Dräger Polytron® 8000 Series

Safety Manual

⚠ **WARNING**
To properly use this product, read and comply with these instructions for use.

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Contents

1 Scope and purpose of safety manual

The purpose of this safety manual is to document the necessary information and assumptions that are required for the integration of the assessed gas transmitters

Dräger Polytron 8100 EC
Dräger Polytron 8200 CAT DQ LC
Dräger Polytron 8700 IR 334/340
Dräger Polytron 8720 IR
Dräger Polytron 8900 UGLD

into a safety instrumented system (SIS) - in compliance with the requirements of IEC 61508 standard.

The safety manual specifies the safety functions. This may be used to support the safety function of a safety instrumented system (SIS).

The safety manual provides the assumptions that have been made on the usage of the gas transmitter. If those assumptions cannot be met by the application, the SIL (Safety Integrity Level) capability has to be evaluated considering the application-specific circumstances.

2 Relevant standards

EN 50402:2017[1)]	Electrical apparatus for the detection and measurement of combustible or toxic gases or vapors or of oxygen – requirements on the functional safety of fixed gas detection systems
IEC 61508:2010	Functional safety of electrical / electronic / programmable electronic safety-related systems

1) EN 50402 is not applicable for Dräger Polytron 8900 UGLD

3 Conventions in this document

3.1 Meaning of the warning notes

The following warning notes are used in this document to notify users of possible dangers. The meanings of the warning notes are defined as follows:

Alert icon	Signal word	Consequences in case of nonobservance
⚠	WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠	CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in injury. It may also be used to alert against unsafe practices.
	NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in damage to the product or environment.

3.2 Trademarks

- HART® is a registered trademark of HART Communication Foundation.
- DrägerService® is a registered trademark of Dräger.
- Dräger Polytron® is a registered trademark of Dräger.

4 For your safety

4.1 General safety statements

- **Safe connection of electrical devices:** Never connect this instrument to other electrical devices as mentioned in the IFU before consulting the manufacturer or an expert.
- **Using the product in areas subject to explosion hazards:** Instruments or components for use in explosion-hazard areas which have been tested and approved according to national, European or international Explosion Protection Regulations may only be used under the conditions specified in the approval and with consideration of the relevant legal regulations.
- The instruments or components may not be modified in any manner.
- The use of faulty or incomplete parts is forbidden.
- The appropriate regulations must be observed at all times when carrying out repairs on these instruments or components.
- Before using this product, carefully read these Instructions for Use and those of the associated products.
- Strictly follow the instruction for use. The user must fully understand and strictly observe the instructions. Use the product only for the purposes and under the conditions specified in the Instructions for Use.
- Comply with all local and national laws, rules, and regulations associated with this product.

– Only trained and competent personnel are permitted to inspect, repair and service the product as detailed in these instructions for use. Further maintenance work that is not detailed in these instructions for use must only be carried out by Dräger or personnel qualified by Dräger.
– Dräger recommends a Dräger service contract for all maintenance activities and that all repairs are carried out by Dräger.
– Use only genuine Dräger spare parts and accessories. Otherwise the proper functioning of the product may be impaired.
– The flameproof / explosion proof joints are not in accordance with the relevant minimum or maximum values of EN/IEC 60079-1. The joints are not intended to be re-worked by the user.
– Do not dispose of the Safety Manual. Ensure that they are retained and appropriately used by the equipment user.

Polytron® 8100 EC-specific:

– **WARNING**: Risk of ignition of flammable or explosive atmospheres! Substitution of components may impair Intrinsic Safety.

5 Field of application

This Safety Manual refers to the herein considered models of the product family Polytron 8xx0 gas transmitters for stationary, continuous monitoring of gases and vapours in a suitable atmosphere.

– Polytron 8100 EC gas transmitter monitors the concentration of toxic gases and vapours or oxygen.
– Polytron 8200 CAT DQ/LC gas transmitter monitors the concentration of combustible gases and vapors containing hydrocarbons and/or H_2.
– Polytron 8700 IR 334/340 gas transmitter monitors the concentration of combustible gases and vapors containing hydrocarbons.
– Polytron 8720 IR gas transmitter monitors the concentration of carbon dioxide.
– Polytron 8900 UGLD gas transmitter monitors the ultrasonic signals caused by gas leaks.

The gas transmitter uses microprocessor technology to monitor the gas concentration and update the outputs accordingly. Depending on the model, the outputs are

1. one 4 to 20 mA analogue signal output, where 4 mA represents 0 % of configured range and 20 mA represents 100 % of configured range.
2. two alarm relays and a fault relay output, additionally to the above mentioned 4 to 20 mA output.

The gas transmitter is designed for one-man calibration and offers a variety of diagnostics and self test features. Different measured gases are listed in an internal gases library (only Polytron 87x0). For all these gases, an individual linearization of the output signal corresponding to the measured gas concentration is provided. Configuration and calibration are menu guided and easy to perform, using a HART® handheld terminal or HMI of the Polytron 8xx0 product family.

