H36.0.01.6C-13

GREISINGER

EN

Hand-held measuring device

for dissolved oxygen and temperature

as of version V2.1

Operating Manual

GMH 3610

CE

Made in Germany

WEEE-Reg.-Nr. DE93889386

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

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1 Designated Use

The GMH 3610 measures the oxygen concentration and the oxygen saturation in liquids.
For the measurement a external sensor of the type GWO 3600 is required. The measurement takes place at the diaphragm head of the external sensor.
Due to the design of the sensor, the device has to be calibrated at regular intervals (e.g. at fresh air =20.95% oxygen) to get accurate measuring values. If the sensor is used up, this will be detected at calibration and the sensor element has to be maintained or replaced before the next measurement.

2 General Note

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

3 Operating and Maintenance Advice

a) 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.

a) When to replace battery:
If ⚠ and ´bAt´ is shown in the lower display the battery has been used up and needs to be replaced. The device will, however, operate correctly for a certain time.
If ´bAt´ is shown in the upper display the voltage is too low to operate the device; the battery has been completely used up.

Please note: The battery has to be taken out, when storing device above 50°C.
We recommend to take out battery if device is not used for a longer period of time.

b) Treat device and sensor carefully and use it only in accordance with its specifications (do not throw, hit against etc.). Protect plug and socket from soiling.

c) Make sure to use only sensors that are suitable for the device. Unsuitable measuring probes may lead to the destruction of the measuring device and 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 device please note that operating voltage has to be 10.5 to 12 V DC.
Do not apply overvoltage!! Cheap 12V-power supply devices often have excessive no-load voltage. Therefore, we recommend using regulated voltage power supply devices. Using the power supply device GNG10/3000 ensures trouble-free operation.
Prior to connecting the power supply device to the mains supply make sure that the operating voltage stated at the power supply device is identical to the mains voltage.

4 Safety Requirements

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

1. Trouble-free operation and reliability of the device can only be guaranteed if the device is not subjected to any other climatic conditions than those stated under "Specifications".
2. If the device is transported from a cold to a warm environment condensation may cause in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
3. If device is to be connected to other devices (e.g. via serial interface) the circuitry has to be designed most carefully. Internal connection in third party devices (e.g. connection GND with earth) may result in not-permissible voltages impairing or destroying the device or another device connected.

   Warning: If device is operated with a defective mains power supply (short circuit from mains voltage to output voltage) this may result in hazardous voltages at the device (e.g. sensor socket, serial interface).
4. If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting.

   Operator safety may be a risk if:
   - there is visible damage to the device
   - the device is not working as specified
   - the device has been stored under unsuitable conditions for a longer time.

   In case of doubt, please return device to manufacturer for repair or maintenance.
5. **Warning:** Do not use these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury or material damage.
   Failure to comply with these instructions could result in death or serious injury and material damage.
6. **This device only serves as monitoring of systems important for the customer.**
   It must not be used instead of compulsory approval monitoring devices and it is not planned 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.

7. **Caution, acid!** The electrode contains **KOH**. KOH can cause severe chemical burns!
If leaking, avoid contact!

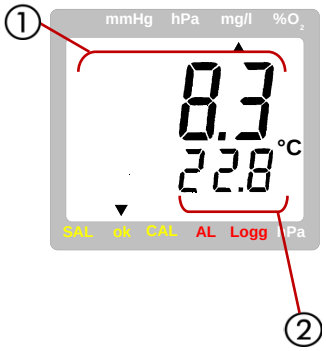
If there was contact:
- to skin: flush contacted area with large amounts of water for several minutes.
- to clothing: remove contaminated clothing.
- to eyes: flush with large amounts of water for several minutes, obtain medical treatment.

After swallowing:
- give large volumes of water. DO NOT induce vomiting!
- obtain medical treatment.

5 Display and control elements

5.1 Display elements

Display with two sensors connected:



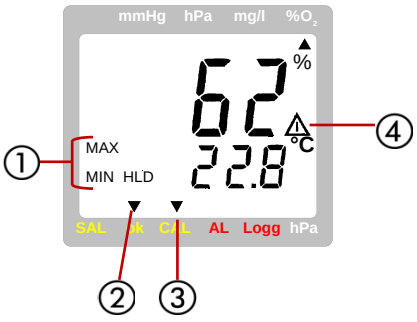
① **Main display:** possible views:
- **Oxygen saturation in %** (% O_2)
- **Oxygen concentration** (mg/l)

② **Secondary display**:
- **Sensor temperature** (°C or °F)

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

The desired view can be selected by pressing the Set Menu -key.

