



# Operation Manual

## EC22

Transmitter for the measurement of toxic gases, oxygen, and hydrogen



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# 1. INTRODUCTION

## 1.1 For your safety

This operating manual points out in accordance with the law, the provision of products to the market (Product Safety Act - ProdSG), on the intended use of the product and serves to protect the safety and health of people and plants. It must be read and followed by all persons that utilise this product or use, service, maintain, and control it. This product can only perform its duties for which it is intended, when it utilised, used, maintained, serviced and controlled according to instruction given by the GfG company.

The warranty provided by GfG, is not valid if it is not used, maintained, controlled or serviced according to the instructions issued by GfG. The above does not alter the information on warranty and liability in the terms and conditions of the GfG.

## 1.2 Operating instructions

Gas warning devices must, according to the national regulations, be inspected for correct operation after installation, but before any measuring operation is carried out (commissioning). In Germany the following applies: "DGUV Information 213-056 (data sheet T 021 / previously BGI 836 section 8.1)" and "DGUV Information 213-057 (data sheet T 023 / previously BGI 518 section 8.1)".

The transmitter has been tested for correct operation and display prior to delivery. The calibration and adjustment was carried out with appropriate testing or calibration gases.

**This does not absolve from a calibration and if necessary adjustment after installation.**

The transmitter EC22 is not approved for use in potentially explosive atmospheres.



### CAUTION

**The supply voltage may exceed 30V DC!  
The same applies to voltage peaks!**

## **2. GENERAL INFORMATION ON THE TRANSMITTER**

### **2.1 General Description**

A stationary gas warning system consists of a transmitter and a gas measurement and evaluation unit (GME, not included in the scope of delivery). Transmitter and GME are connected via a remote sensor cable. The transmitter converts the concentration of gas into an electrical signal for measuring and sends it to the unit for further processing.

EC22 transmitter can be optionally equipped with an additional graphic display with control buttons and acoustic signal generator. The display has a "green" background lighting when in the measuring mode. With an incident or alarm event, the display colour changes to "Red" to give an optical alarm. In addition there is a horn to sound an acoustic alarm with the display version.

Each of the 22 series transmitters has two status LEDs, which indicate the operating status of the device. A "green" LED to indicate the operational readiness, and a "yellow" LED to display an fault or a special condition.

The 22 series transmitter can be delivered either with an analogue output current interface or a digital RS485 interface. The current interface can output the measurement information by default with 4 - 20 mA or alternatively with 0.2 - 1 mA. The communication of the digital RS485 interface uses the Modbus (RTU) protocol.

The electronics takes over many tasks that facilitate the operation and maintenance, and also to significantly increase the reliability and accuracy. The transmitter is characterised by:

- Concentration indicator (with display version)
- Settings by pressing a button without having to open the housing (with display version)
- Compensation of temperature influences
- Permanent status indicator (measuring mode, fault or special status) on the transmitter

### **2.2 Measurement procedure**

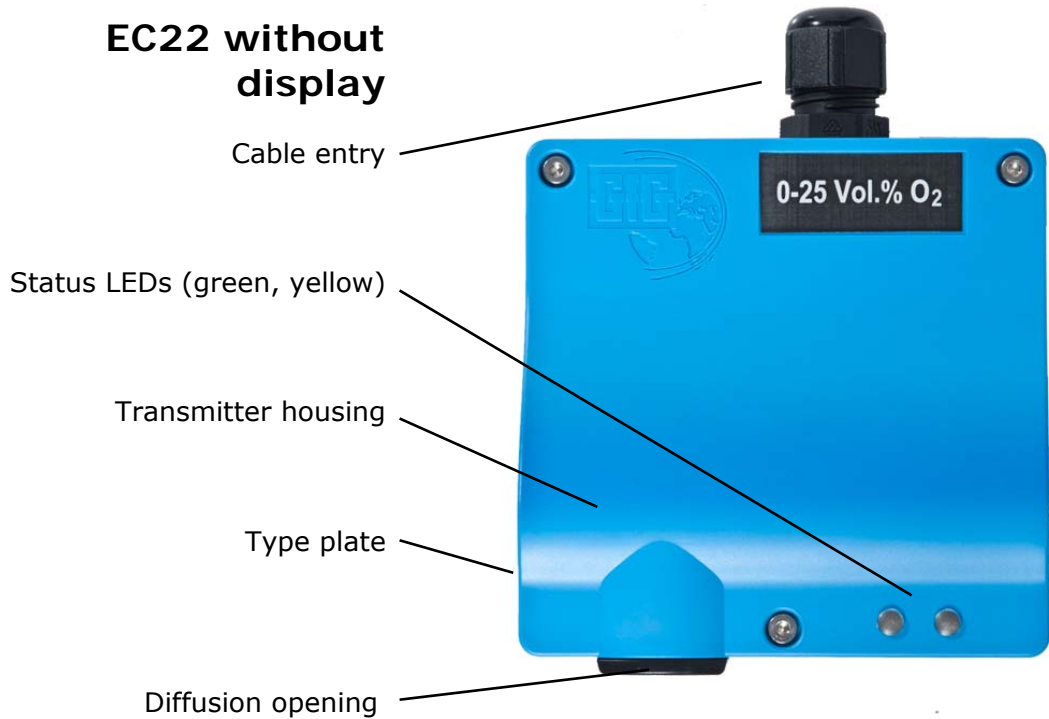
The sensors built into the EC22 transmitter are electrochemical sensors. Electrochemical sensors contain an electrolyte, a working electrode (anode), a counter electrode (cathode) and if necessary a reference electrode. The tuning for the type of gas to be monitored is done with a specific electrode in combination with a suitable electrolyte. This measuring method creates an electrical signal proportional to the concentration of gas in the measuring cell. This electrical signal is amplified in the EC22 and used for display or transmission.