The safety manual is referring to the following models of Polytron 8xx0 product family:

Model	Software release
Dräger Polytron 8100 EC	≥ 1.2
Dräger Polytron 8200 CAT DQ	≥ 1.1
Dräger Polytron 8700 IR Type 334	≥ 1.1
Dräger Polytron 8700 IR Type 340	≥ 1.1
Dräger Polytron 8720 IR	≥ 1.1
Dräger Polytron 8900 UGLD	≥ 2.0.10
Dräger Polytron 8200 CAT LC	≥ 3.0.3

Model Dräger Polytron 8100 EC	Part No.
Dräger Polytron 8100 EC d A 4-20/HART	8344403
Dräger Polytron 8100 EC d A 4-20/HART relay	8344404
Dräger Polytron 8100 EC d S 4-20/HART	8344412
Dräger Polytron 8100 EC d S 4-20/HART relay	8344413
Dräger Polytron 8100 EC e A 4-20/HART	8344421
Dräger Polytron 8100 EC e A 4-20/HART relay	8344422
Dräger Polytron 8100 EC e S 4-20/HART	8344800 ETR 050I
Dräger Polytron 8100 EC e S 4-20/HART relay	8344800 ETR 050J

Model Dräger Polytron 8200 CAT DQ	Part No.
Dräger Polytron 8200 CAT DQ d A 4-20/HART	8344439 XTR 0410
Dräger Polytron 8200 CAT DQ d A 4-20/HART relay	8344440 XTR 0411
Dräger Polytron 8200 CAT DQ d S 4-20/HART	8344448 XTR 0510
Dräger Polytron 8200 CAT DQ d S 4-20/HART relay	8344449 XTR 0511
Dräger Polytron 8200 CAT DQ e A 4-20/HART	8344457 XTR 041I
Dräger Polytron 8200 CAT DQ e A 4-20/HART relay	8344458 XTR 041J
Dräger Polytron 8200 CAT DQ e S 4-20/HART	8344466 XTR 051I

Model Dräger Polytron 8200 CAT DQ	Part No.
Dräger Polytron 8200 CAT DQ e S 4-20/HART relay	8344800 XTR 051J
Dräger Polytron 8200 Re DQ e A 4-20/HART	8344800 XTR 041I
Dräger Polytron 8200 Re DQ e A 4-20/HART relay	8344800 XTR 041J
Dräger Polytron 8200 Re DQ e S 4-20/HART	8344800 XTR 051I
Dräger Polytron 8200 Re DQ e S 4-20/HART relay	8344800 XTR 051J

Model Dräger Polytron 8200 CAT LC	Part No.
Dräger Polytron 8200 CAT LC d A 4-20/HART	8344800 XTR 0420
Dräger Polytron 8200 CAT LC d A 4-20/HART relay[1)]	8344800 XTR 0421
Dräger Polytron 8200 CAT LC d S 4-20/HART	8344800 XTR 0520
Dräger Polytron 8200 CAT LC d S 4-20/HART relay[1)]	8344800 XTR 0521
Dräger Polytron 8200 CAT LC e A 4-20/HART	8344800 XTR 042I
Dräger Polytron 8200 CAT LC A 4-20/HART relay[1)]	8344458 XTR 042J
Dräger Polytron 8200 CAT LCe S 4-20/HART	8344800 XTR 052I
Dräger Polytron 8200 CAT LC e S 4-20/HART relay[1)]	8344800 XTR 052J
Dräger Polytron 8200 Re LC e A 4-20/HART	8344800 XTR 042I
Dräger Polytron 8200 Re LC e A 4-20/HART relay[1)]	8344800 XTR 042J
Dräger Polytron 8200 Re LC e S 4-20/HART	8344800 XTR 052I
Dräger Polytron 8200 Re LC e S 4-20/HART relay[1)]	8344800 XTR 052J

1) Relay shall not be used for safety functions, please refer to section 10.6.2.

Model Dräger Polytron 8700 IR 334	Part No.
Dräger Polytron 8700 IR 334 d A 4-20/HART	8344601
Dräger Polytron 8700 IR 334 d A 4-20/HART relay	8344602
Dräger Polytron 8700 IR 334 d S 4-20/HART	8344610
Dräger Polytron 8700 IR 334 d S 4-20/HART relay	8344611
Dräger Polytron 8700 IR 334 e A 4-20/HART	8344619
Dräger Polytron 8700 IR 334 e A 4-20/HART relay	8344620
Dräger Polytron 8700 IR 334 e S 4-20/HART	8344800 ITR 051I
Dräger Polytron 8700 IR 334 e S 4-20/HART relay	8344800 ITR 051J
Dräger Polytron 8700 Re 334 e A 4-20/HART	8344800 ITR 041I
Dräger Polytron 8700 Re 334 e A 4-20/HART relay	8344800 ITR 041J
Dräger Polytron 8700 Re 334 e S 4-20/HART	8344800 ITR 051I
Dräger Polytron 8700 Re 334 e S 4-20/HART relay	8344800 ITR 051J

Model Dräger Polytron 8700 IR 340	Part No.
Dräger Polytron 8700 IR 340 d A 4-20/HART	8344637
Dräger Polytron 8700 IR 340 d A 4-20/HART relay	8344638
Dräger Polytron 8700 IR 340 d S 4-20/HART	8344800 ITR 0520
Dräger Polytron 8700 IR 340 d S 4-20/HART relay	8344800 ITR 0521
Dräger Polytron 8700 IR 340 e A 4-20/HART	8344655
Dräger Polytron 8700 IR 340 e A 4-20/HART relay	8344656
Dräger Polytron 8700 IR 340 e S 4-20/HART	8344800 ITR 052I
Dräger Polytron 8700 IR 340 e S 4-20/HART relay	8344800 ITR 052J