Special display elements:



① **Min/Max/Hold**:
shows if a min., max. or hold value is displayed in either the main or the 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

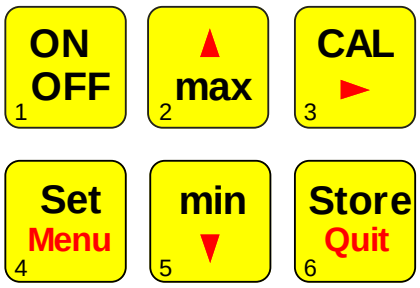
④ **Warning triangle:**
indicates a low battery, full logger storage, etc.

Display at reboot:

After switching on the instrument performs a segment test of 2 seconds.
Afterwards some configurations are displayed sequentially: air pressure and if activated: offset settings.
(p.r.t Chapter 6 'Configuration')

Tip: The display of these settings can be aborted by pressing a key after the segment test (keys 2 - 6).

5.2 Pushbuttons



On/off key

min/max when taking measurements:

press shortly: min. or max. measuring value will be displayed

\+

press for 1 sec.: the min. or max. value will be deleted

up/down for configuration:

to enter values, or change settings

CAL:

press shortly: show state of the electrode

press for 2 sec.: start oxygen calibration

Set/Menu:

press (Set) shortly: changing of the main display.

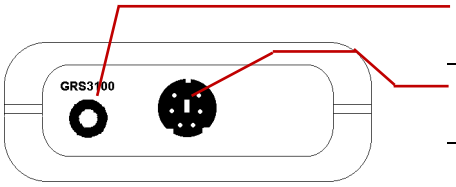
press (Menu) for 2 sec.: configuration will activated.

Store/Quit:

Measurement: Hold current measuring value ('HLD' in display)

Set/Menu: Acknowledge setting, return to measuring

5.3 Connections



Interface: connection for electrically isolated interface adapter (accessory: GRS 3100, GRS3105 or USB3100)

Connection for oxygen sensor
with integrated temperature probe

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

6 Configuration

For configuration of the device press Set Menu -key for 2 seconds: the main menu of the configuration will be called up. Use key Set Menu to select a sub-menu, use the key Tara to actually go into the selected sub-menu and to change parameters.

Use the keys max and min to set the individual value for the parameter. Press the key Set Menu again to memorize the changes and to return to the main menu. Use key Store Quit to leave the configuration.

’Pressure ABs.’: Input of Absolute Pressure

max / min

500 … 2000 hPa abs.

The calculated oxygen values will refer to the entered absolute pressure.

’Offset’: Zero Point Displacement of the Temperature

max / min

-3.0 °C ... 3.0 °C
or
-5.4 °F ... 5.4 °F

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

off:

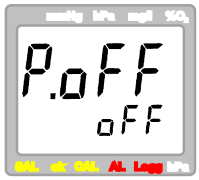
Zero point displacement is deactivated (=0.0°)

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

max / min

°C: All temperature values in degrees Celsius

°F: All temperature values in degrees Fahrenheit



’Power.off’: Selection of Power-Off Delay

max / min

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. (automatically deactivated for cyclic loggers)

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

’Address’: Selection of Base Address’

max / min

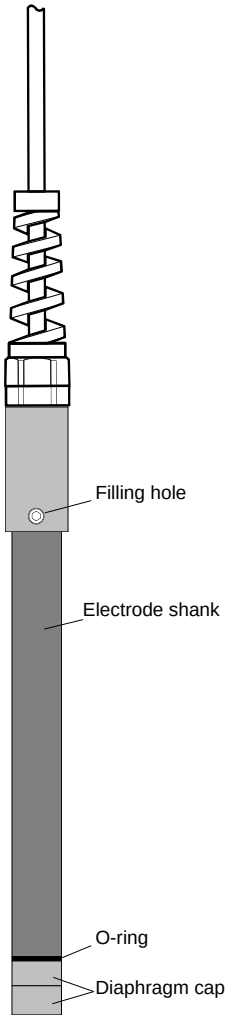
01, 11, 21, …, 91:

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

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

7 The Oxygen Electrode

7.1 Electrode design



The oxygen electrode is an active electrode consisting of a silver cathode and a lead anode with the electrolyte being potassium 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. Therefore, we 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.).