### **2.3 Transmission response**

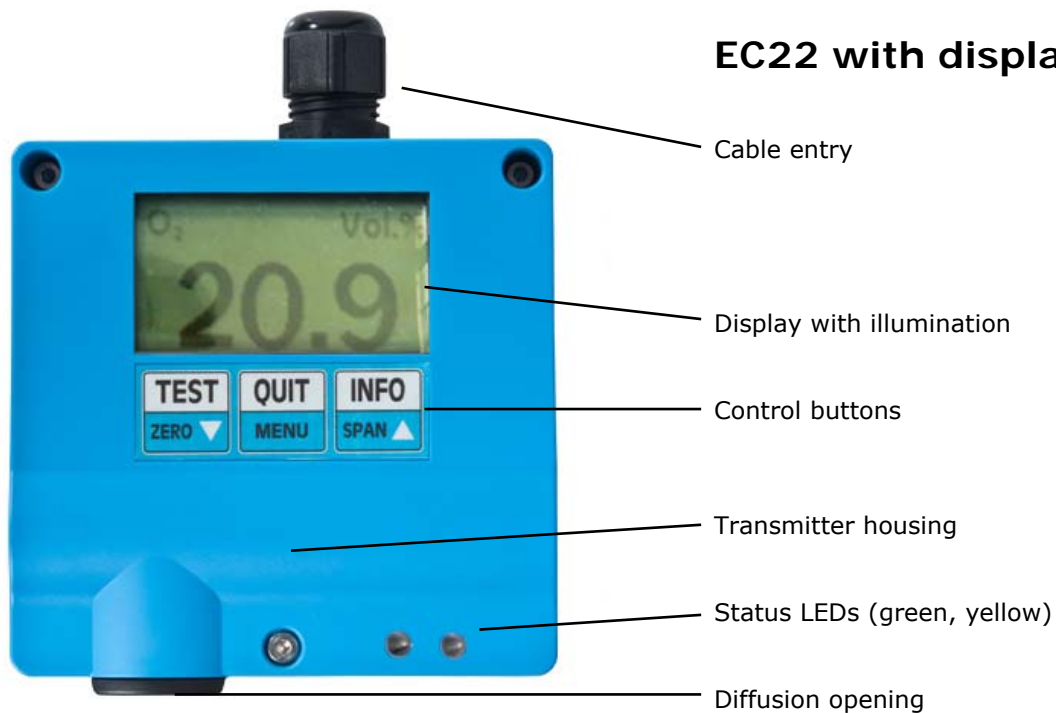
Depending on the nature of the gas, the transmitter has different transmission characteristics. The set times can be different depending on the measuring gas. The gas indicator and signal delivery is always proportional to the concentration of gas.

## 2.4 Unit design

### EC22 without display



### EC22 with display



The gas sensor and the transmitter electronics are installed in the transmitter housing. The electronics transforms the measurement signal into a gas concentration and this is signalled with an analogue current signal 4 - 20 mA or 0.2 - 1 mA or digital RS485 bus signal using the MODBUS RTU protocol. Gas concentration and status information are displayed in the display variant.

The adjustment of the transmitter can be done using a multimeter and two integrated potentiometers or - if available - via the display and the buttons.

## 3. ASSEMBLY AND INSTALLATION INSTRUCTIONS

### 3.1 Installation location

In determining the place of installation, it is important to know the environmental conditions and to take this into account when selecting the location. To achieve representative measurement results, the ventilation conditions must be considered.

The transmitter must be installed in the room so that the gases reach the sensor, even with unfavourable ventilation. If necessary, a measurement must be made, for example with smoke tubes.

In determining the place of installation always ensure that the transmitter is always freely accessible for service and calibration work.

Outside influences are also to be noted:

- Rain water, splash water, dripping water, condensation
- The dust in the atmosphere

The transmitter is largely protected against the ingress of water and dust. In very difficult conditions, special accessories can be used to protect the transmitter from damage. GfG will be happy to advise you on appropriate measures.



**If the sensor is exposed to environmental conditions, which were not known to GfG during planning or delivery, the warranty may become invalid.**

### 3.2 Installation

In determining the place of installation ensure that the transmitter is always freely accessible for service and calibration work. The transmitter must be positioned vertically with the sensor pointing downward.

The transmitter is connected to the evaluation unit in accordance with the connection diagram (see *connections and terminal assignment*). To install, release the three Allen bolts and remove the housing cover. The housing is fastened with three screws. The printed circuit board is inside the housing. The terminals for the connection to the evaluation unit are on the top of the circuit board.

### 3.3 Installing electrical connections

The laying of cables and connection of the electrical installation may only be carried out by an expert taking into consideration the relevant provisions. The cross-section depends on the length of the connection cable and the transmitter version. At this point, check with the bus variant, that the operating voltage is sufficient to also supply the last transmitter on the transmitter bus. If necessary, the power supply must be extended with an additional power source.

For analogue data transmission a cable can be used with the wire diameter of 0.34 mm<sup>2</sup>, this is suitable for short distances up to 500 m. For longer distances the wire cross-section should be 0.75 mm<sup>2</sup>. The cable length should not exceed 1200 m.

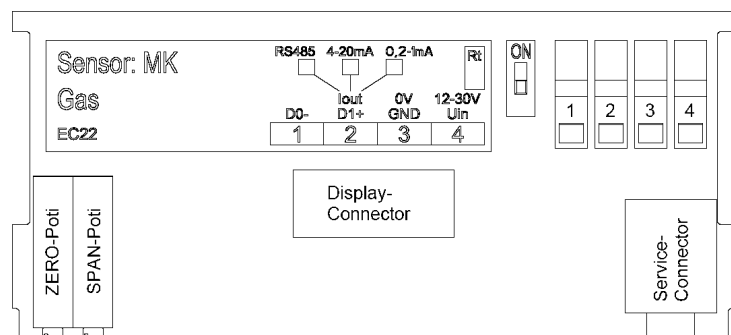
#### Wiring diagram:

##### Terminal for cable connection

- 1: Data- D0
- 2: Data+ D1 / 4 - 20mA / 0.2 - 1 mA
- 3: 0V GND
- 4: 24V DC (12 - 30V DC)

##### Slide switch (Rt)

Terminating resistor for RS485  
(Factory setting = OFF)



After installation, the cover must be closed and screwed again.

## 4. OPERATING INSTRUCTIONS

### 4.1 Commissioning

The EC22 transmitter has been tested for correct operation and display prior to the delivery. The adjustment is carried out with appropriate testing or calibration gases. Deviations can occur dependent on the transport, installation and environmental conditions.

Therefore, the gas detection system must be installed by a competent person and checked for correct operation.

After switching on, the transmitter sometimes requires a few minutes for:

- the self-test, for checking the program and memory
- reading and evaluating the device parameters with concurrent memory testing
- reading and evaluating the sensor parameters with concurrent memory testing
- the stabilising of the sensor

During the start-up phase, the memory tests are carried out during the first few seconds.

#### Version with analogue current interface (0.2 - 1 mA):

Directly after switching in, the current interface delivers 0.0 mA and after 4 seconds 0.08 mA. The green and yellow LEDs are on.

#### Version with analogue current interface (4 - 20 mA):

Directly after switching in, the current interface delivers 0.0 mA and after 4 seconds 1.6mA. The green and yellow LEDs are on.

#### Version with digital Modbus interface (RS485):

With the Modbus version, "Start-up" can be read on the connected evaluation device, e.g. GMA200. If necessary also see the Modbus system for the TRM22 operating instructions.

In the display of the EC22 the information to the *Firmware Version* appears. Then, the measuring range, the measurement unit, type of gas and the calibration gas concentration is shown. The remaining seconds of the run-in phase are counted down in the display. After the run-in phase the EC22 automatically switches the sensor to measuring mode.

