

Operating Manual

Carbon Monoxide Measuring Instrument

GCO 100

as of version 1.0

with integrated sensor

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1 General

1.1 Intended use of GCO 100

The GCO 100 is a high value CO-Measuring instrument for the measuring of up to 1000ppm (0,1Vol %) CO in ambient air.

Via the adjustable alarm function the instrument warns the user optically (display) and acoustically (integrated horn) when dangerous concentrations are present.

The device must not used as a monitoring device for the personal safety !

 measuring inlet is at the opening of the front plate.

Applications

- control and maintenance of heating systems
- monitoring air quality (signalling exceeding of the maximum allowed working place concentration MAK)
- detection of CO in the breath of smokers
- detection of CO-toxication of victims of fires (Fire brigades)
- and much more...

Calibration protocol within scope of supply



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1.2 Safety instructions

This device has been designed and tested in accordance to 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 it.

1. Trouble-free operation and reliability of the device can only be guaranteed if it is not subjected to any other climatic conditions than those stated under "Specification".
2. Transporting the device from a cold to a warm environment condensation may result 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. The circuitry has to be designed most carefully if the device should be connected to other devices. 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.
4. Whenever there may be 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 or 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 product as safety or emergency stop device, 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.

1.3 Operating and maintenance advice:

- If the symbol "BAT" is displayed at the left side of display, the battery is weak, measuring can be continued for a short period. If „bAt“ is displayed in the display the battery is finally used up and has to be replaced. Measuring is no more possible.
- The battery has to be removed, when storing device above 50°C.

Hint: We recommend removing the battery if device is not used for a longer period of time! Risk of Leakage!

- Treat device and probes carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect from soiling, especially in the area of the gas inlet at the front plate.
- Avoid condensation at the sensor, if there was condensation, let the device dry sufficiently

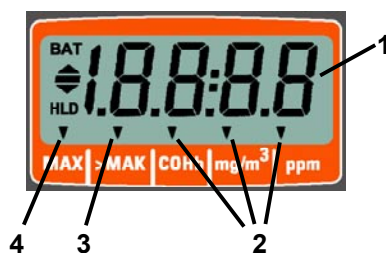
Attention: Do no use solvents or silicone containing substances around the sensor opening, otherwise the measuring might be disturbed or the sensor might even be destroyed!

1.4 Disposal instructions

- Dispense exhausted batteries at destined gathering places.
- The device must not be disposed in the regular domestic waste.
Send the device directly to us (sufficiently stamped), if it should be disposed. We will dispose the device appropriate and environmentally sound.

2 Operation

2.1 Display elements



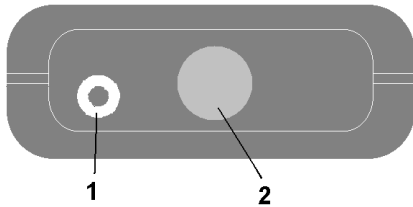
- 1: Main display** Display for the current, frozen or max. CO-value
2: unit arrows display in ppm, mg/m³ or %COHb
3: MAK-warning Flashes, if the allowed value for maximum working place concentration is exceeded.(maximum exposition value for daily 8 hours work = MAK)
4: MAX-arrow The max. value since power-on will be displayed.
Press >2s: max. value will be reset
BAT Indicates low battery
HLD Measure value is ‚frozen‘ (key 3)

2.2 Pushbuttons



- Left key:** **on/off-button**, for power-off press longer
Middle key: **Max:** display of the maximum measured value (MAX-arrow in display)
Right key: **Hold:** hold (frozen) of the current measured value ('HLD' in display)

2.3 Connections



1. **Interface:** Connect to optically isolated interface adapter (accessory: GRS 3100, USB3100, ...)
2. **Sensor opening**

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

2.4 Generals of CO-measuring

Carbon monoxide (CO) is combustible and highly toxic. It is invisible, taste- and odourless, the relative density is 0,97 (a bit lighter than air).

Already smallest concentrations can be dangerous for humans (depending of physical constitution)::

| | |
|--------------|---|
| 30ppm | Maximum allowed working place concentration (MAK) for 8-hours of work per day |
| 70..100ppm | Flue like symptoms after some hours: sniffing nose, headaches, excoriated eyes, short breath |
| 150...300ppm | medium exposure: dizziness, sleepiness and nausea, even vomiting |
| 400ppm | extreme exposure: headache |
| 800ppm | extreme exposure: headache, dizziness, nausea and limb twitching after 45min, unconsciousness within 2h |
| 1600ppm | headache, dizziness, nausea within 45min, death after 2 hours |

CO is produced when burning carbon containing substances (Wood, coal, oil, petrol, gas, cigarettes...), especially when not enough oxygen is available. In fresh uncontaminated air the CO-concentration is near zero. Transportation, heating and industry exhausts are increasing CO concentrations in urban areas.

