value. This can be used to compensate sensor and instrument deviations		
		oFF	No slope adjustment for temperature measurement (=0.00)		
	OFFS hPa	-20 .. 20 hPa	The zero point of the pressure measuring is shifted for the entered value. This can be used to compensate sensor deviations		
		oFF	No zero adjustment for pressure measurement (=0 hPa)		

7 The Oxygen Sensor

7.1 Design of Sensor GWO 5610



The oxygen electrode is an active electrode consisting of a platinum cathode and a lead anode with the electrolyte being potassium hydroxide (KOH). In case of oxygen being present it will be reduced at the platinum cathode, i.e. the electrode supplies a current. No oxygen means no current either. The oxygen measurements uses up the lead anode. The sensor is subject to ageing. Also the e sensor may lose electrolyte due to high temperature or dry operation. Therefore, we recommend to maintain the electrode at monthly intervals (p.r.t.7.3)

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 membrane with soft cloth and remove deposits, if any (algae, bacteria etc.).

Attention: The membrane is delicate – if damaged, caustic electrolyte gets lost and the sensor shows wrong signal

The electrode housing is made of ABS. 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 membrane. This prolongs service life of the electrode. The protective flask contains water. Attention! Use water only; never use potassium chloride (KCl); this is only required for storage of pH-electrode.
- **o Membrane head**: the membrane head is covered with a Teflon membrane. It will be filled with KOH electrolyte and screwed onto the electrode shaft (no air bubbles). Damages in the membrane, large air bubbles or air bubble rings in the membrane head will result in erroneous measurements. This may also be the reason for errors in the calibration. The membrane 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 evaporation. Please refer to Refilling description below.

Attention when working with electrolyte! The electrolyte is caustic! (strong base, KOH)
Avoid contact to skin, protect Your eyes!

Life Time:

At the end of the Lifetime, the signal of the sensor is dropping rapidly. The sensor evaluation in % therefore e can only be taken as a relative measure. An evaluation of 70% does not mean that 70% of life time is left, but that the electrode signal has 70% of a good state reference.

Note: The sensor state evaluation will be stored after a successful calibration of the oxygen sensor

The nominal life time may be reduced due to the application. Negative effecting are:

- Extreme storage and operation temperature
- Dirty water during measuring
- Mechanical stress to sensor membrane
- Dry storage of filled sensor
- Permanent use at higher CO_2-concentrations

Mounting/Operation Position:

The optimum position is with sensor membrane pointing downwards.

Measuring Precision:

The precision can be influenced due to:

- To less flow
- Water and sensor temperature have to be the same, most exact measuring is done, when calibrated at measuring temperature.

Visible Residues in the Inner of Membrane Head:

As a reaction product in operation there will be lead oxide (red and brown – from the reaction with oxygen) and lead carbonate (white – from the reaction of carbon dioxide) in the inner of the sensor.
These substances may accumulate visibly at the membrane, but usually have now negative effect on the operability. Within a maintenance cycle the residues can be washed off the membrane nearly completely. Before screwing the membrane head on sensor body again they should be washed off, to avoid them getting in between platinum cathode and membrane.
A fast occurrence shortly after first filling or an unusual high amount of them (e.g. within some days) may be a sign of air in the sensor – either because of incorrect filling (bubbles), not sufficiently closing Cap or filling screw or a leaking membrane.

7.2 First Start of Operation of Sensor GWO 5610 / Filling

The state of delivery of the sensor is “dry”. Therefore the sensor is easily storable over a long time.
The sensor has to be filled timely towards the measuring. After filling a time of ~ 2 hours has to be considered, until the sensor has stabilized.
Wear suitable gloves*) and protect your eyes when filling the electrolyte! Do not touch the electrolyte with bare skin, if there was contact rinse sufficiently with water.

Material:

- Sensor GWO 5610 with membrane head
- Filling-pipette
- Electrolyte KOH
- Flat blade screw driver
- Paper towel
- Suitable gloves *)
- Wash basin

Figure: Filling with pipette

First Filling:

- Check membrane head GWOK 02: is it in good state? Is Membrane undamaged?
- Open filling screw
- Fill pipette with KOH
- First fill the membrane head up to up to ¾ of his heigth
- Screw on membrane head tightly, rinse excess KOH with water
- Then carefully fill the sensor, try to flick at the shaft from time to time, helping air bubbles coming out. In sum the sensor filling takes around 5 ml.
- If there are no more air bubbles and the filling hole is full, close with filling screw.
- Rinse excess KOH with water
- Turn sensor upwards: Are air bubbles visible below the membrane? If so: Refill once again.
- Wait approximately 2 hours for the sensor to stabilize, afterwards calibrate the sensor – the electrode state evaluation should deliver 100%.