If a device failure is detected in the start-up phase, the device switches into fault mode.

#### Version with analogue current interface (0.2 - 1 mA):

The current interface then emits 0.06 mA. An error message appears in the display (see indicators of special conditions and malfunctions). The yellow fault LED lights up permanently.

#### Version with analogue current interface (4 - 20 mA):

The current interface emits 1.2 mA. An error message appears in the display (see indicators of special conditions and malfunctions). The yellow fault LED lights up permanently.

#### Version with digital Modbus interface (RS485):

With the Modbus version an error message is displayed in the display of the transmitter and/or the GME (see indicators of special conditions and malfunctions). The yellow fault LED lights up permanently.

#### Note:

After the initial commissioning of the transmitter and the run-in period, a check and perhaps an adjustment of the zero point (ZERO) should take place, subsequently also the sensitivity (SPAN).

## 4.2 Measurement mode

With trouble-free operation the green LED is permanently on, and the yellow fault LED off. The digital display shows the currently detected gas concentration when in the measurement mode. The measurement of gas concentration is continuous and is updated every second. The functionality of the electronics is constantly monitored through various tests, such as sensor, processor and storage tests.



In normal measurement mode, a bar graph is displayed in the display of the transmitter showing the current gas concentration with the set measuring range, and once a minute briefly the gas unit and type of gas.

### 4.2.1 Measuring range underflow

Readings below the zero point are shown in the display as a number preceded with a negative sign. Where the underflow of the measured value from 0 to -5% of the measuring range the measured value remains in the display of the transmitter or the evaluation unit (e.g. GMA200).

With an underflow of the measured value from -5 to -7.5% the arrows ↓↓↓ are shown in alternation with the measured value in the display of the transmitter.

With an underflow of the measured value below the measuring range of -7.5%, the arrows ↓ ↓ ↓ appear permanently on the display.

#### Transmitter with analogue current interface 0.2 - 1 mA:

The current interface outputs a signal in the range of 0.14 to 0.2 mA corresponding to the reading.

#### Transmitter with analogue current interface 4 - 20 mA:

The current interface outputs a signal in the range of 2.8 to 4.0mA corresponding to the reading.

#### Transmitter with digital Modbus interface (RS485):

With the Modbus version a corresponding measurement value is displayed in the display of the transmitter and/or the GME (see indicators of special conditions and malfunctions).

### 4.2.2 Measuring range exceeded

Exceeding the measuring range between 100% and 112% of the measuring range the arrows ↑↑↑ are displayed alternately with the measured value.

#### Transmitter with analogue current interface 0.2 - 1 mA:

The current interface outputs a signal in the range of 1.0 to 1.1mA corresponding to the reading.

#### Transmitter with analogue current interface 4 - 20 mA:

The current interface outputs a signal in the range of 20 to 22mA corresponding to the reading.

#### Transmitter with digital Modbus interface (RS485):

With the Modbus version a corresponding measurement value alternating with ↑↑↑ is displayed in the display of the transmitter and/or the GME (see indicators of special conditions and malfunctions).

Exceeding by even more than 112% of the measurement range, the display shows permanent arrows ↑↑↑ and a fast blinking yellow status LED.

#### Transmitter with analogue current interface 0.2 - 1 mA:

The current interface emits 1.1 mA.

#### Transmitter with analogue current interface 4 - 20 mA:

The current interface emits 22 mA.

#### Transmitter with digital Modbus interface (RS485):


With the Modbus version, ↑↑↑ is displayed in the display of the transmitter and/or the GME (see indicators of special conditions and malfunctions).




### 4.2.3 Operating buttons

Using the buttons on the transmitter, the unit can be calibrated and settings adjusted via the menu.

### 4.2.4 Display, LED and horn test [TEST]

With the transmitter with display when in the measuring mode, a short press on the button  initiates the display and LED test. This actuates all LEDs, all segments of the display are shown and also briefly the status LEDs are actuated and there is an audible beep.

### 4.2.5 Display of operating parameters [INFO]

During the measurement mode, pressing the button  briefly shows the following important operational parameters in sequence automatically.

- Measurement gas
- Measurement unit
- Measurement area
- Calibration or test gas concentration

These indicators also appear during the device start-up phase.

### 4.2.6 Sensor service life

Electrochemical sensors have a limited service life. The expected service life of the EC22 sensors used is about 1 - 3 years depending on the operating conditions. Upon reaching the expected service life, the transmitter indicates that the sensor should be replaced at the next maintenance. The display illuminates red and a corresponding message is shown and the yellow LED appears briefly every five seconds. This does not affect the measurement operation and the remaining service life of the sensor.

## 4.3 Calibration and adjustment

### 4.3.1 Zero point calibration

The calibration (control) or adjustment (setting) of the zero point is to make a distinction between oxygen and other electrochemical sensors with regard to the choice of the zero gas.

- Oxygen sensors are to be calibrated or adjusted exclusively with 100 Vol.% N<sub>2</sub>.
- With the other electrochemical sensors fresh air (without disturbing gas components) or also synthetic air can be used in contaminated atmospheres.


#### Calibration (check):

For this, a calibration adapter is plugged into the diffusion opening of the transmitter housing. Via the calibration adapter, the zero gas can be applied to the sensor without pressure with a flow rate of approx. 0.5 l<sub>min</sub>. If the display value moves away from zero, the deviation can be adjusted.

#### Adjusting the display:

The adjustment of the zero point can be performed in different ways depending on the transmitter version. These possibilities are described below.

### 4.3.2 Zero point adjustment with display and keyboard [ZERO]

To perform the zero point adjustment, press and hold the button  (> 3 sec.) to change to the service code query. After entering the default service code "0011" (factory setting), the programme "ZERO calibration" is activated. This is signalled by a flashing yellow status LED and transmitters with analogue interface (4 - 20 mA or 0.2 - 1 mA) by an output signal of 2.4 mA or 0.12 mA.

The display shows the current gas reading (actual) and displays the adjusted zero gas concentration. If the measured gas value is no more than 10% of the measuring range, the zero point adjustment can be started with the left button [start]. If the current measured gas value remains constant during a defined interval of time, the new zero point is taken over and

displayed. Using the right button, the program "ZERO adjustment" can be completed and a changed back to measuring mode can be made.

If the zero point adjustment was not possible because the current measured gas value is more than 10% of the measuring range due to a strong drift, then by using the extended service code "0055" (factory setting), (only to be used by trained service personnel), the zero point can also be adjusted with a deviation of up to 25% of the measuring range. However, make sure that the sensor is in measuring gas-free fresh air or the sensor is fed zero gas.

#### 4.3.3 Zero point adjustment with the ZERO potentiometer

For transmitters without display the zero point adjustment can be carried out when the transmitter cover is open via the ZERO potentiometer using a small screwdriver, a multimeter and with a test lead with service connector (see section "Accessories and spare parts"). The test lead should be connected to the voltage measuring jacks of the multimeter and the service socket inside the service connector of the transmitter. (See also note.)

