



# GfG Instrumentation

Worldwide manufacturer of gas detection solutions

# ZD 22

## Operations Manual



## GfG Instrumentation

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# 1. INTRODUCTION

## 1.1 For your safety

These operating instructions refer to the proper use of the product and serve to ensure personal safety and health. They must be read and followed by all persons that utilize this product or use, maintain, service and check this product. This product is only able to perform the tasks for which it is intended, when it is utilized, used, maintained, serviced and checked in accordance with the information provided by GfG Instrumentation.

The warranty assumed by GfG shall become void if it is not utilized, used, maintained, serviced and checked in accordance with the information provided by GfG. The aforementioned does not alter the warranty and liability information contained in the GfG terms of sale and delivery.

## 1.2 Operating information

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

**This does not absolve from the responsibility of performing a calibration or, where necessary, an adjustment following installation.**

The ZD 22 transmitter is **not approved for use in potentially explosive atmospheres.**



### **CAUTION**

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

## **2. GENERAL TRANSMITTER INFORMATION**

### **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). The transmitter and GME are connected via a remote measuring cable. The transmitter converts the concentration of gas into an electric measurement signal and sends it to the analysis unit for further processing.

The ZD 22 transmitter can be optionally equipped with an additional graphic display with control buttons. The display has a "green" background lighting in measurement mode. The display color changes to "red" in the event of a fault or alarm in order to provide a visual warning.

Each of the 22 series transmitters is equipped with 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 a fault or a special condition.

The 22 series transmitter can be equipped either with an analog output current interface or a digital RS485 interface. The current interface can issue the measurement information with 4-20mA as standard or can, alternatively issue it with 0.2-1mA. The communication of the digital RS485 interface uses the MODBUS (RTU) protocol.

The electronics assume many tasks which, on one hand, make the operation and servicing easier and, on the other hand, significantly increase measurement accuracy. The transmitter is characterized by:

- Concentration display (on display version)
- Settings at the push of a button without the need to open the housing (on display version)
- Compensation of temperature influences
- Permanent status display (measuring mode, fault or special state) on the transmitter

### **2.2 Measurement procedure and measurement gas feed**

The ZD 22 transmitter is equipped with an amperometric oxygen sensor based on an electrochemical oxygen pump cell made of zircon dioxide. If a voltage is applied to the cell, oxygen ions are pumped from the cathode to the anode. Since the cathode is covered by a gas diffusion barrier, a saturation current occurs when increasing the voltage. This saturation current is a measure of the ambient oxygen concentration. The measurement principle is characterized by high long-term stability and selectivity.

Normally, the measurement gas passes through diffusion to the gas sensor. However, if a calibration adapter is attached to the sensor for calibration or adjustment purposes, the following particularities can be noted on the ZD 22.

### **2.3 Particularities when using a calibration adapter**

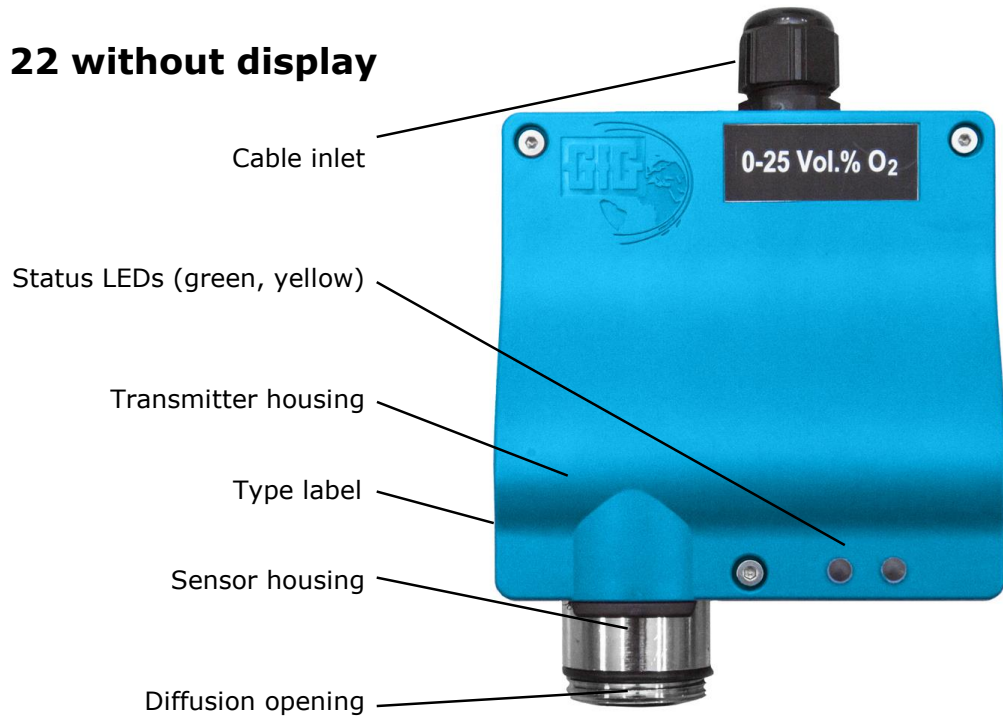
To avoid false display values, especially when measuring ranges of oxygen content of less than 5 % vol., connect a gas hose of at least 12 in / 30 cm in length to the calibration adapter gas outlet. This is the only way to prevent any oxygen molecules from flowing "backwards" to the sensor with a flow rate of 0.5 l/min. The reason for possible incorrect display values of low concentrations is due to partial oxygen pressure outside of the calibration adapter.

### **2.4 Transmission response**

The gas indicator and signal delivery are always proportional to the concentration of gas. The reaction times can be different depending on the sensor type used.