Model Dräger Polytron 8700 IR 340	Part No.
Dräger Polytron 8700 Re 340 e A 4-20/HART	8344800 ITR 042I
Dräger Polytron 8700 Re 340 e A 4-20/HART relay	8344800 ITR 042J
Dräger Polytron 8700 Re 340 e S 4-20/HART	8344800 ITR 052I
Dräger Polytron 8700 Re 340 e S 4-20/HART relay	8344800 ITR 052J

Model Dräger Polytron 8720 IR	Part No.
Dräger Polytron 8720 IR d A 4-20/HART	8344709
Dräger Polytron 8720 IR d A 4-20/HART relay	8344710
Dräger Polytron 8720 IR d S 4-20/HART	8344800 ITR 0550
Dräger Polytron 8720 IR d S 4-20/HART relay	8344800 ITR 0551
Dräger Polytron 8720 IR e A 4-20/HART	8344727
Dräger Polytron 8720 IR e A 4-20/HART relay	8344728
Dräger Polytron 8720 IR e S 4-20/HART	8344800 ITR 055I
Dräger Polytron 8720 IR e S 4-20/HART relay	8344800 ITR 055J
Dräger Polytron 8720 Re e A 4-20/HART	8344800 ITR 045I
Dräger Polytron 8720 Re e A 4-20/HART relay	8344800 ITR 045J
Dräger Polytron 8720 Re e S 4-20/HART	8344800 ITR 055I
Dräger Polytron 8720 Re e S 4-20/HART relay	8344800 ITR 055J

Model Dräger Polytron 8900 UGLD	Part No.
Dräger Polytron 8900 UGLD d S 4-20/HART relay	8328030 ETR 0521

6 Assumptions and restrictions for usage of the gas transmitter

6.1 General

For proper installation, operation, maintenance and calibration of the gas transmitter and its accessories strictly follow the instructions for use as well as the assembly instructions for accessories.

See instructions for use for information about assembly and functional description, operating conditions and interface specification.

6.2 Trainings

For available trainings contact DrägerService®

6.3 Installation

The parameterisation of the gas transmitter must be checked after installation. Also a calibration and a proof test (see 7 Proof test) have to be executed. The user has to ensure that the requirements regarding supply voltage and power consumption, as well as the 4 to 20 mA loop requirements are within the specified range. The accuracy of gas measurement is dependent upon ambient parameters. See Instructions for Use for details and measuring performance.

6.4 Maintenance

The reason for repeated maintenance of the gas transmitter is to ensure the safety function of the instrument. Therefore the functionality, the calibration and the parameterisation of the gas transmitter have to be checked at regular intervals taking into account the application requirements.

6.5 Calibration

For calibration ensure that only approved and certified calibration gas is used in accordance with the internal parameterization of the gas transmitter.

If the deviation of the calibration result is outside the corresponding limits listed in the Instructions for use, the following actions are recommended to be performed:

– Check if the optical surface areas have not been contaminated (only Polytron 87x0 IR).
– Check the leak tightness of the calibration equipment.
– Check filters and/or chemical converters.
– Ensure proper calibration gas flow.
– Rerun the calibration.

See Instruction for Use for calibration procedure.

6.6 Replacement

If a gas transmitter needs to be replaced (for repair or exchange), the parameterisation of the replacing gas transmitter must be checked. A calibration and a proof test have to be executed. The time assumed for replacement is eight hours.

⚠ CAUTION
SIL status is not activated by default.
The SIL status must be activated.
► Activate the SIL status within the menu of the transmitter.

6.7 Hardware and/or SW Configuration

The gas transmitter is configurable over a wide range of settings. If any setting is changed the parameters must be confirmed by the authorized personal. Check all parameters listed on the confirmation screen.

⚠ CAUTION
Not all interfaces are SIL-compliant.
The usage of the HART signal and the usage of the serial output signal is not allowed in SIL-related applications.
► Only the following outputs may be used in SIL 2 applications:
  – 4 to 20 mA
  – Relays

6.8 Use of Accessories

Use only original accessories. For installation information, Part No. and description, see instructions for use.

6.9 Access Rights option

Three levels of access rights and related user groups of different qualification are distinguished.

– Operator – Shall not know any password to unlock the Polytron 8xx0 for calibration or modification of parameters.
– Calibration personnel – Knows the password for calibration to unlock the Polytron 8xx0 for calibration purposes and to lock it again after successful calibration. Additionally he can see some parameters but he cannot change any safety-related parameters.
– Parameterization personnel – Knows the password to unlock the Polytron 8xx0 for modification and parameterization of safety-related parameters. Additionally he/she can see and modify all the other parameters too and can make a calibration.

7 Proof test

All safety-related data are based on repeated proof tests performed at regular intervals, provided that the proof tests have been successful. Proof testing is an essential part of functional safety because this is the only way to reveal dangerous undetected failures. The compliance with these proof test intervals is under the responsibility of the user of the safety equipment. During the proof test the functional safety is affected and must be ensured by other measures, also organisational measures, or the safety instrumented system needs to be forced and maintained in a safe state.

NOTICE
Not only the gas transmitter needs to be tested, but the safety function of the whole safety instrumented system.

The proof test consists of the following steps, as described in the following chapters.

7.1 Proof test frequencies

Suitable intervals for inspection and maintenance have to be defined according to the desired application and the SIL capability. It has to be taken into account that the calibration intervals may be part of the characterization of the SIL capability.