As long as the ZERO potentiometer is not turned, a voltage value is shown on the multimeter between 0.2 - 1 VDC, this indicates the current gas measurement in the range of 0 - 100% of the measuring range proportional.

Once the ZERO potentiometer is turned the setpoint can be read on the multimeter for the zero point adjustment. This is signalled by the flashing yellow status LED. It must be turned until a voltage value of 0.200 V is displayed. As long as this setpoint remains unchanged for a considerable time, the zero point adjustment is started by the transmitter. The yellow status LED goes off once the adjustment is complete.

The zero point adjustment with the ZERO potentiometer can be performed for display values up to 25% of the measuring range. If the transmitter, despite correct task of the calibration gas, jumps back to the original (unadjusted) measurement value after the adjustment, this could mean that the adjustment was not successful due to exceeding the tolerable signal limits or there was excessive signal noise. This can be a sign that the sensor is defective and should be replaced so as soon as possible.

##### Note:

If no test lead is available with service socket, the output current ( $I_{out}$ ) of the transmitters with analogue interface (4 - 20 mA and 0.2 - 1 mA) can be measured directly between terminal 2 and terminal 3 (GND). During this current measurement nothing may be connected to terminal 2 except the multimeter.

#### 4.3.4 Sensitivity calibration



**When dealing with toxic gases special behaviour instructions must be observed depending on the test gas used. Information is available in the corresponding safety data sheets.**


For calibration (control) or adjusting the gas sensitivity a calibration adapter is connected on the diffusion opening of the transmitter's housing. Via the calibration adapter the test or calibration gas is fed to the sensor (with an oxygen sensor fresh air or synthetic air) without pressure at a flow rate of approx.  $0.5 \frac{l}{min}$ .

The indicated value can be observed on the display. If the indicated value deviates from the calibrated gas concentration, a sensitivity adjustment is necessary.

##### Calibration of the display:

Before any adjustment of the sensitivity, the zero point should be checked and if necessary readjusted. The adjustment of the sensitivity can be done in different ways depending on the transmitter version. Both possibilities are described below.

#### 4.3.5 Sensitivity adjustment with display and keyboard [SPAN]

To perform the sensitivity adjustment, press and hold the button  (> 3 sec.) to change to the service code query. After entering the default service code "0011" (factory setting), the programme "SPAN calibration" is activated. This is signalled by a flashing yellow status LED and transmitters with analogue interface (4 - 20 mA or 0.2 - 1 mA) by an output signal of 2.4 mA or 0.12 mA.

The display shows the current gas reading (actual) and displays the adjusted test gas concentration. After pressing the middle button [gas] the test gas concentration can be changed with the left or right buttons, and saved with the centre button.

If the measured gas value is at least 7% of the measuring range, the sensitivity adjustment can be started with the left button [start]. Once a stable reading is detected for a defined period, the sensitivity is adjusted and the new measured value is displayed. Using the right button, the program "SPAN adjustment" can be completed and a changed back to measuring mode can be made.

#### 4.3.6 Sensitivity adjustment with the SPAN potentiometer

For transmitters without display the sensitivity adjustment can be carried out when the transmitter cover is open via the SPAN potentiometer using a small screwdriver, a multimeter and with a test lead with service connector (see section "Accessories and spare parts"). The test lead should be connected to the voltage measuring jacks of the multimeter and the service socket inside the service connector of the transmitter. (See also note.)

As long as the SPAN potentiometer is not turned, a voltage value is shown on the multimeter between 0.2 - 1 VDC, this indicates the current gas measurement in the range of 0 - 100% of the measuring range proportional.

Once the SPAN potentiometer is turned the setpoint can be read on the multimeter for the sensitivity adjustment. This is signalled by the flashing yellow status LED. It must be turned until a voltage value of for example 0.600 V (for 50% MR) is displayed. As long as this setpoint remains unchanged for a considerable time, the sensitivity adjustment is started by the transmitter. The yellow status LED goes off once the adjustment is complete.

If the transmitter, despite correct task of the calibration gas, jumps back to the original (unadjusted) measurement value after the adjustment, this could mean that the adjustment was not successful due to exceeding the tolerable signal limits or there was excessive signal noise. This can be a sign that the sensor is defective and should be replaced so as soon as possible.

##### Note:

If no test lead is available with service socket, the output current ( $I_{out}$ ) of the transmitters with analogue interface (4 - 20 mA and 0.2 - 1 mA) can be measured directly between terminal 2 and terminal 3 (GND). During this current measurement nothing may be connected to terminal 2 except the multimeter.

### 4.4 Main and service menu [MENU]

To get to the main menu, and from there to change to the service menu, the middle button [MENU] must be pressed and held for at least 3 seconds. Access to the main menu is not protected by an access code.

#### 4.4.1 Main menu

In the main menu itself and when changing to the individual menu items, the transmitter remains in measuring mode. This means that the data acquisition, processing, and output continues to work in the background. There is an exception with the service menu, which is described in the next section.

The main menu is structured as follows:

- Transmitter status
- Transmitter information
- Test functions
- Service menu
- Leave

The following information is available with the transmitter status, current system error, error in the measuring process, service needed, and events. Behind these groups, there are figures in brackets. These figures indicate the number of the existing information.

## 4.4.2 Service menu

To get into the service menu, a special access code must be entered. For the default service menu the code is "????". Additional functions are available in an advanced service menu. To reach the advanced service menu, the code "????" must be entered. The service menu is described in a later edition of this operating manual.

## 4.5 Indicators and messages

### 4.5.1 Overview of the status LED states and current output signals

The following table lists the different display states of the two status LEDs and the power output signals with reference to their meanings.

green LED	yellow LED	Current output	See description in section ...
Off	Flashes with 1 Hz	0.0 mA	Display of special conditions... No. 001
Off	On	0.0 mA	Display of special conditions... No. 002
Off	To	1.2 mA	Display of special conditions... No. 103 - 111
Single pulse every 5 s	To	1.2 mA	Display of special conditions... No. 101
Flashes with 1 Hz	To	1.6 mA	Display of special conditions... No. 002, 003
On	Flashes with 1 Hz	2.0 mA	Display in service mode... No. 204, 205
On	Flashes with 1 Hz	2.4 mA	Display in service mode... No. 203
On	Flashes with 1 Hz	4 - 20 mA	Display in service mode... No. 201, 202
On	Single pulse every 5 s	2.8 - 22 mA	Display in service mode... No. 309, 310
On	On	2.8mA	Display in service mode... No. 307, 308
On	Off	2.8 - 22 mA	Display in service mode... No. 303 - 306
On	Flashes with 5Hz	22mA	Display in service mode... No. 301, 302

### 4.5.2 Indicating special conditions (device start and fault)

The following table shows the states with a description in which the yellow fault LED lights up and the 4 - 20 mA current output transmits a signal  $\leq 1.6$  mA.