## 2.5 Unit design

### ZD 22 without display



### ZD 22 with display



The gas sensor and the transmitter electronics are installed in the transmitter housing. The electronics convert the measurement signal into a gas concentration and indicates it with an analog current signal of 4-20mA or 0.2-1mA or with a digital RS485 bus signal in the MODBUS RTU protocol. The gas concentration and status information are displayed on the display version.

The transmitter can be adjusted by using a multimeter and customer test leads and two installed potentiometers or, on display version, by using the display and the control 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 unfavorable ventilation. If necessary, calculations must be made, for example with smoke tubes.

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

External influences such as those listed below must also be taken into consideration:

- 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 provide you with information regarding suitable measures.



**The warranty may become void if the sensor is exposed to environmental conditions that GfG was unaware of during planning or delivery.**

### 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 analysis unit in accordance with the circuit diagram (see *Installation of electrical connections*). 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 analysis unit are on the top of the circuit board.

### Mounting

For connecting the ZD22 refer to the connection diagram (also refer to the terminal diagram of your GMA controller). For mounting the transmitter remove the three screws and lift the casing top off.



**The ZD22 comes equipped with a protective cap on the sensor. Do not remove this cap until immediately prior to applying power to the transmitter.**

**The protective cap must be reinstalled whenever power is not applied to the ZD22.**



**In order for the ZD22 to properly detect O<sub>2</sub>, the protective cap must be removed.**

**Once the ZD22 is properly installed and under power it has a heater that helps to keep the sensor clear from most contaminants in the environment.**



**If maintenance is being performed in the area, the protective cap must be used.**

**Failure to follow these instructions may cause damage to the sensor and will void the warranty.**



**The ZD22 is not certified for use in hazardous areas.**

### 3.3 Installation of electrical connections

The laying of cables and connection of the electrical installation may only be carried out by a specialist taking into consideration the relevant provisions. The wire cross-section is based on the length of the connection cable and the transmitter version. When dealing with the bus version, it may be necessary to check whether 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 analog data transmission a cable can be used with the wire diameter of 18 AWG gauge, this is suitable for short distances up to 1,640ft / 500m. For longer distances the wire cross-section has to be 16 AWG gauge. The cable length should not exceed 3,937ft / 1200m.

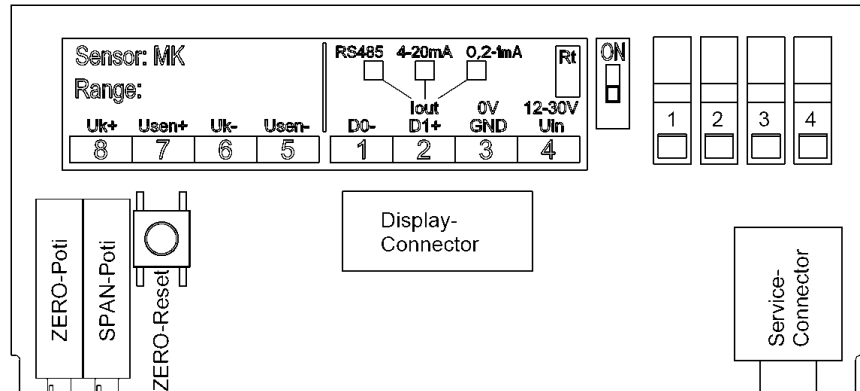
#### Wiring diagram:

##### Terminal for cable connection

- 1: Data- D0
- 2: Data+ D1 / 4-20mA / 0.2-1mA
- 3: 0V GND
- 4: 24 V DC (15-30 V DC)

##### Slide switch (Rt)

Terminating resistor for RS485  
(Factory setting = OFF)



Following installation, the housing cover must, once again, be sealed and screwed into place.



## 4. OPERATING INSTRUCTIONS

### 4.1 Commissioning

The ZD 22 transmitter has been tested for proper 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 qualified person and checked for proper operation.

After switching on, the transmitter requires a 2–3 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 stabilizing of the sensor

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

Directly after switching on, the current interface displays 0.0mA and after 4 seconds displays 0.08mA. In doing so, the green and yellow LEDs are on.

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

Directly after switching on, the current interface displays 0.0mA and after 4 seconds displays 1.6mA. In doing so, 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 analysis unit, e.g. the GMA 200. For further information, see the Modbus system for the TRM22 operating instructions.

The information regarding the *firmware version* initially appears in the ZD 22 display. The measurement range, the unit of measurement, the gas type and the calibration gas concentration are then displayed. A countdown of the remaining seconds of the run-in phase can be seen on the display. The ZD 22 automatically switches into measurement mode following completion of the run-in phase.



The device switches to fault mode if a device error is detected during the start-up phase.

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

The current interface then displays 0.06mA. An error message appears in the display (see *Display of special conditions* section).

The yellow fault LED is permanently illuminated.

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

The current interface displays 1.2mA. An error message appears in the display (see *Display of special conditions* section).

The yellow fault LED is permanently illuminated.

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

With the Modbus version an error message displays on the transmitter and/or the GME (see *Display of special conditions* section).

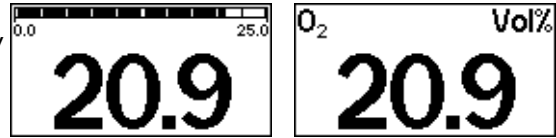
The yellow fault LED is permanently illuminated.

#### Note:

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

## 4.2 Measurement mode

The green operating LED is permanently on and the yellow fault LED is off when the measurement mode is operating flawlessly. In measurement mode, the digital display shows the gas concentration currently being detected. The measurement of the gas concentration takes place constantly and is being refreshed every second. The functionality of the electronics is constantly monitored by various tests such as sensor, processor and memory tests.