7.3 Sensor Maintenance of GWO 5610

If the sensor can no more be calibrated or only unstable values are displayed, it has to be maintained or even or the membrane head has to be exchanged.
Wear suitable gloves*) when filling the electrolyte! Do not touch the electrolyte with bare skin, if there was contact rinse sufficiently with water.
Material:

- Sensor GWO 5610, eventually spare membrane head GWOK 02
- Filling pipette
- Electrolyte KOH
- Flat blade screw driver
- Paper towel
- Suitable gloves *)
- Wash basin

The maintenance is performed similar to the first filling, at first the membrane head is screwed off and the old electrolyte is washed out. Attention! Do not touch the electrolyte with bare skin!
Mount new membrane head. (If the membrane head is undamaged, it may be reused)
The filling of the sensor is like described above.

*) suitable gloves: Acc. to DIN EN 420, e.g. natural latex, natural rubber, butyl rubber, nitrile rubber, polychloroprene, fluorinated rubber.

8 Dissolved Oxygen Measuring - Please Note

Please observe the following points when measuring dissolved oxygen:

- **For measuring remove the protective flask.**
- **Sensor needs to be calibrated** (p.r.t. 'How to calibrate oxygen sensor')
- **The temperatures of the sensor and of the liquid to be measured have to be identical** (if necessary, wait till temperatures match)
- **The sensor has to be submerged at least 3 cm into the liquid to being measured**
- **The measured liquid has to stream along the sensor membrane with at least 30 cm/sec** for measurements to be sufficiently accurate: either stir continuously or use agitator.
- The sensor measurement is sensitive against shocks! By stirring of the sensor in the measured liquid be careful that the sensor does not hit the container.
- The **optimum operation position** is: with the sensor inlet pointing downwards

The instrument calculates the oxygen concentration [mg/l], the oxygen saturation [%] and the oxygen partial pressure [hPa] from the sensor signal and the temperature. According to DIN38408-C22 all measurements refer to steam saturated air.

8.1 Ambient Pressure and Measuring Depth of the Sensor

The pressure at the sensor membrane is important for:

- The calculation of the oxygen saturation (%sat).
  At air water can get 100% saturation. Assumed that there are no oxygen consuming processes (biological degradation, chemical effects) and that there are no oxygen enriching processes (e.g. excessive ventilation or photosynthesis)
- The calculation of oxygen concentration (mg/l or ppm)
- The sensor evaluation at calibration

Therefore it is necessary to compensate the pressure influence via integrated sensor or, like practised with more primitive instruments via tables and manual input of pressure or elevation above sea level values.

8.2 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. The corrections are based on the 'International Oceanographic Tables' (IOT).

9 Calibration of the Sensor

In order to compensate for ageing of the sensor, the sensor has to be calibrated at regular intervals.
The device is equipped with an easy-to-use calibration function.
We recommend to calibrate the sensor at least all 7 days, or to get maximum precision, before each measuring series.
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.

9.1 How to Calibrate

The calibration adjusts the sensor to the oxygen content of the atmosphere (20.95%). Remove protective flask prior to calibration and wipe membrane with a soft piece of cloth. You can choose between two modes of calibration for which the electrode has to be prepared accordingly.

Air calibration without accessories
The electrode will be exposed to **ambient air.** To protect it from draughts, wrap electrode in a paper towel. (before calibration, expose sensor at least 15 minutes to the ambient air, to let the temperature adjust 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 is, the smaller the deviation.
Recommended temperature: < 25°C.
For error compensation please refer to the opposite table.

	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 when carrying out an air calibration without accessories,
*O2-saturation= display value*corr. 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 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 membrane is in the air chamber.
Attention: By no means must the membrane 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 sensor **GWO 5610** shows **102 % O_2 sat** (or 106 - 109% with GWO 5600**)** at air and at room temperature.

Start calibration: press cal-key for 2 seconds

The display will show 'Air PT. 15 and as soon the values for oxygen and temperature are stable, the calibration will be finished.
Then the electrode state resulting of the successful calibration will be shown for a short time (evaluation in 10% steps: xx% ELEC).

In case of error messages being displayed during the calibration process, please refer to our notes at the end of this manual! If a calibration cannot be carried out after an extended period of time, at least one of the measuring values is unstable (oxygen partial pressure, temperature). Please check your measuring arrangements!

9.2 Evaluation of Sensor State (ELEC)

Watch sensor state: press key cal shortly once display show for a short time xx% ELEC.
It will show the electrode state resulting of the last successful calibration carried out.
The valuation is displayed in 10 percent steps: 100% means optimal sensor condition. Lower values are indicating that the sensor life time will be reached soon.

Remark: But also an erroneous pressure may be the cause of low valuation values.