Test	Frequency per week	Frequency per year
Visual inspection proof test	1[1)]	52[1)]
Gas response proof test[2)]		Shall be determined application dependent.
Test of the 4 to 20 mA output		1
Test of the relay outputs		Shall be determined application dependent.
Ultrasound Response Proof Test[3)]		Shall be determined application dependent.

1) EN 50402, 5.2.4, SIL2 application: Must not be exceeded if the transmitter contains filter or chemical converters.
2) For Dräger Polytron 8900 UGLD replaced by “Ultrasound Response Proof Test”
3) Dräger Polytron 8900 UGLD only

7.2 Visual inspection proof test

Visual inspection of the Polytron 8xx0 gas detector shall be conducted weekly to confirm that no external blockage of gas/vapor path into the sensing chamber exists, e. g. debris, trash, snow, mud, external equipment, etc. Corrective action shall include removal of such impediments should they exist. All gas detectors must be inspected to ensure that they are capable of providing expected performance and protection. Application dependent, shorter proof test interval may be necessary.

1. If necessary, remove protective equipment (splash guard, etc.).
2. Check if external blockage of gas/vapor path into the sensing chamber exists, e. g. debris, trash, snow, mud, external equipment, etc.
3. Remove such impediments should they exist.
4. Check the status LEDs/Display.

7.3 Gas response proof test

7.3.1 Gas response test 1

Gas response test 1 consists of the following steps:

1. Bypass the safety PLC or take other appropriate action to avoid a false trip (i. e. inhibit alarms).
2. Apply an adequate gas concentration to reach the desired alarm value(s) (A1, A2), in order to verify that:
   – Configuration 4 to 20 mA: The analog output current is equal to applied gas concentration within an acceptable, application-specific tolerance.
   – Configuration relay: The corresponding Alarm relay will be de-energized.

   This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.

   ℹ The relay reaction is configuration-dependent. Alarm acknowledgement could be required after the gas concentration has reached a “non-alarm” concentration to reset the alarm state.
3. Repeat step 2 for every alarm value.
4. Restore the loop to full operation.
5. Remove the bypass from the safety PLC or otherwise restore normal operation.

This test detects approximately 50% of possible “dangerous undetected (du)” failures in the transmitter.

7.3.2 Gas response test 2

Gas response test 2 consists of the following steps:

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Perform a two-point calibration of the transmitter (Zero and Span calibration).
3. Perform Proof Test 1.
4. Restore the loop to full operation
5. Remove the bypass from the safety PLC or otherwise restore normal operation.

This test will detect more than 90 % of possible “du” failures in the transmitter.

7.4 Test of the 4 to 20 mA output

Test of the 4 to 20 mA output will check the correct setting of the 4 to 20 mA output.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Send a command to the transmitter to set the output current above the desired alarm value to verify that the analog current reaches that value.
3. Send a command to the transmitter to go above the low alarm current output and verify that the analog current reaches that value.
4. Restore the loop to full operation.
5. Remove the bypass from the safety PLC or otherwise restore normal operation.

7.5 Test of the relay outputs

Test of the relay output will check the correct function of the relay outputs.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Check the “A1” relay by using the test function.
3. Check the “A2” relay by using the test function.
4. Check the “Fault” relay by using the test function.
5. Restore the loop to full operation.
6. Remove the bypass from the safety PLC or otherwise restore normal operation.

7.6 Ultrasound Response Proof Test

7.6.1 Ultrasound response test 1

Ultrasound response test 1 consists of the following steps.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip (i. e. inhibit alarms).
2. Apply an adequate ultrasound level to reach the desired alarm value(s) (A1, A2), in order to verify that:
   – Configuration 4 to 20 mA: The analog output current is equal to applied ultrasound level within an acceptable, application-specific tolerance.
   – Configuration Relay: The corresponding Alarm relay will be de-energized.

   This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.

   ℹ The relay reaction is configuration-dependent. Alarm acknowledgment could be required after the gas concentration has reached a “non alarm” concentration to reset the alarm state.
3. Repeat step 2 for every alarm value.
4. Restore the loop to full operation.
5. Remove the bypass from the safety PLC or otherwise restore normal operation.

This test will detect approximately 50% of possible “dangerous undetected (du)” failures in the transmitter.

7.6.2 Ultrasound response test 2

Ultrasound response test 2 consists of the following steps.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Perform a two-point calibration of the transmitter (Zero and Span calibration).
3. Perform Proof Test 1.
4. Restore the loop to full operation
5. Remove the bypass from the safety PLC or otherwise restore normal operation.

This test will detect more than 90 % of possible “du” failures in the transmitter.

8 Safety relevant parameters

8.1 Safety relevant parameters

Parameter	Confirmation Screen	
Gas settings		
Measured gas	**Gas**	Selected measured gas (e. g. “Methane”)
LEL category	**Category**	Three categories available 1: NIOSH, 2: “IEC”, 3: “PTB”
Measured gas unit	**Unit**	Selected gas unit (e. g. “%LEL”)
Range	**Range**	Selected measuring range
LEL of measured gas	**LEL gas**	Gas concentration in Vol.-% where the Lower Explosion Limit (LEL) is 100 % depending on national or regional regulations.
	LEL gas default	Default gas concentration in Vol.-% where the Lower Explosion Limit (LEL) is 100 % depending on national or regional regulations.
Capture limits	**Negative capture** **Positive capture**	Clamping of measurements in range of the capture offset value + positive/negative capture for both display and current output.
Capture value	**Capture offset**	Concentration, where the capture value is active. Smoothing of measurements close to the capture offset value for both display and current output.
Calibration gas	**Calibration gas**	Selected calibration gas (e.g. “Methane”).
	Calibration unit	Selected unit for calibration gas concentration (e.g. “Vol.-%”).
	LEL cal. gas	Calibration gas LEL conversion factor.
Calibration gas concentration	**Not listed**	Concentration of calibration gas. The user has to check the parameter against labelling of the calibration gas cylinder.
	Sensor test	Enables and disables the sensor selftest of the electrochemical sensor. Must be activated for SIL applications.