In normal measurement mode, a bar chart showing the current gas concentration complete with the set measurement range is shown on the transmitter display, also in 5 seconds intervals the type of gas and gas unit.

### 4.2.1 Measuring range underflow

Readings below the zero point are shown in the display as a number preceded with a negative sign. In the event of a measurement value underflow of 0 to -5% of the measurement range, the measurement value continues to be shown on the transmitter display or on the analysis unit (e.g. the GMA 200).

In the event of a measurement value underflow of -5 to -7.5%, the arrows  $\Downarrow\Downarrow$  are shown alternatively with the measurement value in the display.

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

Transmitter with analog current interface 0.2-1mA:

In accordance with the measurement value, the current interface displays a signal within the 0.14 to 0.2mA range.

Transmitter with analog current interface 4-20mA:

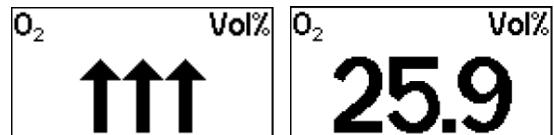
In accordance with the measurement value, the current interface displays a signal within the 2.8 to 4.0mA corresponding to the reading.

Transmitter with digital Modbus interface (RS485):

In the Modbus version, the respective measurement value is shown on the transmitter and/or the GME display (see *Display of special conditions* section).

### 4.2.2 Measuring range exceeded

Exceeding the measuring range between 100% and 112% of the measuring range the arrows  $\Uparrow\Uparrow\Uparrow$  are displayed alternating with the measured value.



Transmitter with analog current interface 0.2-1mA:

In accordance with the measurement value, the current interface displays a signal within the 1.0 to 1.1mA range.

Transmitter with analog current interface 4-20mA:

In accordance with the measurement value, the current interface displays a signal within the 20 to 22mA range.

Transmitter with digital Modbus interface (RS485):

In the Modbus version, the respective measurement value alternating with  $\Uparrow\Uparrow\Uparrow$  is shown on the transmitter and/or the GME display (see *Display of special conditions* section).

Exceeding by even more than 112% of the measurement range, the display shows permanent arrows  $\Uparrow\Uparrow\Uparrow$  and a rapidly-flashing yellow status LED.



Transmitter with analog current interface 0.2-1mA:

The current interface displays 1.1 mA.

Transmitter with analog current interface 4-20mA:

The current interface displays 22mA.


Transmitter with digital Modbus interface (RS485):

With the Modbus version,  $\Uparrow\Uparrow\Uparrow$  is displayed in the display of the transmitter and/or the GME (see *Display of special conditions* section).

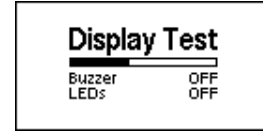
### 4.2.3 Operating buttons (Display version only)

Using the control buttons on the    transmitter the unit can be calibrated and settings adjusted through the menu.


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

In measurement mode, a display and LED test can be performed through the menu by briefly pressing the test/zero button .

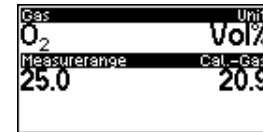
In doing so, all LEDs are triggered, all segments of the display are shown and all status LEDs as well as an audible beep are triggered.



### 4.2.5 Display of operating parameters [INFO]

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

- Measurement gas
- Unit of Measurement
- Measurement range
- Calibration / test gas concentration



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

### 4.2.6 Sensor service life

Zircon dioxide sensors have a limited service life. The expected service life of the ZD 22 sensors is up to five years depending on the operating conditions. Once the expected service life has been reached, the transmitter displays that the sensor should be replaced during the next service. The display illuminates red and a corresponding message is shown and the yellow fault LED briefly flashes every five seconds. This has no impact on the measurement mode and the remaining service life of the sensor.

## 4.3 Calibration and adjustment

### 4.3.1 Zero point calibration

When calibrating (checking) or adjusting (setting) the zero point, 100 vol% nitrogen is used as zero gas. Please refer also to section 2.3 "Particularities when using a calibration adapter".


#### Calibration (check):

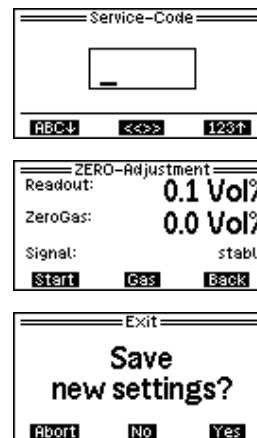
In this case, a calibration adapter must be screwed on the sensor housing. Through the calibration adapter, the zero gas can then be applied to the sensor in a pressure-free manner with a flow rate of approx. 0.5 l<sub>min</sub>. If the display value deviates from zero, the deviation can be adjusted.

#### Adjustment of the display:

depending on the transmitter version, the adjustment of the zero point can be performed in different ways. These options are described next.

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

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



The display shows the current gas reading (indicated value) 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 accepted and displayed. Using the right button, the program "ZERO adjustment" can be aborted and a change back to measuring mode can be made.