Aufbau der Elektrode

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.

- **Protective flask**: The protective flask is used to moisten the diaphragm. The 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.
- **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.
- **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. 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 corrosive! (strong base, KOH)

7.2 Electrode Maintenance

If electrode can no longer be calibrated, it needs maintenance.
Attention! The electrolyte is a corrosive.
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 had contact with electrolyte, immediately rinse thoroughly with clear water.
2. Clean silver cathode with sand 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. Put back 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 screw diaphragm head to 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 plug on protective flask. Re-connect electrode to measuring device and wait for at least 3 hours till electrode can be calibrated.

8 Notes to Special Functions

8.1 Input of absolute pressure ('P.Abs')

To get most accurate measuring values the absolute pressure should be checked before calibration and measurements and if needed entered at the configuration menu.

8.2 Zero Displacement (’Offset’) temperature

A zero displacement can be carried out for the temperature measurement.

temperature displayed = temperature measured - offset

Standard setting: ’off’ = 0.0°, i.e. no zero displacement will be carried out. The zero displacement is mainly used to compensate for sensor deviations. Unless ’off’ is set, this value will be displayed shortly after the device is switched on.

8.3 Base Address (’Adr.’)

Using the interface converter GRS3105 it is possible to connect several instruments 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 configurate the base addresses accordingly. 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)

9 Oxygen Measuring - please note

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 Electrode has to be submerged at least 3 cm into the liquid being measured**
- **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 **optimum operation position** is: with the sensor inlet pointing downwards

The GMH3630 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.

9.1 Absolute atmospheric pressure

The absolute atmospheric pressure at the water surface 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 do measurements/calibration.

10 Calibration of The Oxygen Sensor

Check the absolute pressure which you have preset in the device before carrying out any calibration!

In order to compensate for ageing of the sensor, the sensor has to be calibrated at regular intervals.
The device is equipped with a easy-to-use calibration function. We recommend to calibrate the electrode 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.

10.1 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 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 Kleenex. (before calibration, expose electrode 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 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 and at room temperature.

	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 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 and at room temperature.

Start calibration: press CAL-key for 2 sec.

The display will show 'CAL'; calibration will be automatically completed as soon as the measuring values for oxygen and temperature are stable.
Then the electrode state resulting of the successful calibration will be shown for a short time (evaluation in 10% steps).

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 in unstable (oxygen partial pressure, temperature). Please check your measuring arrangements!

10.2 Valuation 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 a erroneous pressure entry may be the cause of low valuation values.

11 Error And System Messages

Display	Description / Reason	Remedy
SEnS Erro	No sensor or sensor defective	Connect sensor sensor defective => return sensor to manufacturer for repair
108 bAt	Low battery voltage device will continue operation only for a short time	replace battery
bAt	Low battery voltage	replace battery
	- If mains operation: wrong voltage	replace power supply, if fault continues to exist: device damaged
No display or **mazy characters**	- Battery voltage too low	replace battery
	- If mains op.: power supply defective or wrong voltage/polarity	check/replace mains supply
	- System error	disconnect battery or power supply, wait for a short time, re-connect
	- Device defective	return to manufacturer for repair
Err.1	Values exceeding measuring range	Are there any values exceeding the measuring range specified? ->measuring value too high
	Sensor/cable defective	-> replace probe
Err.2	Values below measuring range	Are there any values below the measuring range specified? -> measuring value too low
	Sensor/cable defective	-> replace probe
Err.7	System fault	switch on again: if fault continues to exist, device is damaged -> return to manufacturer for repair
Err.9	No sensor	connect suitable sensor
	Error in sensor	Sensor defective => return to manufacturer for repair
	Temperature display correct, oxygen display incorrect	check: plug in sensor housing connected? Open PG-glanding and pull up plug as far as possible.
Er.11	Value could not be calculated	One measuring variable required for calculation is missing (no sensor) or incorrect (over-flow/underflow)

11.1 Error and System Messages during Oxygen Calibration

Display	Description / Reason	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	Current too low	membrane dried up / polluted => store electrode in water for 2 hours. regenerate or replace electrode. check calibration environment (p.r.t. 'How to calibrate oxygen electrode.')