Parameter	Confirmation Screen	
Gas settings		
Sensorlock	**Sensor lock**	If Sensor lock is activated, the Polytron 8100 EC checks a replaced sensor against the previous installed sensor. For Polytron 8100 EC a different sensor part number will be rejected. For Polytron 8700 IR a PIR 7000 transmitter with a different wavelength will be rejected if Sensor lock is activated.

Parameter	Confirmation Screen	
Relays		
Alarm enable/disable	**Alarms**	When Alarms are set to disabled, the alarm logic is disabled.
Alarm concentration	**A1 alarm** **A2 alarm**	Gas concentration in configured unit, where the alarm will be activated.
Hysteresis	**A1 hysteresis** **A2 hysteresis**	Concentration bandwidth, where the alarm is valid after it has been activated.
Alarm mode	**A1 latching** **A2 latching**	Latching – not latching: In non-latching mode, the alarm status clears if the gas concentration does not meet the alarm condition anymore.
	A1 direction **A2 direction**	Rising – falling: Configuring whether the alarm should be triggered by a rising or falling gas concentration.
	A1 acknowledge **A2 acknowledge**	Acknowledgeable – not acknowledgeable: In Acknowledgeable configuration, the alarm relay can be reset, before alarm conditions clear.
	A1 relay **A2 relay**	Normally energized – energized: “Normally energized” means, the relay coil is energized if the alarm condition is not met. Due to this, a power fail will lead to an alarm.

⚠ WARNING
No alarm indication
The capture range may block out the alarm value.
► The capture value must be lower than the alarm value.
► The capture range values must not interfere with the alarm value.

⚠ CAUTION
Malfunction of the instrument due to incorrect parameterization
Parameterization could be carried out incorrectly.
► Correct parameterization must be checked by a gas proof test.

ℹ Default configuration parameter are device- and sensor-dependent. Refer to the Instruction for use and sensor data-sheet for further information.

9 Conditions of use

9.1 General

– Local, state, national laws and regulations that govern the installation of gas monitoring equipment have to be complied with strictly.
– Strict compliance must be given to the electrical codes that govern the routing and connection of electrical power and signal cables to gas monitoring equipment.
– For non-conduit installations, an approved cable gland must be used (e.g. Hawke A501/421/A/¾" NPT or equivalent)
– The physical data of the gas or vapor to be detected and the specifics of the application, (e.g. possible leaks, air movement/draft, etc.) must be taken into account.
– The future use of accessories and maintenance equipment must be kept in mind.
– The access of the gas or vapor to the sensor must not be obstructed.
– Only properly trained personnel may use and service this equipment. For available trainings contact DrägerService®.
– For combustible applications, an alarm set point ≤40 %LEL is recommended.

9.2 Access restrictions

⚠ CAUTION
Unintentional or unauthorized manipulation of the instrument
To prevent manipulations, Polytron 8xx0 must be locked.
► Use the provided password function to lock Polytron 8xx0.
► The end user must ensure that only personnel qualified for calibration may know the password to unlock the Polytron 8xx0 for calibration.
► The end user must ensure that only personnel qualified for parameterization know the password to unlock the device for parameterization.

9.3 SIL activation

⚠ CAUTION
SIL status is not activated by default.
The SIL status must be activated.
► Activate the SIL status within the menu of the transmitter.

9.4 Proof tests

⚠ CAUTION
Impaired measurement performance
Standards require proof tests at regular intervals.
Environmental influences and application changes may have negative influence on measurement and signaling performance.
► Proof tests shall be performed at regular intervals.
► The proof test interval shall be determined with respect to the application.

9.5 Filters

Filters and chemical converters required for the safety function shall be checked frequently. The test interval depends on the application and the environmental conditions.

⚠ WARNING
Impaired measurement performance
Installation of filters and chemical converters may affect sensitivity, gas response time and/or cross sensitivity.
Filters may increase the gas response time and therefore the time to alarm.
Filters have a limited capacity.
► Check filters on a regular basis.
► Exchange filters if they are dirty.
► The exchange interval is application-dependent.

ℹ For EN50402 compliance, the test interval must not exceed 1 week.

9.6 Relays

⚠ CAUTION
Damage to relays and relay malfunction
Too much load can damage relays.
► The relays must be externally fused with a 3 A fuse and operated normally energized.

ℹ For firmware version <= 2.0.:
The fault relay indicates the special state fault only. Other special states should be monitored via the 4 to 20 mA output.

9.7 4 to 20 mA output

⚠ CAUTION
Impaired fault signal
Standards require a clearly distinguishable fault signal.
Signals must be clearly distinguishable. The distance between other signals and the fault signal is crucial.
► Ensure that the fault signal is configured lower than 1.2 mA.