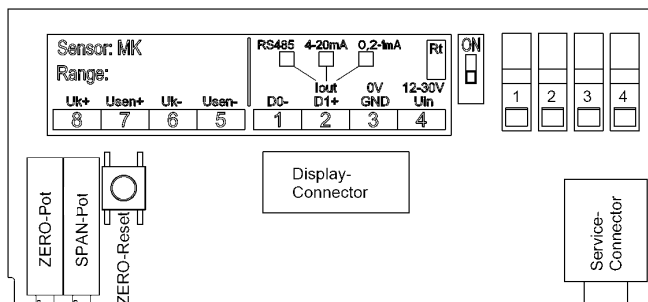
### 4.3.3 Zero point adjustment using the ZERO reset button

For transmitters without a display, the easiest way to adjust the zero point is to press the ZERO reset button. To access this button, the transmitter cover has to be removed. Afterwards, press and hold the button for 3 seconds in order to start the adjustment procedure. The adjustment procedure is signaled by a flashing yellow status LED and a power output signal of 2.0mA (or 0.1mA). If the measured value remains constant during a defined interval of time, the new zero point is accepted. The adjustment process is then automatically finished.

**Note:**

While waiting for a constant measurement value, the adjustment procedure can be shortened by pressing and holding the ZERO reset button. The hardware immediately starts the zero point adjustment.

If the current measured value is outside the permissible limit values, the transmitter switches back to measurement mode without having performed the adjustment.



### 4.3.4 Zero point adjustment with the ZERO potentiometer

For transmitters without a display, the zero point adjustment can be carried out when the transmitter cover is open on the ZERO pot using a small screwdriver, a multimeter and a test cable with service plug (see *Accessories and spare parts* section). The test cable must be connected to the voltage measuring jacks of the multimeter and the service plug must be inserted into the service connector of the transmitter (also see note).

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

Once the ZERO pot is turned the setpoint can be read on the multimeter for the zero point adjustment. This is signaled by the flashing yellow status LED. It must be turned until a voltage value of 0.200V 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 cable is available with service plug, the output current (I<sub>out</sub>) of the transmitters with analog interface (4-20mA and 0.2-1mA) 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 during this current measurement. Multimeter in mA scale.

### 4.3.5 Sensitivity calibration


For calibration (checking) or adjusting the gas sensitivity, a calibration adapter has to be screwed on the sensor housing. The test or calibration gas is supplied to the sensor without pressure at a flow rate of approx. 0.5 l<sub>min</sub> via the calibration adapter. Depending on the measuring range, fresh air or synthetic air can also be used.

The indicated value is shown on the display. A sensitivity adjustment is required if the display value deviates from the calibration gas concentration.

Adjustment of the display:

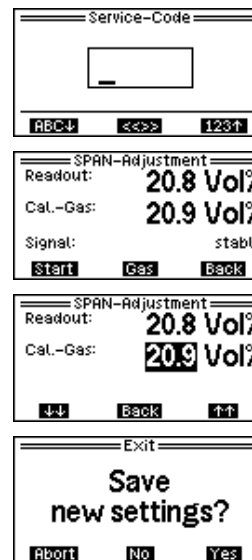
Before any adjustment of the sensitivity, the zero point should be checked and if necessary re-adjusted. The adjustment of the sensitivity can be done in different ways depending on the transmitter version. Both options are described below.

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

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

The display shows the current gas reading (indicated value) and displays the adjusted test gas concentration (cal gas). After pressing the middle button [Gas] the test gas concentration can be changed with the left or right control buttons, and saved with the center control 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 "SPAN Adjustment" program can be completed and a change back to measurement mode can be made.



### 4.3.7 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 pot using a small screwdriver, a multimeter and with a test cable with service plug (see *Accessories and spare parts* section). The test cable should be connected to the voltage measuring jacks of the multimeter and the service socket inside the service connector of the transmitter (also see note).

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

Once the SPAN pot is turned the setpoint can be read on the multimeter for the sensitivity adjustment. This is signaled by the flashing yellow status LED. It must be turned until a voltage value of for example 0.600V (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 cable is available with service plug, the output current (Iout) of the transmitters with analog interface (4-20mA and 0.2-1mA) 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. Multimeter in mA scale.

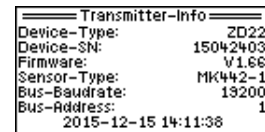
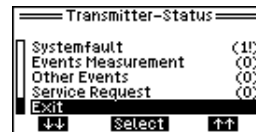
## 4.4 Main and service menu [MENU]

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

### 4.4.1 Main menu

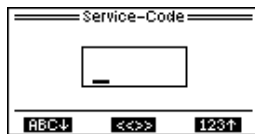
The transmitter remains in measurement mode in the main menu itself and when switching into the individual menu items. This means that the measurement value recording, processing, and output continues to function in the background. There is an exception in the service menu, and this is described in the next section. The main menu is structured as follows:

- Transmitter Status
- Transmitter Info
- Service Menu
- Exit



Current system errors, errors in the measurement procedure, service needs and incidents can be retrieved in the transmitter status. Numbers inside parenthesis can be found after these groups. These numbers indicate the number of the existing information.

### 4.4.2 Service menu



To access the service menu, a special access code must be entered. For the default service menu the code is "1100". Additional functions are available in an advanced service menu. Only GfG service personnel are permitted to access the advanced service menu.



The service menu is subdivided as follows:

**System settings:** This menu contains general settings for the RS485 bus interface and/or analog interface, language, display contrast, tolerance range and acoustic alarm.

**Sensor settings:** This menu contains the settings required for sensor replacement as well as the selection of the measurement range.

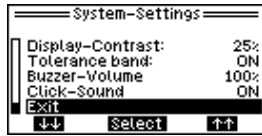
**Readout simulation:** This menu allows to generate measurement values without test gas for checking the output signal interface and the subsequent signal processing.

Within the following subsections, the setting options are described in detail.