For the 0.2 - 1 mA current output the value of the output signal is shown in brackets ( $\leq 0.08$  mA).

#### Behaviour when starting the device:

No.	Display	green LED	yellow LED	Current output	Cause	Note / Explanation
001	Boot V1.07 GfG EC22 Error:Flash	Off	Flashes with 1 Hz	0.0 mA	During the memory test, a fault was encountered in the program memory.	Restart the transmitter. If the fault message occurs again a firmware update is necessary.
002	Boot V1.07 GfG EC22 Verify	Off	On	0.0 mA	Program and memory tests during the first few seconds of the device start-up	after approx. 4 seconds automatic transition during the initialisation phase
003	V1.55 GfG EC22	Flashes with 1 Hz	On	1.6 mA (0.08 mA)	Initialisation phase of the transmitter	after approx. 3 seconds automatic transition during the sensor run-in phase
004	Warm up XX Seconds remaining	Flashes with 1 Hz	On	1.6 mA (0.08 mA)	Sensor run-in phase	after the time has elapsed automatic transition in the measurement mode

#### Behaviour in case of failure:

No.	Display	green LED	yellow LED	Current output	Cause	Note / Explanation
101	Sensor defective	Single pulse every 5 s	On	1.2 mA (0.06 mA)	Sensor no longer properly reacts to gas. The sensor may be too old.	The sensor must be replaced.
102	Supply voltage incorrect	Off	On	1.2 mA (0.06 mA)	The transmitter supply voltage is too small or too large.	Check the power supply and adjust
103	Temp.signal < MIN Temp.signal > MAX	Off	On	1.2 mA (0.06 mA)	Temperature measurement is probably faulty.	
104	Watchdog error	Off	On	1.2 mA (0.06 mA)	When testing the external watchdog a hardware fault was detected.	Restart the device. If the error message occurs

105	FLASH fault	Off	On	1.2 mA (0.06 mA)	During the memory test, an error was encountered in the program memory	again exchange the device.
106	RAM fault	Off	On	1.2 mA (0.06 mA)	During the memory test, a faulty memory was discovered.	
107	EEPROM fault 1 EEPROM fault 2 EEPROM fault 2c EEPROM fault 1 + 2 EEPROM fault 1 <> 2	Off	On	1.2 mA (0.06 mA)	Fault in parameter memory or when accessing the external parameter memory module.	
108	Wrong type of PCB	Off	On	1.2 mA (0.06 mA)	An incorrect printed circuit board type or a printed circuit board fault was detected.	Restart the device. If the error message occurs again exchange the device.
109	Digital potentiometer fault	Off	On	1.2 mA (0.06 mA)	A hardware fault was detected with the digital potentiometer.	
110	ADC error 1 ADC error 2	Off	On	1.2 mA (0.06 mA)	A fault was detected in the analogue/digital converter.	
111	Program runtime error	Off	On	1.2 mA (0.06 mA)	A logical sequence error was encountered during the program execution.	

### 4.5.3 Indications during service mode and during sensor adjustment

The following table shows the states with a description in which the green operation LED lights up and the 4 - 20 mA current output transmits a signal 2.0 - 2.4 mA.

For the 0.2 - 1 mA current output the value of the output signal is shown in brackets (0.10 - 0.12 mA).

No.	Display	green LED	yellow LED	Current output	Cause	Note / Explanation
201	Adjustment Zero point (ZERO-Poti)	On	Flashes with 1 Hz	4 - 20 mA (0.2 - 1 mA)	AutoCal program for zero point adjustment has been activated with ZERO potentiometer	Zero gas setting is made with the ZERO potentiometer
202	Adjustment Sensitivity (SPAN-Poti)	On	Flashes with 1 Hz	4 - 20 mA (0.2 - 1 mA)	AutoCal program for sensitivity adjustment has been activated with SPAN potentiometer	Calibration gas setting is made with the SPAN potentiometer
203	Menu item	On	Flashes with 1 Hz	2.4 mA (0.12 mA)	Service menu has been activated using the keyboard	Select the menu item. If there is no input for one minute, automatic return to measuring mode
204	Adjustment Zero point	On	Flashes with 1 Hz	2.0 mA (0.10 mA)	Zero point adjustment has been activated using the keyboard	AutoCal-adjustment of the zero point
205	Adjustment Sensitivity	On	Flashes with 1 Hz	2.0 mA (0.10 mA)	Sensitivity adjustment has been activated using the keyboard	AutoCal-adjustment of the sensitivity

### 4.5 Indications during measuring mode

The following table shows the states with a description in which the green operation LED lights up and the 4 - 20 mA current output transmits a signal 2.8 - 22 mA.


For the 0.2 - 1 mA current output the value of the output signal is shown in brackets (0.14 - 1.1 mA).

No.	Display	green LED	yellow LED	Current output	Cause	Note / Explanation
301	↑↑↑ permanent	On	Flashes with 5Hz	22mA (1.1mA)	The gas concentration has exceeded the measuring range of the transmitter electronics.	
302	↑↑↑ permanent	On	Flashes with 5Hz	22mA (1.1mA)	The gas concentration has clearly exceeded the measuring range (Gas ≥ 112.5% MR)	
303	↑↑↑ alternating with reading	On	Off	20 - 22 mA (1 - 1.1 mA)	The gas concentration has exceeded the measuring range (100 to 112% MR)	
304	Measurement value	On	Off	4 - 20 mA (0.2 - 1 mA)	Trouble-free measuring operation	

305	Measurement value	On	Off	3.2 - 4 mA (0.16 - 0.2 mA)	Underflow of the measuring range (-5.0 to 0.0% MR)	
306	Measurement value alternating with ↓↓↓	On	Off	2.8 - 3.2 mA (0.14 - 0.16 mA)	Underflow of the measuring range (-7.5 to -5.0% MR)	Zero point calibration is useful
307	Permanent ↓↓↓	On	On	2.8 mA (0.14 mA)	Underflow of the measuring range (below -7.5% MR)	Zero point calibration is necessary
308	Permanent ↓↓↓	On	On	2.8mA (0.14mA)	Measuring signal has fallen below the measuring range of the transmitter electronics	Zero point calibration is necessary and check the sensitivity
309	<i>Sensor replacement &lt; 1 Month</i>	On	Single pulse every 5 s	2.8 - 22 mA (0.14 - 1.1 mA)	Expected service life of the sensor is almost reached.	Sensor replacement or adjustment required
310	<i>Sensor replacement necessary</i>	On	Single pulse every 5 s	2.8 - 22 mA (0.14 - 1.1 mA)	Expected service life of the sensor is exceeded.	Sensor replacement or adjustment required

#### 4.5.5 Priority of indicators and messages during measurement mode

The indicators of conditions with low priority are overwritten with the indicators that have a higher priority. The conditions of lower priority are not reset.