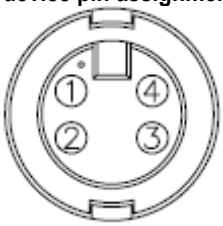
9.3 Calibration Interval (C.Int)

You can enter the interval after which the device reminds you to recalibrate in the configuration.
The interval times should be chosen according to the application and the stability of the sensor.
“CAL” flashes on the display as soon as the interval has expired.

10 Universal Output

The output can be used as serial interface (for USB5100 interface converter). If the output is not needed, it is strongly recommended to deactivate it (Out oFF) to lower power consumption. This increases battery life time.
If the device is used together with interface adapter USB 5100 the device is supplied from the interface.

device pin assignment:



1: external supply +5V, 50mA

2: GND

3: TxD/RxD (3.3V Logic)

4: without function

Only suitable adaptor cables are permitted (accessories)!

10.1 Interface

The following standard software packages are available:

- **GSOFT3050**: Operating and evaluation software for the integrated logger function
- **EBS20M / -60M**: 20-/60-channel software for measuring value display
- **GMHKonfig**: Configuration Software (for free on internet)

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

- a universally applicable Windows functions library ('GMH3x32e.DLL') with documentation, can be used by all ‘established’ programming languages, suitable for:
  Windows XP™, Windows Vista™, Windows 7™, Windows 8™
- Programming examples Visual Studio 2010 (C#, C++ and VB), Testpoint™, LabView™, etc.

The device has 4 channels:

- oxygen concentration in mg/l or ppm
- oxygen saturation in percent or partial pressure in hPa or mmHg
- temperature value at the time of recording in °C or °F
- absolute pressure in hPa abs or mmHg abs

Supported interface-functions:

1	2	3	4	Code	Name/Function	1	2	3	4	Code	Name/Function
x	x	x	x	0	read nominal value	x	x	x	x	199	read measuring type in display
x	x	x	x	3	read system status	x	x	x	x	200	read min. display range
x				12	read ID-no.	x	x	x	x	201	read max. display range
x	x	x		22	read min alarm limit	x	x	x	x	202	read unit of display
x	x	x		23	read max alarm limit	x	x	x	x	204	read decimal point of display
x	x	x	x	176	read min. measuring range	x				208	read channel count
x	x	x	x	177	read max. measuring range	x				222	read turn-off-delay
x	x	x	x	178	read measuring range unit	x				223	Set turn-off-delay
x	x	x	x	179	read measuring range decimal point	x				240	Reset
x	x	x	x	180	read measuring type	x				254	read program identification

- *The measuring and range values read via interface are always in the selected display unit!*

11 Adjustment of Temperature Input

The temperature input can be adjusted with offset and scale. A reasonable adjustment presumes reliable references (e.g. ice water, controlled precision water bath, etc.).

If the inputs are adjusted (i.e. offset and scale are different from default settings) the device will shortly display “Corr” after turned on.
Default setting for offset and scale are ‘off’ = 0.0, i.e. inputs are not changed.

Zero point correction: **Displayed value = measured value – OFFS**

Zero point and slope correction: **Displayed value = (measured value – OFFS) * (1 + SCAL / 100)**
Displayed value °F = (meas. value °F - 32°F - OFFS) • (1 + SCAL / 100)

12 Inspection of the Accuracy / Adjustment Services

The instrument can be sent to the manufacturer for adjustment and function test.
Only the manufacturer can check all systems on correct them if necessary.

Calibration certificates – DKD-certificates – other certificates:
If device should be certificated for its accuracy, this is not possible for dissolved oxygen measuring, only for abs. pressure and temperature.

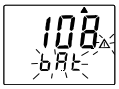
13 Replacing Batteries

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

Avoid unnecessary opening of the instrument!

1. Open the 3 Phillips screws at the backside of the instrument.
2. Lay down the still closed instrument, so that the display side points upwards.
   The lower half of the housing incl. the electronics should be kept lying down during battery change.
   This avoids loss of the 3 sealing rings placed in the screw holes.
3. Lift off upper half of housing. Keep an eye on the six function keys, to be sure not to damage them.
4. Change carefully the two batteries (Type: AAA).
5. Check: Are the 3 sealing rings placed in the housing?
   Is the circumference seal of the upper half sound and clean?
6. Close the housing, taking care that it is positioned correctly, otherwise the sealing may be damaged. Afterwards press the two halves together, lay the instrument with display pointing downwards and screw it together again
   Take care to screw only until you feel increasing resistance, higher screwing force does not result in higher water protection!