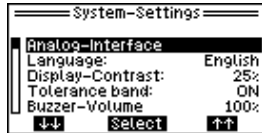
#### 4.4.2.1 System settings



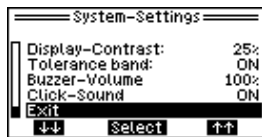
If the transmitter includes a RS485 bus interface, the **Bus address** can be set to a range from 1 to 247 (0 = inactive). However, you are not allowed to use this bus address several times within the same bus segment.



**Bus baudrate** can be set to 9600, 19200 or 38400 bauds. By default it is set to 19200 bauds. The baud rate can be reduced to 9600 bauds for very long bus lines and increased to 38400 bauds for very many participating bus stations. The same baud rate has to be set for all bus stations within one bus segment.



**Language** can be set to German or English and is relevant for all display outputs for the menus in particular.



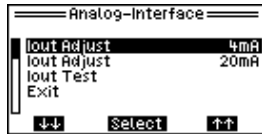
**Display contrast** can be set from 0 to 100%. This value can vary depending on the display type and is typically set to 25...40%.

**Tolerance band** can be set to "ON" or "OFF". If it is set to "ON" (standard), minor signal deviations of fresh air are indicated as 20.9 vol % O<sub>2</sub>. The actual measurement value is only indicated when exceeding or falling below the tolerance range. If this item is set to "OFF", the actual measurement value is always indicated.

**Buzzer volume** can be set from 0 to 100%, but is only relevant, if the transmitter is used to trigger an alarm in case of hazardous gas levels.

**Click sound** can be set to "ON" or "OFF". If it is set to "ON" (standard), the internal acoustic alarm produces a short clicking each time a button is actuated.

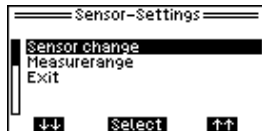
If the transmitter is provided with an analog 4-20mA (0.2-1mA) interface, the menu item **Analog interface** of the advanced service menu can be used to adjust and check the current interface.



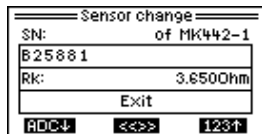
**Iout adjustment:** Caution!!! The current interface may only be adjusted with the help of a very precise ammeter.

**Iout test:** The current output can be checked in a range from 0.5 to 24.5mA using this item. Caution!!! It is possible that connected control devices respond to these test levels.

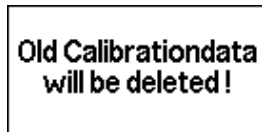
#### 4.4.2.2 Sensor settings



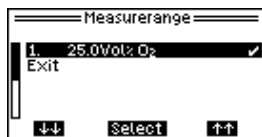
The following sensor-related settings can only be set in the advanced service menu:



**Sensor replacement:** If a gas sensor has been used up and is to be replaced by a new gas sensor of the same type (MK...), this menu item has to be used to enter the serial number of the new gas sensor. The sensor resistance R<sub>k</sub> must also be set for certain sensor types (e.g. MK442-1). When all data are entered, the calibration data of the former sensor are deleted and replaced by new standard values. In any case, the zero point and the gas sensitivity of the new gas sensor need to be adjusted.

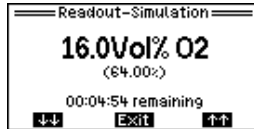
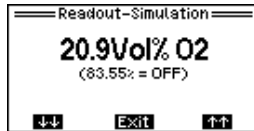


**Measurement range** Upon delivery, the transmitter will be set with the measuring range requested by the customer. However, if another measuring range is requested later and further measuring ranges are available for the respective sensor, this menu item can be used to select another measuring range.



Due to the different limit values of the measuring ranges, the calibration data of the former measuring range are not adopted. Thus, if another measuring range is selected, the zero point and the gas sensitivity may possibly need to be adjusted.

#### 4.4.2.3 Measurement value simulation



Thanks to the measurement value simulation, the output signal interface, transmission of measurement value and subsequent signal processing can be checked. Over a restricted period of time, measurement values can be generated without an appropriate test gas being available.

At the beginning, the display still shows the current measured value. Simulation mode is only started by pressing the left or right key. The maximum remaining simulation time is then indicated above the keyboard labeling. If the simulation value is modified with the help of the left or right key, the remaining simulation time is again set to 5 minutes. The simulation mode can be terminated by pressing the center key. If no key is pressed, the simulation mode is terminated upon expiry of the remaining simulation time and the device automatically switches over to measurement mode.

### 4.5 Displays and messages

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

The various display statuses of both of the status LEDs and the power output signals complete with a reference to their meaning are listed in the following table.

Green LED	Yellow LED	Power output	For description, please see Section ...
Off	Flashes at 1 Hz	0.0mA	Display of special conditions... No. 001
Off	On	0.0mA	Display of special conditions... No. 002
Off	On	1.2mA	Display of special conditions... No. 103-113
Single pulse every 5s	To	1.2mA	Display of special conditions... No. 101
Flashes at 1Hz	On	1.6mA	Display of special conditions... No. 002, 003
On	Flashes at 1 Hz	2.0mA	Displays in service mode... No. 204, 205
On	Flashes at 1 Hz	2.4mA	Displays in service mode... No. 203
On	Flashes at 1 Hz	4-20mA	Displays in service mode... No. 201, 202
On	Single pulse every 5 s	2.8-22mA	Displays in measurement mode No. 309
On	On	2.8mA	Displays in service mode No. 307, 308
On	Off	2.8-22mA	Displays in service mode... No. 303-306
On	Flashes at 5Hz	22mA	Displays in service mode No. 301, 302

#### 4.5.2 Display of special conditions (device start-up and fault)

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

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

##### Behavior during device start-up:

No.	Display	Green LED	Yellow LED	Power output	Cause	Information / Explanation
001	Boot V1.07 GfG ZD 22 Error:Flash	Off	Flashes at 1 Hz	0.0mA	An error was detected in the program memory during the memory check.	Restart the transmitter. Firmware update is required if an error message is displayed again.
002	Boot V1.07 GfG ZD 22 Verify	Off	On	0.0mA	Program and memory tests in the first seconds of device start-up.	Automatic transition to initialization phase after approximately 4 seconds.
003	V1.66 GfG ZD 22	Flashes at 1 Hz	On	1.6mA (0.08mA)	Initialization phase of the transmitter.	Automatic transition to sensor start-up phase after approximately 3 seconds.
004	Warm up XX Seconds remaining	Flashes at 1 Hz	On	1.6mA (0.08mA)	Sensor start-up phase.	Automatic transition into measurement mode after time has elapsed.