ℹ The analog offset correction of the 4 to 20 mA output is limited ±0.1 mA, if SIL is activated.

9.8 Polytron 8100 EC

⚠ WARNING
Sensor unfit for dedicated field of application
Dräger provides sensors for various applications.
► Refer to the applicable sensor data-sheet for detailed information and constraints in safety-related applications.
► Contact Dräger to ensure suitability of the electrochemical sensor in the specific safety-related application.

⚠ CAUTION
Sensor poisoning
Certain substances in the atmosphere to be monitored can impair the sensitivity of the EC sensor.
► Refer to the applicable sensor data-sheet for detailed information.

⚠ CAUTION
Incorrect operation of EC sensors
Polytron 8100 EC offers a range of EC sensor-specific menu functions. For SIL-related operations, the following settings and precautions must be kept.
► Dongle with functionality sensor test must be installed.
► Sensor test must be enabled.
► Configured range must be ≥ sensor default range.
► Sensor lock must be enabled.
► Exchange of sensor must be done via menu “change sensor”

9.9 Polytron 8200 CAT DQ/LC

9.9.1 Poisoning substances

Certain substances in the atmosphere to be monitored can impair the sensitivity of the catalytic bead sensor. The following are known at present:

1. Polymerizing substances such as ethylene oxide, acrylonitrile, butadiene, styrene.
2. Catalyst poisons such as sulphur and phosphorous compounds, halogenated hydrocarbons, silicon compounds and metal vapors.

⚠ WARNING
Sensor poisoning
Certain substances in the atmosphere to be monitored can impair the sensitivity of the catalytic bead sensor.
► Ensure that no poisoning substances in the application exist.

9.9.2 Required O_2 concentration

Catalytic bead sensors require a minimum oxygen concentration to work properly.

⚠ WARNING
Sensor malfunction
Catalytic sensors need oxygen (O_2) to work properly. If O_2 concentrations are too low, a catalytic reaction is not possible.
► Ensure that O_2 concentrations are ≥12 Vol.-%.

9.9.3 Protection against ambiguous measurement values

If the non-ambiguity of the measured values of the whole apparatus at gas concentrations above the upper limit of the measuring range (e.g. when catalytic sensors are used) is affected by transmission errors the apparatus shall pass over to a defined latching special state. If this is not handled by the gas detection controller the setting „***DD sensor Latching***“ must be activated.

9.10 Polytron 8700 IR 334/340

ℹ The PIR 7x00 may not be configured stand-alone.

9.11 Polytron 8720 IR

ℹ The PIR 7x00 may not be configured stand-alone.

9.12 Polytron 8900 UGLD

⚠ CAUTION
Incorrect operation of UGLD sensor
Polytron 8900 UGLD offers a range of UGLD sensor-specific menu functions. For SIL-related operations, the following settings and precautions must be kept.
► Dongle with functionality sensor test must be installed.
► Sensor test must be enabled.
► Configured range must be ≥ sensor default range.
► Sensor lock must be enabled.
► Exchange of sensor must be done via menu “change sensor”.
► Adjust the UGLD sensor to the specific background noise.

10 Safety functions

10.1 General

The gas detector Polytron 8xx0 shall monitor gas concentrations of combustible or toxic gases and vapors or CO_2 or O_2 in the ambient air or ultrasound emitted by gas leaks by using different sensor technologies and set the outputs based on this monitoring.

The output consists of

1. A 4 to 20 mA output that reflects the gas concentration where
   4 mA represents 0 % of range
   20 mA represents 100 % of range
2. 2 alarm relays with configurable alarms. The relay will be switched when gas concentration / ultrasound level exceeds the configured threshold value.
   1 fault relay.

10.2 Safety accuracy

Fail-safe State	
4 to 20 mA configuration	The fail-safe state is defined as the instrument sets the analog output in the failure information range according to Namur NE43.
Relay	The fail-safe state is defined as the instrument sets the fault relay to the de-energized state. The fault relay is normally energized. Recommended wiring: Normally open contact

Definition Fail Dangerous: Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state) or deviates the output measurement value more than 20 % of full scale.The deviation between measured value and true concentration can exceed above errors, depending on application conditions. Definition failure information range: The failure information range is defined as the signal bands of ≤ 3.5 mA and ≥ 21 mA.

10.3 Failure rates

10.3.1 Assumptions

The following assumptions have been made during the Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the gas transmitters Polytron 8100 EC, Polytron 8200 CAT DQ/LC, Polytron 8700 IR 334/340, Polytron 8720, and Polytron 8900 UGLD.

– Failure rates are constant, wear out mechanisms are not included.
– Propagation of failures is not relevant.
– Failures during parameterization are not considered.
– Sufficient tests are performed prior to shipment to verify the absence of vendor and/or manufacturing defects that prevent proper operation of specified functionality to product specifications or cause operation different from the design analyzed.
– Materials are compatible with process conditions.
– The instrument is locked against unintended operation/modification.
– External power supply failure rates are not included.
– The mean time to restoration (MTTR) after a safe failure is 8 hours.
– The test time of a connected safety PLC to react on a dangerous detected failure and bring the process to the safe state is 1 hour.
– The 4 to 20 mA output signal is fed to a SIL 2 compliant analogue input board of a safety PLC.
– The listed failure rates are valid for operating stress conditions typical of an industrial environment similar to IEC 60654-1 class C (sheltered location) with temperature limits within the manufacturer's rating and an average temperature over a long period of time of 40 °C (25 °C ambient temperature plus internal self heating). For a higher average temperature of 60 °C, the failure rates should be multiplied with an experience-based factor of 2.5. A similar multiplier should be used if frequent temperature fluctuation (daily fluctuation of > 15 °C) must be assumed. Humidity levels are assumed within manufacturer's rating.
– Only the described versions are used for safety applications.
– The application program in the safety logic solver is configured according to NAMUR NE43 to detect under-range and over-range failures and does not automatically trip on these failures; therefore these failures have been classified as dangerous detected failures.
– General necessary gas detection tests have successfully been passed.