14 Error and System Messages

Display	Meaning	Remedy
	low battery voltage, device will continue to work for a short time	replace battery
	If mains operation: wrong voltage	replace power supply, if fault continues to exist: device damaged
bAt	low battery voltage	replace battery
	If mains operation: wrong voltage	Check/replace power supply, if fault continues to exist: device damaged
No display or weird display Device does not react on keys	low battery voltage	replace battery
	If mains operation: wrong voltage	check/replace power supply, if fault continues to exist: device damaged
	system error	disconnect battery or power supply, wait some time, re-connect
	device defective	return to manufacturer for repair
SEnS Erro	sensor error: no sensor cable connected	connect suitable sensor
	Sensor, cable or instrument defect	return to manufacturer for repair
Err.1	Value exceeding measuring range	Check: Is the value exceeding the specified measuring range? ->value too high!
	Wrong sensor connected	Check sensor
	Sensor, cable or instrument defect	return to manufacturer for repair
Err.2	Value below display range	Check: Is the value below the specified measuring range? ->value too low!
	Wrong sensor connected	Check sensor
	Sensor, cable or instrument defect	return to manufacturer for repair
Err.7	system error	return to manufacturer for repair

If "bAt" is flashing, the battery will be exhausted soon. Further measurements are possible for short time.

If "bAt" is displayed continuously the battery is ultimately exhausted and has to be replaced. Further measurements aren't possible any more.

Messages During Calibration/Adjustment

>CAL< CAL flashing in display	either preset calibration interval has expired or last calibration is not valid	Device has to be calibrated!
CAL Err.1	wrong reference point at air	check sensor and reference gas / solution
CAL Err.2	slope too low	
	reference gas / solution wrong	check sensor and reference gas / solution
	sensor is defect	replace sensor / perform maintenance
CAL Err.3	slope too high	
	reference gas / solution wrong	check sensor and reference gas / solution
	sensor is defect	replace sensor / perform maintenance
CAL Err.4	incorrect calibration temperature	calibration can only be done at 0…40 °C
CAL Err.5	Zero value to low/negative	
	sensor is defect	replace sensor / perform maintenance
CAL Err.6	zero value to high	
	reference gas / solution wrong	check sensor and reference gas / solution
	sensor is defect	replace sensor / perform maintenance
CAL Err.7	incorrect calibration pressure	check calibration pressure
CAL Err.8	signal not stable / timeout	check sensor and reference gas / solution
CAL Err.9	sensor not known: cannot be calibrated	check sensor and wiring

15 Reshipment and Disposal

15.1 Reshipment

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

Use an adequate transport package for reshipment, especially for fully functional devices. Please make sure that the device is protected in the package by enough packing materials.

15.2 Disposal instructions

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.

16 Specification

Measuring ranges	Oxygen concentration	0.00 ... 70.00 mg/l or ppm	electrochemical sensors GWO 5600/5610
	Oxygen saturation	0.0 ... 600.0 % O_2	
	Oxygen partial pressure	0 ... 1200 hPa O_2 (0.0 .. 427.5 mmHg)“	
	Sensor temperature	-5.0 ... + 50.0 °C	NTC 10k (integrated in GWO 3600)
	Absolute pressure	10 ... 1200 hPa abs.	integrated pressure sensor
Accuracy at 25°C, 1000 hPa abs	Oxygen	±1.5 % of measured value ±0,2 mg/l (0-25 mg/l) or ±2.5 % of measured value±0,3 mg/l (25-70 mg/l)	
	Sensor temperature	± 0.1 °C	
Accuracy	Absolute pressure	3 hPa or 0.1% of measured value (the higher one to be applied)	
Working conditions		Sensor 0 .. 40 °C / Instrument -25 .. 50°C; 0 .. 95 % rel.H. (non condensing)	
Nom. temperature		25°C	
Storage temp.		Sensor 0 .. 40 °C / Instrument -25 .. 70 °C	
Connections	O_2 & temperature	7 pole waterproof bayonet connector	
	Interface / external supply	4 pole waterproof bayonet connector (USB adapter USB 5100)	
Display		LCD, white backlight, two 4½ digits 7-segment (main and auxiliary display) with additional symbols	
Calibration	automatic	1 -point calibration at ambient air (20.95%)	
Additional functions		Min / max / hold / auto hold	
Housing		Break-proof ABS housing, incl. silicone protective cover	
	Protection class	IP65 / IP67	
	Dimensions L*W*H [mm]	160 * 86 * 37 incl. silicone protective cover, approx. 250 g incl. battery and cover	
Power supply		2*AAA battery (included in scope of supply) or external	
	Current consumption	0.9 mA (for Out = oFF, equivalent to 1000 h), backlight ~10mA (auto-off)	
	Battery indicator	4-stage battery state indicator, Change battery display for exhausted battery: “bAt”, warning: “bAt” flashing	
Auto-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 1and 120 min.; it can be completely deactivated.	
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%	