Priority	Status	See description in section ...
	significant measuring range overflow	Display in service mode No. 301, 302
	slight measuring range overflow	Display in measurement mode No. 303
	Measurement range underflow	Display in service mode No. 305 - 308
	Sensor replacement	Display in service mode No. 309, 310

The sensor fault No. 101 and the transmitter interference No. 102 - 113 stop the measuring operation with their respective messages.

## 4.6 Fault, cause, remedy

Fault	Cause	Remedial action
Zero point can no longer be set	Sensor defective	Replace sensor
Sensitivity can no longer be set	Sensor defective	Replace sensor
Output current has dropped to 0 mA	Defective fuse or electronics	Replace circuit board
	Line disconnected	Re-connect

## 5. ATTACHMENTS

### 5.1 Cleaning and care

External contamination of the transmitter's housing can be removed with a damp cloth. Do not use any solvents or cleaning agents!

### 5.2 Maintenance and repair

The maintenance and servicing includes regular visual inspection, functional check and the system control as well as the repair of the gas warning system. In Germany the following applies: "DGUV Information 213-056 (data sheet T 021 / previously BGI 836 section 9)" and "DGUV Information 213-057 (data sheet T 023 / previously BGI 518 section 9)".

#### 5.2.1 Visual inspection

The visual inspection should be regular, with a maximum time interval of one month, and must include the following activities:

- Check the indicator light and the status messages, e.g. operation indicator "On", alarm and fault indicators "Off"
- Check for mechanical damage and external contamination

### 5.2.2 Functional check

The functional check can be carried out at intervals dependent on the risk of the gas to be monitored. For gas detection systems used for explosion protection, there should be a control period of 4 months, for the measurement of toxic gases and oxygen 6 months, according to the regulations T 021 and T 023 of the Employer's Liability Insurance Association BG RCI.

This includes the following activities:

- Visual inspection according to section 5.2.1 of this operating manual
- Check and evaluation of measured value indicated
- Triggering the alarm thresholds
- Triggering of test functions for display elements, visual and audible signalling device without triggering the switching functions
- Check of stored messages, malfunctions and maintenance requirements

### 5.2.3 System check

The system check must be carried out at regular intervals. The period must not exceed 1 year.

This includes the following activities:

- Functional check according to section 5.2.2 of this operating manual
- Check of all safety features including the release of the switching functions.
- Check of the parameterisation through a target / actual comparison
- Check of the messaging and logging devices

### 5.2.4 Repair

The repair includes all repair and replacement work. They may only be performed by the manufacturer and by persons who have been authorised by the manufacturer GfG Gesellschaft für Gerätebau mbH. Only approved and released original spare parts from the manufacturer as well as original components may be used.

## 5.3 Sensor replacement

The transmitter cover must be removed to replace the sensor. When power is removed the electronics can be pulled out of the guide with the sensor. Then the old sensor can be removed and the new sensor plugged in. The rest of the installation is done in reverse order. Only a sensor of the same type may be used to replace the sensor, its serial number must be entered in the service menu after the installation and commissioning of the transmitter.

## 5.4 Notes on the environmentally friendly disposal of used parts

Pursuant to § 11 of the general terms and conditions of the GfG the purchaser of the device is responsible for the environmentally friendly disposal of the device or device components according to §§ 11, 12 ElektroG (Electrical and Electronic Equipment Act). On request, the proper disposal can be taken care of by the GfG in Dortmund.

## 5.5 Accessories and spare parts

	Designation	Item no.
1.	Calibration adapter for EC 22	2220200
2.	Service test cable for EC22, CC22, ZD22, CS22 and CI22	2220201
3.	Replacement sensors for EC22	on request