10.3.2 Useful lifetime

Although a constant failure rate is assumed by the probabilistic estimation method, this only applies provided that the useful lifetime of components is not exceeded. Beyond their useful lifetime the result of the probabilistic calculation method is therefore meaningless, as the probability of failure significantly increases with time. The useful lifetime varies and is highly dependent on the component itself and other factors, including but not limited to its operating frequency and conditions – temperature in particular.

This assumption of a constant failure rate is based on the "bathtub curve", which shows the typical behavior for the electronic components. Therefore it is obvious that the PFD_{AVG} calculation is only valid for components which have this constant domain and that the validity of the calculation is limited to the useful lifetime of each component. The experience-based useful lifetime is usually between 8 and 12 years.

10.3.3 PFD calculation

The shown PFD values have been calculated using a complex formula. Calculations using formulas of IEC 61508, Part 6, chapter 3.2.2. differ but may be used.

10.4 Polytron 8100 EC

10.4.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault and maintenance signal may be configured as follow.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	yes
3.4	Maintenance signal	yes
> 21	Defect in analogue interface	---

ℹ For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3,6 mA
Architecture	1oo1
MTBF	50 years
Useful lifetime (maximum, 10.3.2)	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetecte[1)]d	0
λ_{DD} Fail dangerous detected	1538
λ_{DU} Fail dangerous undetected	125
λ_{AU} Fail annunciation undetected	15

Safe failure fraction (SFF)	92.4 %
DC_D	92.4 %

PFD_{AVG} (T[Proof] = 1 year)	1.08 E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

Operation in current sink operation

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	1531
λ_{DU} Fail dangerous undetected	123
λ_{AU} Fail annunciation undetected	15

Safe failure fraction (SFF)	92.5 %
DC_D	92.5 %

PFD_{AVG} (T[Proof] = 1 year)	1.06E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

10.4.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

ℹ For detailed information see Instruction for use.

ℹ For further information see: "Safety relevant parameters", page 9.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Fault relay will be de-energized
Architecture	1oo1
MTBF	48 years
Useful lifetime (maximum, 10.3.2)	10 years

Failure rate

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected	542
λ_{DD} Fail dangerous detected	1062
λ_{DU} Fail dangerous undetected	165
λ_{AU} Fail annunciation undetected	38
Safe failure fraction (SFF)	90.6 %
DC_D	86.5 %
PFD_{AVG} (T[Proof] = 1 year)	1.40E-03

10.5 Polytron 8200 CAT DQ

10.5.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault and maintenance signal may be configured as follow.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	yes
3.4	Maintenance signal	yes
> 21	Defect in analogue interface	---

ℹ For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3,6 mA
Architecture	1oo1
MTBF	29 years
Useful lifetime (maximum, 10.3.2)	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λ_{SD} fail-safe detected	0
λ_{SU} fail-safe undetected[1)]	0
λ_{DD} fail dangerous detected	3301
λ_{DU} fail dangerous undetected	211
λ_{AU} fail annunciation undetected	14
Safe failure fraction (SFF)	94.0 %
DC_D	94.0 %
PFD_{AVG} (T[Proof] = 1 year)	1.84E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

Operation in current sink operation

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	3294
λ_{DU} Fail dangerous undetected	209
λ_{AU} Fail annunciation undetected	14
Safe failure fraction (SFF)	94.0 %
DC_D	94.0 %
PFD_{AVG} (T[Proof] = 1 year)	1.82E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation

10.5.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

ℹ For detailed information see Instruction for use.

ℹ For further information see: "Safety relevant parameters", page 9.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Fault relay will be de-energized
Architecture	1oo1
MTBF	28 years
Useful lifetime (maximum, 10.3.2)	10 years

Failure rate

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected	841
λ_{DD} Fail dangerous detected	2526
λ_{DU} Fail dangerous undetected	251
λ_{AU} Fail annunciation undetected	37
Safe failure fraction (SFF)	93.1 %
DC_D	91.0 %
PFD_{AVG} (T[Proof] = 1 year)	2.15E-03

10.6 Polytron 8200 CAT LC

10.6.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault and maintenance signal may be configured as follow.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	yes
3.4	Maintenance signal	yes
> 21	Defect in analogue interface	---

ℹ For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3,6 mA
Architecture	1oo1
MTBF	27 years
Useful lifetime (maximum, 10.3.2)	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λ_{SD} fail-safe detected	0
λ_{SU} fail-safe undetected[1)]	0
λ_{DD} fail dangerous detected	3348
λ_{DU} fail dangerous undetected	284
λ_{AU} fail annunciation undetected	14
Safe failure fraction (SFF)	92.0 %
DC_D	88.0 %
PFD_{AVG} (T[Proof] = 1 year)	2.42E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

Operation in current sink operation

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	3340
λ_{DU} Fail dangerous undetected	282
λ_{AU} Fail annunciation undetected	14
Safe failure fraction (SFF)	92.0 %
DC_D	88.0 %
PFD_{AVG} (T[Proof] = 1 year)	2.43E-03

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation

10.6.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

ℹ For detailed information see Instruction for use.