### Behavior in the event of a fault:

No.	Display	Green LED	Yellow LED	Power output	Cause	Information / Explanation
101	Sensor defective	Single pulse every 5s	On	1.2mA (0.06mA)	Sensor no longer responds correctly to gas. The sensor may be too old.	The sensor must be replaced.
102	Supply voltage incorrect	Off	On	1.2mA (0.06mA)	The transmitter supply voltage is either too low or too high.	Examine the power supply and adjust
103	Sensor Uk incorrect	Off	On	1.2mA (0.06mA)	Heating voltage for the sensor is incorrect.	
104	Sensor Ik < MIN Sensor Ik > MAX	Off	On	1.2mA (0.06mA)	Heating current for the sensor is too low or too high.	
105	Temp.signal < MIN Temp.signal > MAX	Off	On	1.2mA (0.06mA)	Temperature measurement is presumably incorrect.	
106	Watchdog error	Off	On	1.2mA (0.06mA)	A hardware error was detected during the external watchdog test.	Restart the device. Replace the device if the error message displays again.
107	FLASH error	Off	On	1.2mA (0.06mA)	An error was detected in the program memory during the memory check.	
108	RAM error	Off	On	1.2mA (0.06mA)	Defective memory was detected during the memory check.	
109	EEPROM error 1 EEPROM error 2 EEPROM error 2c EEPROM error 1 + 2 EEPROM error 1 <> 2	Off	On	1.2mA (0.06mA)	Error in the parameter memory or when accessing the external parameter memory module.	
110	Incorrect PCB type	Off	On	1.2mA (0.06mA)	An incorrect printed circuit board type or printed circuit board error was identified.	
111	Digital pot error	Off	On	1.2mA (0.06mA)	A hardware error was detected on the digital potentiometer.	
112	ADC error 1 ADC error 2	Off	On	1.2mA (0.06mA)	An error was detected on the analog-to-digital converter.	
113	Program sequence error	Off	On	1.2mA (0.06mA)	A logical process error was identified during program processing.	

### 4.5.3 Displays in 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 4-20mA current output transmits a signal 2.0-2.4mA.

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

No.	Display	Green LED	Yellow LED	Power output	Cause	Information / Explanation
201	Zero point adjustment (ZERO-Pot)	On	Flashes at 1 Hz	4-20mA (0.2-1mA)	AutoCal program for zero point adjustment was activated with ZERO potentiometer	Zero gas setting takes place with the ZERO potentiometer
202	Sensitivity adjustment (SPAN-Pot)	On	Flashes at 1 Hz	4-20mA (0.2-1mA)	AutoCal program for sensitivity adjustment was activated with SPAN potentiometer	Calibration gas setting takes place with the SPAN potentiometer
203	Menu item	On	Flashes at 1 Hz	2.4mA (0.12mA)	Service menu was activated using the keyboard	Select the menu item. An automatic return to measurement mode takes place if no entry is performed for a period of 1 min.
204	Zero point adjustment	On	Flashes at 1 Hz	2.0mA (0.10mA)	Zero point adjustment has been activated using the keyboard	AutoCal adjustment of the zero point
205	Sensitivity adjustment	On	Flashes at 1 Hz	2.0mA (0.10mA)	Sensitivity adjustment was activated using the keyboard	AutoCal adjustment of the sensitivity


#### 4.5.4 Displays in measurement mode

The following table shows the states with a description in which the green operation LED lights up and the 4-20mA current output transmits a signal 2.8-22mA.  
For the 0.2-1mA current output the value of the output signal is shown in parenthesis (0.14-1.1mA).

No.	Display	Green LED	Yellow LED	Power output	Cause	Information / Explanation
301	↑↑↑ permanent	On	Flashes at 5Hz	22mA (1.1mA)	The gas concentration has exceeded the measurement range of the transmitter electronics	
302	↑↑↑ permanent	On	Flashes at 5Hz	22mA (1.1mA)	The gas concentration has significantly exceeded the measurement range (Gas ≥ 112.5% MR)	
303	↑↑↑ alternating with the measurement value	On	Off	20-22mA (1.0-1.1mA)	The gas concentration has exceeded the measurement range (100 to 112% MR)	
304	Measurement value	On	Off	4-20mA (0.2-1mA)	Fault-free measurement mode	
305	Measurement value	On	Off	3.2-4.0mA (0.16-0.2mA)	Underflow of the measurement range (-5.0 to 0.0% MR)	
306	Measurement value alternating with ↓↓↓	On	Off	2.8-3.2mA (0.14-0.16mA)	Underflow of the measurement range (-7.5 to -5.0% MR)	Zero point calibration is useful
307	Permanent ↓↓↓	On	On	2.8mA (0.14mA)	Underflow of the measurement range (below -7.5% MR)	Zero point calibration is necessary
308	Permanent ↓↓↓	On	On	2.8mA (0.14mA)	Measurement signal has fallen below the measurement range of the transmitter electronics	Zero point calibration is necessary and sensitivity must be checked
309	<i>Sensor replacement required</i>	On	Single pulse every 5s	2.8-22mA (0.14-1.1mA)	Expected service life of the sensor is exceeded.	Sensor replacement or adjustment required

#### 4.5.5 Priority of displays and messages in measurement mode

The display of statuses with lower priority are overwritten by displays with higher priority.  
The statuses with lower priority are not reset.