There could be measured CO also in the breath of smokers:

| | |
|---------------|------------|
| None smokers | <6ppm |
| Light smoker | 6...10ppm |
| Smoker | 10...20ppm |
| Strong smoker | >20ppm |

Like with alcohol concentration in blood, also the CO is decomposed in the blood: around every 5h the CO content is cut by half. Via the CO concentration of exhaled air, the saturation of the CO in blood haemoglobin can be derived. The carboxy-haemoglobin in % can be displayed directly by the instrument: %COHb (p.r.t. Configuration of the instrument). This value is an estimation of the carboxy-haemoglobin of blood via the exhaled breath. The calculation above 5ppm is done according to: M.J. Jarvis, M. Belcher, C. Vessey and D.C.S. Hutchison, Low cost carbon monoxide monitors in smoking assessment. Thorax 41 (1986), pp. 886-887

Procedure for the measuring of exhaled gas

We suggest to use the ESA-100 adapter and the T-piece (picture at right) in combination with a suitable mouthpiece (accessories).

- switch on instrument, respectively reset the max-value by pressing Max key for 2 seconds
 - inhale deeply and hold your breath 20 seconds, if possible (now CO migrates from the blood to the air)

- exhale slowly and complete via the T-piece (preferably with mouthpiece)

- read the Maximum value by pressing the Max key shortly

If no T-piece is available, an estimation can done, by exhaling/blowing in the direction of the sensor-opening at a distance of fewer than 5 cm.

Wait sufficiently between measurings to allow the sensor to dry and to degrade CO of the previous measuring, if there was some.



3 Alarm functions

There are 3 possible settings for the alarm function: off (AL oFF), on with horn (AL on) and on without horn (AL no.So)
 The alarm will be issued under the following circumstances:

- measuring value higher or equalling upper alarm limit 'AL.Hi'
- sensor error
- measuring values exceeding/falling below measuring ranges
- battery voltage too low or error in device ('Err.7')

The alarm function is supported by the interface, thus, it can easily be monitored by a connected computer.





The acoustic alarm is depending of the value. It is an interrupting tone, increasing in intensity with the value, above 300ppm the tone is permanent.




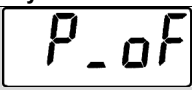
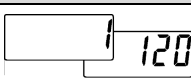
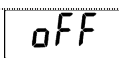

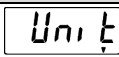
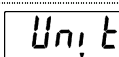
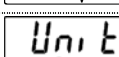

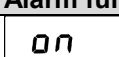
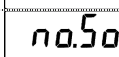
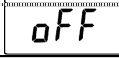

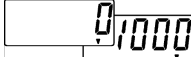
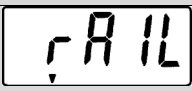
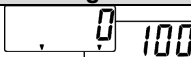
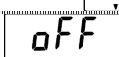



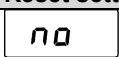
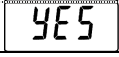
Visual alarming: „AL.Hi“ flashes in the display


Additionally the exceeding of the MAK value is signalled with the MAK-arrow independently from the alarm settings. Because the maximum workplace concentration differ from country to country, this value is adjustable.

4 Configuration of the instrument

To configure the instruments according to Your needs proceed like follows::

- Switch off instrument.
- Switch on and press **max-key during the segment test** () , until the display shows the first parameter ,P_oF'
- If a parameter should be edited, press key up or down ( ) , the setting of the parameter will be shown and can be changed via up/down keys.
- Jump to the next parameter with key 

| parameter | value | meaning |
|---|--|---|
| key  | keys   | |
|  | Auto Power-Off | |
| |  | Auto Power-Off in minutes. If there won't be pressed any key and no interface communication takes place for the time of the power off time setting, the device will be switched off automatically to save battery power. |
| |  | automatic power-off is deactivated (continuous operating) |
|  | Unit of the CO-display | |
| |  | Selection of the display unit "ppm" (factory setting) |
| |  | Selection of the display unit "mg/m ³ " |
| |  | Selection of the display unit " %COHb" |
|  | Alarm function | |
| |  | Alerting over display and buzzer (factory setting) |
| |  | Alerting only via display |
| |  | No alarm |
|  | Alarm boundary (not available if alarm function is deactivated: AL = OFF) | |
| |  | Alarm boundary in the selected display unit, factory setting: 10ppm |
|  | Warning boundary for maximum working place concentration | |
| |  | Value for warning boundary in the selected display unit. Setting for Germany: 30ppm, value may vary for different countries. |
| |  | Warning for maximum working place concentration f is deactivated |
|  | Base address of the interface | |
| |  | Base address (refer to „the serial interface“) |
|  | Reset settings to Ex-Works | |
| |  | Settings are kept |
| |  | Settings of configuration and adjustment menue are reset to ex-works settings |

Pressing  again stores the settings, the instruments restarts (segment test)

Please note: *If there is no key pressed within the menu mode within 60 seconds, the configuration will be cancelled, the entered settings are lost!*

5 Adjustment


The adjustment of the GCO100 is stable within 5% within in a year.