## 5.6 Sensor specification

<b>MK347-O Electrochemical sensor for nitric oxide NO</b>			
Measurement range	0 - 50/100/200ppm		
Resolution / tolerance range:	0.5 ppm / $\pm 2$ ppm		
Time setting:	$t_{50} < 15$ sec	$t_{90} < 40$ sec	
Pressure 80 - 120 kPa:	max. $\pm 1$ ppm or $\pm 7\%$ of the display		(reference 100 kPa)
Moisture 15% - 90% R.H.:	max. $\pm 1$ ppm or $\pm 7\%$ of the display		(reference 50% R.H.)
	@20°C		
Temperature -20 to +40(50)°C:	max. $\pm 2(4)$ ppm or $\pm 7\%$ of the display		(reference 20°C)
Cross sensitivities:	NO <sub>2</sub> < 30%; H <sub>2</sub> S $\approx$ 10%; CO:0%; SO <sub>2</sub> :0%; (*1)		
Expected service life:	2 - 3 years		
Running-in period:	3 minutes to 1 day - depending on the switch-off time		
<b>MK348-O Electrochemical sensor for nitrogen dioxide NO<sub>2</sub></b>			
Measurement range	0 - 20/30/50/100 ppm		
Resolution / tolerance range:	0.1 ppm / $\pm 0.5$ ppm		
Time setting:	$t_{50} < 10$ sec	$t_{90} < 30$ sec	
Pressure 80 - 120 kPa:	max. $\pm 0.3$ ppm or $\pm 5\%$ of the display		(reference 100 kPa)
Moisture 15% - 90% R.H.:	max. $\pm 0.3$ ppm or $\pm 5\%$ of the display		(reference 50% R.H.)
	@20°C		
Temperature -20 to +50°C:	max. $\pm 0.3$ ppm or $\pm 5\%$ of the display		(reference 20°C)
Cross sensitivities:	Cl <sub>2</sub> $\approx$ 100%; H <sub>2</sub> S $\approx$ -8%; CO:0%; NO:0%; SO <sub>2</sub> :0%; (*1)		
Expected service life:	3 years		
<b>MK369-O Electrochemical sensors for carbon monoxide CO</b>			
Measurement range	0 - 100/200/300/500 ppm		
Resolution / tolerance range:	1 ppm / $\pm 3$ ppm		
Time setting:	$t_{50} < 20$ sec	$t_{90} < 50$ sec	$t_{10} < 50$ sec (decay time)
	If the sensor is exposed to high concentrations above the measuring range for several minutes then a significantly delayed zero return in CO free air can be expected. This may take several hours depending on the level of concentration and duration of exposure to the gas. During this time, the sensor must not be adjusted.		
Pressure (70) 90 - 110 (130) kPa:	max. $\pm 1$ ppm or $\pm 2(8)\%$ of the display		(reference 100 kPa)
Moisture 5% - 95% R.H.:	max. $\pm 1$ ppm or $\pm 2\%$ of the display		(reference 50% R.H.)
	@20°C		
Temperature -20 to +40(55)°C:	max. $\pm 3(6)$ ppm or $\pm 10\%$ of the display		(reference 20°C)
Long term stability per month:	max. $\pm 1$ ppm or $\pm 1\%$ of the display		(below lab conditions)
Cross sensitivities [#]:	H <sub>2</sub> S < $\pm 3\%$ ; C <sub>2</sub> H <sub>4</sub> :60%; NO:35%; NO <sub>2</sub> < 10%; H <sub>2</sub> < 7%; SO <sub>2</sub> :0%; (*1)		
Expected service life:	2 - 3 years		
<b>MK390-O Electrochemical sensor for chlorine Cl<sub>2</sub></b>			
Measurement range	0 - 10/20/50ppm		
Resolution / tolerance range:	0.1 ppm / $\pm 0.2$ ppm		
Time setting:	$t_{50} < 10$ sec	$t_{90} < 30$ sec	
Pressure 80 - 120 kPa:	max. $\pm 0.2$ ppm or $\pm 10\%$ of the display		(reference 100 kPa)
Moisture 10% - 95% R.H.:	max. $\pm 0.2$ ppm or $\pm 10\%$ of the display		(reference 50% R.H.)
	@20°C		
Temperature -20 to +50°C:	max. $\pm 0.2$ ppm or $\pm 10\%$ of the display		(reference 20°C)
Cross sensitivities:	ClO <sub>2</sub> :50%; F <sub>2</sub> :40%; NO <sub>2</sub> :20%; O <sub>3</sub> :20%; SO <sub>2</sub> :18%; CO <sub>2</sub> :0%; CO:0%; H <sub>2</sub> S:0%; H <sub>2</sub> :0% (*1)		
Expected service life:	2 - 3 years		
<b>MK393-O Electrochemical sensor for Ammonia NH<sub>3</sub></b>			
Measurement range	0 - 100/200 ppm		
Resolution / tolerance range:	1 ppm / $\pm 3$ ppm		
Time setting:	$t_{50} < 20$ sec	$t_{90} < 60$ sec	
Pressure 80 - 120 kPa:	max. $\pm 1$ ppm or $\pm 10\%$ of the display		(reference 100 kPa)
Moisture 10% - 95% R.H.:	max. $\pm 1$ ppm or $\pm 10\%$ of the display		(reference 50% R.H.)
	@20°C		
Temperature (-20)-10 to +50°C:	max. $\pm 1(2)$ ppm or $\pm 10(20)\%$ of the display		(reference 20°C)
Cross sensitivities:	H <sub>2</sub> S:10%; CO:0%; CO <sub>2</sub> :0%; H <sub>2</sub> :0%; (*1)		
Expected service life:	2 - 3 years		
<b>MK396-O Electrochemical sensor for Hydrogen H<sub>2</sub></b>			
Measurement range	0 - 1000/2000 ppm		
Resolution / tolerance range:	2 ppm / $\pm 50$ ppm		
Time setting:	$t_{50} < 30$ sec	$t_{90} < 90$ sec	
Pressure 80 - 120 kPa:	max. $\pm 10$ ppm or $\pm 10\%$ of the display		(reference 100 kPa)
Moisture 15% - 90% R.H.:	max. $\pm 10$ ppm or $\pm 10\%$ of the display		(reference 50% R.H.)
Temperature -20 to +50°C:	max. $\pm 20$ ppm or $\pm 20\%$ of the display		(reference 20°C)
Cross sensitivities:	C <sub>2</sub> H <sub>4</sub> $\approx$ 80%; NO $\approx$ 35%; HCN $\approx$ 30%; CO < 20%; H <sub>2</sub> S < 20%; NO <sub>2</sub> =SO <sub>2</sub> =Cl <sub>2</sub> =HCl=0%; (*1)		
Expected service life:	2 - 3 years		



<b>MK398-O Electrochemical sensor for Oxygen O<sub>2</sub></b>		
Measurement range	0 - 25 Vol.%	
Resolution / tolerance range:	0.1 Vol.% / ±0.3 Vol.%	
Time setting:	t <sub>20</sub> ≤ 10 sec	t <sub>90</sub> ≤ 20 sec
Pressure	80 - 120 kPa:	max. ±0.2 Vol.% or ±2.5% of the measurement range (reference 100 kPa)
Moisture	0% - 90% R.H.:	max. ±0.2 Vol.% or ±2.5% of the measurement range (reference 50% R.H. @40°C)
Temperature	-20 to +50°C:	max. ±0.5 Vol.% or ±2.5% of the display (reference 20°C)
Expected service life:	2 years in air	

<b>MK399-O Electrochemical sensor for Ammonia NH<sub>3</sub></b>		
Measurement range	0 - 500/1000 ppm	
Resolution / tolerance range:	5 ppm / ±10 ppm	
Time setting:	t <sub>50</sub> < 20 sec	t <sub>90</sub> < 90 sec
Pressure	80 - 120 kPa:	max. ±5 ppm or ±10% of the display (reference 100 kPa)
Moisture	10% - 95% R.H.:	max. ±5 ppm or ±10% of the display (reference 50% R.H. @20°C)
Temperature	-20 to +50°C:	max. ±5 ppm or ±10% of the display (reference 20°C)
Cross sensitivities:	SO <sub>2</sub> :<200%; H <sub>2</sub> S:10%; CO:0%; Cl <sub>2</sub> :0%; NO <sub>2</sub> :0%; H <sub>2</sub> :0%; (*1)	
Expected service life:	2 - 3 years	

<b>MK429-O Electrochemical sensor for Hydrogen Sulfide H<sub>2</sub>S</b>		
Measurement range	0 - 30/50/100/200/300/500 ppm	
Resolution / tolerance range:	0.1 ppm / ±0.3 ppm	
Time setting:	t <sub>50</sub> < 15 sec	t <sub>90</sub> < 30 sec    t <sub>10</sub> < 30sec (decay time)
Pressure	70 - 130 kPa:	max. ±0.2 ppm or ±5% of the display (reference 100 kPa)
Moisture	5% - 95% R.H.:	max. ±0.2 ppm or ±2% of the display (reference 50% R.H. @20°C)
Temperature	-20 to +40(55)°C:	max. ±0.2 ppm or ±5(16)% of the display (reference 20°C)
Long term stability	per month:	max. ±0.2 ppm or ±2% of the display (below lab conditions)
Cross sensitivities <sup>[#]</sup> :	SO <sub>2</sub> ≈ 20%; NO <sub>2</sub> ≈ -20%; CO <1%; NO <0.2%; H <sub>2</sub> <0.1%; (*1)	
Expected service life:	3 years	