Priority	Status	For description, please see Section ...
	Significant measurement range overflow ( <b>ambiguity</b> )	Displays in service mode No. 301, 302
	Slight measuring range overflow	Displays in measurement mode No. 303
	Measurement range underflow	Displays in service mode No. 305 - 308
	Sensor replacement	Displays in measurement mode No. 309

Sensor fault no. 101 and the transmitter fault no. 102 - 113 stop the measuring operation with their respective messages.

#### 4.6 Fault, cause, remedy

Fault	Cause	Remedy
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 0mA	Defective fuse or electronics	Replace printed circuit board
	Line interrupted	Re-establish connection

## **5. APPENDIX**

### **5.1 Cleaning and care**

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

### **5.2 Servicing and maintenance**

The servicing and maintenance includes a regular visual inspection, functional check and the system check as well as the repair of the gas warning system.

#### **5.2.1 Visual inspection**

The visual inspection should take place regularly, at least once per month, and consist of the following activities:

- Check the indicator light and the status messages, e.g. operation display "On", alarm and fault display "Off"
- Check for mechanical damage and outer soiling

#### **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 the measurement of toxic gases and oxygen 6 months is recommended.

This includes the following activities:

- Visual inspection according to section 5.2.1 of this operating manual
- Check and assessment of measurement value displays
- Triggering the alarm thresholds
- Triggering of test functions for display elements, visual and audible signaling device without triggering the switching functions
- Check of stored messages, faults and maintenance requirements.

#### **5.2.3 System check**

The system check must be performed 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 triggering of switch functions
- Check of the parameterization 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 authorized by the manufacturer, GfG Instrumentation. Only original spare parts as well as original assemblies that have been tested and approved by the manufacturer may be used.

### **5.3 Sensor replacement**

The transmitter cover must be removed in order to replace the sensor. Once power is removed, the sensor cables can then be removed from the terminals 5-8. The printed circuit board must then be pulled out of the guide so that the old sensor can be unscrewed. The assembly of the replacement sensor takes place in reverse order. Only a sensor of the same type may be used for this purpose. Furthermore, the serial number must be entered into the service menu of the transmitter once it has been installed and commissioned.

## 5.4 Accessories and spare parts

	Description	Part No.
1.	Calibration adapters for ZD 22 transmitter	2000209
2.	Service test cable w/service plug for ZD 22 transmitters	2220201
3.	MK435-1 Replacement sensor for 0..2 vol.% O <sub>2</sub> (oxygen)	On request
4.	MK442-1 Replacement sensor for 0..25 vol.% O <sub>2</sub> (oxygen)	On request

## 5.5 Sensor specification

<b>MK395-1 Zircon dioxide sensor for oxygen O<sub>2</sub></b>	
Measuring range / resolution:	0.1...25 vol.% / 0.1 vol.%
Measuring accuracy:	±0.25 vol.%
Reproducibility:	±0.1 Vol.%
Time setting t <sub>90</sub> :	< 5 sec
Pressure influence 80...500 kPa:	< 0.05 % of measurement value per 10kPa
15...80 kPa:	< 2.0% of measurement value per 10kPa
Influence of humidity 0...99 % r.h.:	negligible
Temperature influence -4 to +122°F:	negligible
Flow velocity 0...6 m/s:	negligible
Cross sensitivities:	approx. -1.1 vol.% @ 40 vol.% CO <sub>2</sub> approx. -0.1 vol.% @ 1000 ppm CO approx. 0.11 vol.% @ 1000 ppm NO <sub>2</sub> approx. -0.03 vol.% @ 1000 ppm SO <sub>2</sub> approx. -0.2 vol.% @ 1000 ppm CH <sub>4</sub> ≈0.0 vol.% @ 400 ppm H <sub>2</sub> S ≈0.0 vol.% @ 20 0ppm NH <sub>3</sub>
Expected service life:	4 - 5 years
<b>MK435-1 Zircon dioxide sensor for oxygen O<sub>2</sub></b>	
Measuring range / resolution:	0.01...2 vol.%
Measuring accuracy:	±200ppm
Reproducibility:	±100ppm
Time setting t <sub>90</sub> :	< 5 sec
Pressure influence 80...500 kPa:	< 0.05 % of measurement value per 10kPa
15...80 kPa:	< 2.0% of measurement value per 10kPa
Influence of humidity 0...99 % r.h.:	negligible
Temperature influence -20 to +50°C:	negligible
Expected service life:	4 - 5 years
<b>MK442-1 Zircon dioxide sensor for oxygen O<sub>2</sub></b>	
Measuring range / resolution:	0.1...25 vol.% / 0.1 vol.%
Measuring accuracy:	±0.5 vol.%
Reproducibility:	±0.1 Vol.%
Time setting t <sub>90</sub> :	< 30 sec
Influence of humidity 0...99%r.h.:	negligible
Temperature influence -20 to +50°C:	negligible
Expected service life:	4 - 5 years