The measuring precision can be checked by means of suitable test-gas mixtures and the suitable testing accessories. Alternatively the instrument can be sent to the manufacturer for test and recalibration.

Attention! If the adjustment is altered, the included Calibration protocol is no more valid!

5.1 Adjustment Menue

To adjust a measuring offset and scale proceed like follows:

- Switch off instrument.
- Switch on
and press **hold-key during the segment test** () , until the display shows the first parameter ,OFFS‘
- Press ‘up‘ or ‘down‘ key, the currently selected offset adjustment appears.
- Choose the desired value by pressing ‘up‘ or ‘down‘ key. (max. selectable values: ±20ppm)
- Enter by pressing On/Off-key: SCAL appears in the display
- Press ‘up‘ or ‘down‘ key, the currently selected scale appears
- Choose the desired value by pressing ‘up‘ or ‘down‘ key. (28.00 ... 62.00 nA/ppm).
- Store the values by pressing ‘On/Off‘ key. The instrument will restart (segment test).

Please note: If during the changing of the offset adjust no key is pressed within 60 seconds, the input will be aborted. Eventually made changes won't be stored!

5.2 Automatic zero point adjusting

To compensate a deviation of the zero point proceed like following:

- Switch on instrument and bring it to a CO-free atmosphere (fresh air or good vented room without any CO sources)
- If there was measured at higher CO levels before, please wait at least 3 minutes.
- press **hold-key 10 seconds**, until the display shows 'nuLL‘

The zero point adjusting is now performed automatically and will be stored in the instrument. The instrument will automatically show the measured value after successful adjustment.

If the adjusting could not be performed (display shows nuLL permanently), there is a higher CO-value in the ambient air or the sensor is defect. Turn device off and on to return to measuring – Note: zero point adjusting was not stored.

The zero point can be viewed in the adjustment menue at parameter ‘OFFS‘.

5.3 Adjustment with reference gas

The instrument can be adjusted to a reference gas by means of a test gas cap and the suitable test gas bottle with gas valve. Depending on the application two concentration are offered as standard:

"GZ-02" 12l disposable test gas bottle cont. 12l of 30ppm CO
 "GZ-03" 12l disposable test gas bottle cont. 12l of 300ppm CO

Ca. 10 calibrations can be done per bottle.

Additionally needed:

"GZ-04" Gas Valve unit MiniFlo
 "GZ-10" test gas cap for GCO100

Preparation of GCO100:

Perform automatic zero point adjusting first (p.r.t. chapter 5.2).

The Instrument as well as the gas bottle should have adjusted to room temperature.

Set the instruments display to the unit [ppm], if another one is displayed (p.r.t. chapter 4)

Preparation of the test gas and accessories

Screw the closed gas valve unit "GZ-04 MiniFlo" on the gas bottle

Screw the test gas cap "GZ-10" to the instrument

Connect the test gas cap "GZ-10" to the valve unit via the hose

The Gas bottle has to stand upright, for the flow-display of the gas valve unit is able to work properly

Scale Adjustment

Open the valve carefully, until the ball of the flow display is positioned in the middle of the scale.

Wait until the measurement display at GCO100 has stabilised (ca. 1min), and write down the displayed value.

Close the valve accurately an disconnect the bottle from the instrument.

Correction of scale value

If the displayed value differs from the nominal test gas concentration, the scale has to be adjusted.

For this read the "old" scale value("Scal") from the adjustment menue (p.r.t. chapter 5.1)

Calculate the new scale like follows:

$$Scal_new = Scal_old * gas\ concentration / display\ at\ gas\ concentration$$

Enter Scal_new to the adjustment menue "Scal", and close the menue.

The instrument is now adjusted.

Attention: The referring calibration protocol is then no more valid!

The ex works settings can be recalled with the "Init-YES" function of the configuration menu (p.r.t chapter 4).

6 System Messages

- Er. 1 = measuring range has been exceeded, measured value is to high
 Er. 2 = measuring range is undershot, measured value is to low
 -- = Sensor error: Value could not be calculated
 Er. 7 = System fault - the device has detected a system fault (defective or far outside allowable ambient temperature range)

If "**BAT**" is displayed at the left side of display, the battery is weak, measuring can be continued for a short period.

If "**bAt**" is displayed in the main display the battery is used up and needs to be replaced. Measuring is no more possible.

7 The serial interface

By means of the serial interface and a suitable electrically isolated interface adapter (GRS3100, GRS3105 or USB3100) the device can be connected to a computer for data transfer. With the GRS3105 up to 5 devices of the GMH3xxx- series can be connected to one interface (see also manual of GRS3105).