CAL Err.4	Current too high	check calibration environment (p.r.t. 'How to calibrate oxygen electrode.') air bubbles in the diaphragm head?
CAL Err.6	timeout: no stable measuring value	check calibration environment (p.r.t. 'How to calibrate oxygen electrode.'). electrode needs maintenance or has to re-placed

12 The serial interface

All measuring data and settings of the device can be read and changed by means of the serial interface and a suitable electrically isolated interface adapter (GRS3100, GRS3105 or USB3100).
In order to avoid faulty transmission, we have designed elaborate security measures for interface communication.

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

- **EBS20M** more channel software to display of all measuring value (channel 1 ... 4)
- **EASYCONTROL**: Universal multi-channel software (EASYBUS-, RS485-, or GMH3000- operation possible) for real-time recording and presentation of measuring data in the ACCESS®-data base format.

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

- a universally applicable Windows functions library ('GMH3000.DLL') with documentation, can be used by all 'established' programming languages, suitable for: Windows XP™, Windows Vista™, Windows 7™.
- Programming examples Visual Basic 4.0, Delphi 1.0, Testpoint

12.1 The following interface functions will be supported:

Channel				Dll-Code	Name / function
1 (Oxygen Saturation)	2 (Oxygen Concentration)	3 (Temperature)	4 (abs. air pressure)		
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 meas. range unit
x	x	x	x	179	Read meas. range decimal point
x	x	x	x	180	Read meas. range meas. mode
		x		194	Set display unit
x				195	Set decimal point of display
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 unit
x				254	Read program identification

13 Specification

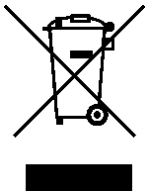
Measuring range:

Oxygen concentration	0.0...25.0 mg/l
Oxygen saturation	0...300 %
Electrode temperature	0.0…50.0 °C
Accuracy in the device	(at nominal temperature)
Oxygen meas. ranges	±1.5% ±0.2mg/l
Electrode temperature	±0.1°C ±1digit

Atmospheric pressure compensation: setable: 500 .. 2000 hPa abs.

Nominal temperature:	20 °C
Working temperature:	0 to +50 °C
Relative humidity:	0 to 95 %RH (non-condensing)
Storage temperature:	-20 to +70 °C (electrode: 0 to +60°C)
Sensor connection:	6-pin Mini-DIN-socket
Electrode	oxygen electrode (active diaphragm type) with integrated NTC resistor
Response time:	95% in 10 sec., depending on temperature
Operation life:	guaranteed 12 month (assuming appropriate usage and on proper maintenance)
Operating pressure:	max. 3 bar
Mounting diameter:	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
Display:	2 four digit LCDs (12.4 mm high and 7 mm high) for temperature, and for min./ max values, hold function, etc. as well as additional pointing arrows.
Pushbuttons:	6 membrane keys altogether for on/off switch, selection of thermoelements, min. and max. value memory, hold-function etc.
Interface:	serial interface (3.5 mm jack), serial interface can be directly connected to USB or RS232 interface of a PC via interface adapter USB3100, GRS3100 or GRS3105 (see accessories).
Power supply:	9V-battery, type IEC 6F22 (included) or additional d.c. connector (internal pin Ø 1.9 mm) for external 10.5-12V direct voltage supply. (suitable power supply: GNG10/3000)
Power consumption:	approx. 1.5 mA, during audio alarm approx. 2 mA
Automatic-off-function:	Device will be automatically switched off if no key is pressed/no interface communication takes place for the time of the power-off delay. The power-off delay can be set to values between 1and 120 min.; it can be completely deactivated.
Min-/max-value memory:	Both the max. and the min. value will be memorized for each measurement taken.
Hold-function:	Press button to memorize current measuring values.
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 (device incl. Battery)
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%

14 Disposal instruction:



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