<b>MK440-O Electrochemical sensor for Sulphur Dioxide SO<sub>2</sub></b>		
Measurement range	0 - 10/20/50/100 ppm	
Resolution / tolerance range:	0.1 ppm / ±0.2 ppm	
Time setting:	t <sub>50</sub> < 10 sec	t <sub>90</sub> < 30 sec
Pressure	80 - 120 kPa:	max. ±0.2 ppm or ±5% of the display (reference 100 kPa)
Moisture	15% - 90% R.H.:	max. ±0.3 ppm or ±3% of the display (reference 50% R.H. @20°C)
Temperature	-20 to +50°C:	max. ±0.3 ppm or ±5% of the display (reference 20°C)
Cross sensitivities:	C <sub>2</sub> H <sub>2</sub> <300%; NO <sub>2</sub> <-170%; C <sub>2</sub> H <sub>4</sub> <90%; HCN <50%; Cl <sub>2</sub> <-40%; NO <10%; H <sub>2</sub> S <0.4%; CO <0.4%; H <sub>2</sub> <0.3%; NH <sub>3</sub> = 0%; (*1)	
Expected service life:	3 years	

<b>MK441-O Electrochemical sensor for carbon monoxide CO</b>		
Measurement range	0 - 200/300/500/1000/1500/2000 ppm	
Resolution / tolerance range:	1 ppm / ±3 ppm	
Time setting:	t <sub>50</sub> < 8 sec	t <sub>90</sub> ≤ 15 sec (at 20°C)
Pressure	80 - 120 kPa:	max. ±2 ppm or ±5% of the display (reference 100 kPa)
Moisture	15% - 95% R.H.:	max. ±1 ppm or ±2% of the display (reference 50% R.H. @20°C)
Temperature	-20 to +55°C:	max. ±3 ppm or ±7% of the display (reference 20°C)
Cross sensitivities:	C <sub>2</sub> H <sub>4</sub> <100%; C <sub>2</sub> H <sub>2</sub> <90%; Cl <sub>2</sub> <40%; H <sub>2</sub> <30%; NO <30%; NO <sub>2</sub> <30%; H <sub>2</sub> S = 0%; SO <sub>2</sub> = 0%; NH <sub>3</sub> = 0%; C <sub>2</sub> H <sub>6</sub> O = 0% (*1)	
Expected service life:	3 years	

## 5.7 Technical specifications

<b>Type designation:</b>	<b>EC22</b>
<b>Ambient conditions</b> Operating temperature: Storage temperature Humidity: Pressure:	-20 to +50°C (sensor dependent) -25 to +60°C (recommended 0 to +30°C) 20 - 95% R.H. (sensor dependent) 80 - 20 kPa (sensor dependent)
<b>Power supply</b> Operating voltage: Power consumption : Fuses:	24V DC (12 - 30V DC allowable) type 10 mA/max.30 mA @24V DC type 15 mA/max.50 mA @24V DC (4 - to 20 mA version) 250 mA (not changeable)
<b>Sensors</b> Measuring range and measurement gas: Measurement gas feed	sensor dependent Diffusion
<b>Display and operating elements</b> Status LEDs: Display, buttons: Potentiometer:	green for operation and yellow for fault or service 2.2 "- Graphic display and 3 function buttons (with display version) for ZERO and SPAN adjustment (optional)
<b>Service connector</b> Design: Analogue output: Digital input:	3.5 mm stereo jack (internal) 0.2 - 1.0 V corresponding to 0 - 100% MR for sensor calibration for configuration and firmware update
<b>Signal output</b> analogue: or analogue: or digital:	4 - 20 mA (max. load: 150Ω/400Ω/650Ω @12V/18V/24V supply) 0.2 - 1 mA (max. load: 4K5/9K3/14K1 @12V/18V/24V supply) RS485; Half-Duplex; max. 38400 Baud; Modbus-protocol, Sliding switch for 120Ω termination resistor
<b>Connection cable</b> Cable entries: Connecting terminals: Cable (analogue): Cable (digital):	1 or 2 piece M16 x 1.5 (for cable diameter 4.5 - 10 mm) 4 pieces (for 0.08 - 2.5 mm <sup>2</sup> Conductor cross-section) 3-wire e.g. LiYY 3 x 0.34 to 0.75 mm <sup>2</sup> or LiYCY 4-wire e.g. LiYY 4 x 0.75 to 1.5 mm <sup>2</sup> or bus line Y(St)Y 2 x 2 x 0.8
<b>Housing</b> Protection class: Material: Measurements: Weight:	IP54 according to IEC 60529 Plastic 96 x 123 x 49mm (W x H x D) with sensor 125 to 50g or 170 or 195g (with display version)
<b>Authorisations/tests</b> Electromagnetic Compatibility	DIN EN 50270:2006 Interference: Type class I Immunity: Type class II

Technology for people and the environment



GfG Gesellschaft für Gerätebau mbH  
Klönnestr.99 - D-44143 Dortmund  
Telephone: +49 (0)231-564 00-0  
Fax: +49 (0)231-516 313  
Email: info@gfg-mbh.com  
Internet: www.gfg.biz

218-000.30\_OM\_EC22.doc,  
Subject to change,

State: March 11, 2015  
firmware version 1.55

## 5.8 EC declaration of conformity

### EC- Declaration of Conformity **GfG Gesellschaft für Gerätebau mbH**

#### Transmitter

#### EC22

Klönnestrasse 99  
D-44143 Dortmund  
Tel: +49 (231) 56400-0  
Fax: +49 (231) 516313  
E-Mail: [info@gfg-mbh.com](mailto:info@gfg-mbh.com)  
[www.gfg.biz](http://www.gfg.biz)



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GfG Gesellschaft für Gerätebau mbH develops, produces and sells gas sensors and gas warning devices, which are subject to a **quality management system** as per DIN EN ISO 9001.

Subject to supervision by means of a **quality system** -Certificate No. BVS 03 ATEX ZQS / E 187- issued by the notified body, DEKRA EXAM GmbH, is the production of electrical apparatus of instrumentation Group I and II, categories M1, M2, 1G and 2G for gas sensors, gas detectors, gas warning systems in ignition protection classes explosion- proof encasing, increased safety, encapsulation and intrinsic safety, as well as their measuring function.

The Transmitter **EC22** complies with **council directive 2004/108/EC** for electromagnetic compatibility.

The guidelines have been complied with under consideration of the standard mentioned below:

#### ■ Electromagnetic compatibility

- Electrical apparatus for the detection and measurement of combustible gases, toxic gases and oxygen. EN 50270
- Radio shielding: Type class 1
- Interference resistance: Type class 2

The EMC testing laboratory EM TEST GmbH, Kamen has been charged with testing and evaluation of the electromagnetic compatibility.

Always adhere to the safety notes of the operation manual 218-000.30.

Dortmund, 09.March 2015

H.J. Hübner  
President CEO