To avoid transmission errors, there are several security checks implemented e.g. CRC.

The following standard software packages are available:

- **EBS9M**: 9-channel software to display the measuring values
- **EASYCONTROL**: for real-time recording and presentation of measuring data of one device 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
- Programming examples: Visual Basic™, Delphi 1.0™, Testpoint™, EXCEL™ VBA

The device has 2 channels: Channel 1: CO-concentration [ppm], [mg/m³] or [%COHb]
 Channel 2: temperature (nearly) [°C]

Note: The measuring-/ alarm- and display range values read back from the interface are always in the selected measurement unit!

Supported functions:

| Code | name/function | code | name/function | code | name/function |
|------|---------------------------|------|-----------------------------------|------|----------------------------|
| 0 | Read measurement value | 178 | Read measuring range unit | 204 | Read display decimal point |
| 3 | Read system state | 179 | Read meas. range decimal point | 208 | Read number of channels |
| 7 | Read max. measured value | 180 | Read kind of measuring or sensor | 222 | Read power-off time |
| 12 | Read ID number | 199 | Read kind of measuring or display | 223 | Set power-off time |
| 23 | Read max alarm limit | 200 | Read min. display range | 240 | Reset |
| 176 | Read min. measuring range | 201 | Read max. display range | 254 | Read Program version |
| 177 | Read max. measuring range | 202 | Read display unit | | |

Note for operation with GAM3000: Keep in mind that the instrument just support max-, not min-alarm ! Therefore the control-function of the GAM3000 could not be used, just the alarm function!

8 Specification

| | |
|-----------------------------|---|
| Measuring principle | electrochemical CO measuring cell |
| Measuring range | 0 ... 1000 ppm CO-concentration |
| Display ranges | 0 ... 1000 ppm CO-concentration 0 ... 1250 mg/m ³ CO- concentration (conversion of the ppm value with factor at norm-conditions) 0 ... 60.0 % COHb (estimation of the carboxy-haemoglobin of blood via exhaled breath gas) |
| Resolution | 1 ppm, 1 mg/m ³ or 0.1 % COHb |
| Life time meas. cell | >5 years at proper usage at air suggested test interval: every 6months (depending on precision requirements) |
| Accuracy | linearity $\leq \pm 5$ % of measured value, repeatability $\leq \pm 5$ % of measured value (at range 0 ... 500 ppm) Calibration protocol in scope of supply |

Interference

| gas | concentration (ppm) | residence time (minutes) | display (ppm CO) |
|-------------------|---------------------|--------------------------|------------------|
| hydrogen sulphide | 25 | 5 | 0 |
| sulphur dioxide | 50 | 600 | <1 |
| nitrogen dioxide | 50 | 900 | -1 |
| nitric oxide | 50 | 5 | 8 |
| chlorine | 2 | 5 | 0 |
| hydrogen | 100 | 5 | 20 |
| Carbon dioxide | 5000 | 5 | 0 |
| ammonia | 100 | 5 | 0 |
| ethanol | 2000 | 30 | 5 |
| iso-propanol | 200 | 120 | 0 |
| acetone | 1000 | 5 | 0 |
| acetylene | 40 | 5 | 80 |

| | |
|----------------------------|---|
| Nominal temperature | 25°C |
| Ambient condition | temperature -10 ... +50°C , for short time -20 ... +50°C humidity 15 ... 90 %RH (non-condensing), for short time 0 ... 90 %RH |
| Storage temperature | -10 ... +50°C |
| Housing | impact-resistant ABS, membrane keyboard, transparent panel, Front side IP65, integrated pop-up clip for table top or suspended use. |
| Dimensions | 142 x 71 x 26 mm (L x W x D) |
| Wight | approx. 155 g |
| Power supply | 9V-battery, type IEC 6F22 (in scope of supply) as well as additional d.c. connector (diameter of internal pin 1.9 mm) for external 10.5-12V direct voltage supply. (suitable power supply: GNG10/3000) |
| Power consumption | < 0,25mA (with standard battery > 1000 operating hours) |
| Display | approx. 11 mm high, 4½-digit LC-display with additional elements |
| Pushbuttons | 3 membrane keys for on/off, menu handling, MAX/Hold-function, etc. |
| Hold-/Maxfunction | by keypress the current measuring will be "frozen" (HLD), max. measured value will be stored (MAX) |
| Alerting | adjustable alarm rail, value depending alarm sound, display alarm: flashing „AL.Hi“ additionally signalling of exceeding of the MAK-value („>MAK“-arrow) |
| Power-Off-function | the device will be automatically switched of if no key is pressed or 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 minutes or 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). EN61326 +A1 +A2 (appendix B, class B), Additional fault: <1% FS. |