## 5.6 Technical data

<b>Type designation:</b>	<b>ZD 22</b>
<b>Ambient conditions</b> Operating temperature: Storage temperature Humidity: Pressure:	-4 to +122°F / -20 to +50°C (sensor dependent) -13 to +140°F / -25 to +60°C (recommended +32 to +86°F / 0 to +30°C) -5 - 95%r.h. non-condensing (sensor dependent) 80 - 120kPa (sensor dependent)
<b>Power supply</b> Operating voltage: Power consumption: Fuses:	24V DC (15-30V DC allowable) typ.120mA / max.140mA @ 24V DC (MK442) typ.130mA / max.160mA @ 24V DC (MK395, MK435) typ.150mA / max.180mA @ 24V DC (4...20mA version with MK395, MK435) 250mA (not changeable)
<b>Sensors</b> Measuring range and measurement gas: Measurement gas feed	Sensor dependent Diffusion
<b>Display &amp; operating elements</b> Status LEDs: Display, buttons: Auto ZERO key: Potentiometer:	Green for operation and yellow for fault or service 2.2" graphic display and 3 function buttons (on display version) For ZERO adjustment For ZERO and SPAN adjustment (optional)
<b>Service connector</b> Design: Analog output: Digital input:	3.5mm stereo jack socket (internally located) 0.2-1.0V corresponding to 0-100% range for sensor calibration for For configuration and firmware update
<b>Signal output</b> analog: or analog: or digital:	4-20mA (max. load: 150Ω/400Ω/650Ω @12V/18V/24V supply) 0.2-1mA (max. load: 4K5/9K3/14K1 @12V/18V/24V supply) RS485; half duplex; max. 38400 bauds; Modbus protocol, Slide switch for 120Ω termination resistor
<b>Connector cable</b> Cable inlets: Connection terminals: Cable (analog): Cable (digital):	1 or 2 units of M16 x 14 AWG (for cable diameter 4.5 - 10 mm) 4 units (for 28...13 AWG gauge conductor cross-section) 3-wire e.g. LiYY 3 x 18...16 AWG gauge or LiYCY 4-wire e.g. LiYY 4 x 18...16 AWG gauge or bus line Y(St)Y 2x2x0.8 <b>*1</b>
<b>Housing</b> Protection class: Material: Dimension: Weight:	IP54 according to IEC 60529 Plastic 3.8 x 5.5 x 2in / 96 x 140 x 49mm (W x H x D) with sensor 6oz or 8 oz / 175g or 220g (display version)
<b>Approvals/tests</b> Electromagnetic compatibility:	DIN EN 50270:2006 Interference: Type class I Immunity: Type class II

**Explanation regarding\*1:** Bus line Y(St)Y 2x2x0.8 is only suitable for supplying several bus transmitters with power using the same cable via short cabling distances. The possible distance depends on the quantity and local distribution of the transmitters on the bus cable.

## 5.7 EC Declaration of Conformity

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

#### Transmitter

#### ZD22

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Tel: +49 (231) 56400-0  
Fax: +49 (231) 516313  
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[www.gfg.biz](http://www.gfg.biz)



Edited: 09.02.2015

Amended:

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 **ZD22** 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 219-000.31

Dortmund, 09.March 2015

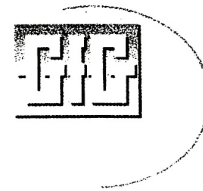
H.J. Hübner  
President CEO

## 5.8 SIL Declaration of Conformity

### SIL- Declaration of Conformity ZD22

### GfG Gesellschaft für Gerätebau mbH

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Issued: 2016-04-25

Changed:

The transmitter **ZD22** with 4 - 20mA analogue output signal respectively with RS 485 digital output signal complies with the following European Standards for Functional Safety:

Functional safety of electrical/electronic/programmable electronic safety-related systems  
**EN 61508-2: 2011**

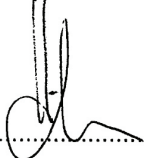
The following parameters for single channel and dual channel use of **transmitter ZD22** with analogue respectively digital output have been determined:

	Single channel use	Redundant use
Safety function	Oxygen measurement e.g. to inerting monitoring	
Sensor type / Metering range	MK395-1: 0–25Vol.% O <sub>2</sub> (dangerous: signal too low) MK395-1: other O <sub>2</sub> measuring ranges (dangerous: signal too low)	
SIL level hardware	2	3
Device type	B	
SFF	92.55% resp. 92.60%	
HFT	0	1
β factor	—	10%
PFD	6.01×10 <sup>-4</sup> resp. 5.97×10 <sup>-4</sup> (per annum)	6.05×10 <sup>-5</sup> resp. 6.01×10 <sup>-5</sup> (per annum)
λ <sub>du</sub>	1.31×10 <sup>-7</sup> resp. 1.30×10 <sup>-7</sup> (per h)	
λ <sub>dd</sub>	2.53×10 <sup>-7</sup> resp. 2.61×10 <sup>-7</sup> (per h)	
λ <sub>su</sub>	1.36×10 <sup>-6</sup> resp. 1.35×10 <sup>-6</sup> (per h)	
λ <sub>sd</sub>	1.63×10 <sup>-8</sup> resp. 1.62×10 <sup>-8</sup> (per h)	
Proof Test interval	1 Year	
MTTR	72 h	

The calculation of the parameters was done by GWW GasWarn Dr. Wenker GmbH, and the accuracy of the statement is confirmed by the conformity statement of GWW GasWarn Dr. Wenker GmbH as independent expert.

Always consider the following operational conditions and safety notes of the operation manual 219-000.31.

Dortmund, 25. April 2016

  
.....  
H. J. Hübner  
President CEO

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# **GfG Instrumentation**

Worldwide Manufacturer of Gas Detection Solutions

Rev. 3 (07/10/18)