10.7 Polytron 8700 IR 334/340

10.7.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault, maintenance and beam block warning signal may be configured as follows.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	Yes
3.4	Maintenance signal	Yes
2	Beam block warning	Yes
> 21	Defect in analogue interface	---

ℹ For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3,6 mA
Architecture	1oo1
MTBF	56 years
Useful lifetime (maximum, see 10.3.2)	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	1137
λ_{DU} Fail dangerous undetected	65
λ_{AU} Fail annunciation undetected	17
Safe failure fraction (SFF)	94.6 %
DC_D	94.6 %
PFD_{AVG}(T[Proof]=1 year)	5.70E-04

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

Operation in current sink mode

Failure category	Failure rates (in FIT)
λSD Fail safe detected	0
λSU Fail safe undetected[1)]	0
λDD Fail dangerous detected	1130
λDU Fail dangerous undetected	
λAU Fail annunciation undetected	17
Safe failure fraction (SFF)	94.7 %
DCD	94.7 %
PFDAVG (T[Proof] = 1 year)	5.52E-04

1) λSU has been added λDD because of fail low behavior in current sink or current source mode operation.

10.7.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

For further information see: "Safety relevant parameters", page 9.

For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Fault relay will be de-energized
Architecture	1oo1
MTBF	53 years
Useful lifetime (maximum, 10.3.2	10 years

Failure rate

Failure category	Failure rates (in FIT)
λSD Fail safe detected	0
λSU Fail safe undetected	242
λDD Fail dangerous detected	964
λDU Fail dangerous undetected	105
λAU Fail annunciation undetected	41
Safe failure fraction (SFF)	92.0 %
DCD	90.1 %
PFDAVG (T[Proof] = 1 year)	8.99E-04

10.8 Polytron 8720 IR

10.8.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault, maintenance and beam block warning signal may be configured as follows.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	Yes
3.4	Maintenance signal	Yes
2	Beam block warning	Yes
> 21	Defect in analogue interface	---

For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3.6 mA
Architecture	1oo1
MTBF	61 years
Useful lifetime (maximum, 10.3.2	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λSD Fail safe detected	0
λSU Fail safe undetected[1)]	0
λDD Fail dangerous detected	1137
λDU Fail dangerous undetected	65
λAU Fail annunciation undetected	17
Safe failure fraction (SFF)	94.6 %
DCD	94.6 %
PFDAVG (T[Proof] = 1 year)	5.70E-04

1) λSU has been added λDD because of fail low behavior in current sink or current source mode operation.

Operation in current sink operation

Failure category	Failure rates (in FIT)
λSD Fail safe detected	0
λSU Fail safe undetected[1)]	0
λDD Fail dangerous detected	1130
λDU Fail dangerous undetected	63
λAU Fail annunciation undetected	17
Safe failure fraction (SFF)	94.7 %
DCD	94.7 %
PFDAVG (T[Proof] = 1 year)	5.52E-04

1) λSU has been added λDD because of fail low behavior in current sink or current source mode operation.

10.8.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

ℹ For further information see: "Safety relevant parameters", page 9.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Fault relay will be de-energized
Architecture	1oo1
MTBF	53 years
Useful lifetime (maximum, 10.3.2)	10 years

Failure rate

Failure category	Failure rates (in FIT)
λSD Fail safe detected	0
λSU Fail safe undetected	242
λDD Fail dangerous detected	964
λDU Fail dangerous undetected	105
λAU Fail annunciation undetected	41
Safe failure fraction (SFF)	92.0 %
DCD	90.1 %
PFDAVG (T[Proof] = 1 year)	8.99E-04

10.9 Polytron 8900 UGLD

10.9.1 4 to 20 mA current output

The entire valid measurement range for the output signal is between min. 3.8 mA and max. 20.5 mA. Fault and maintenance signal may be configured as follow.

Current [mA]	Meaning	Configurable (0.7 … 3.6 mA)
< 1.2	Fault	yes
3.4	Maintenance signal	yes
> 21	Defect in analogue interface	---

ℹ For detailed information see Instruction for use.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Configured alarm ≤ 3,6 mA
Architecture	1oo1
MTBF	50 years
Useful lifetime (maximum, 10.3.2)	10 years

Operation in current source mode

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	1370
λ_{DU} Fail dangerous undetected	84
λ_{AU} Fail annunciation undetected	92
Safe failure fraction (SFF)	94,2 %
DC_D	94 %
PFD_{AVG} (T[Proof] = 1 year)	7,33E-04

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

Operation in current sink mode

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected[1)]	0
λ_{DD} Fail dangerous detected	1363
λ_{DU} Fail dangerous undetected	82
λ_{AU} Fail annunciation undetected	92
Safe failure fraction (SFF)	94,3 %
DC_D	94 %
PFD_{AVG} (T[Proof] = 1 year)	7,15E-04

1) λ_{SU} has been added λ_{DD} because of fail low behavior in current sink or current source mode operation.

10.9.2 Relay output

The relay output consists of a Fault, an A1 and an A2 relay. A device error will be indicated by switching the fault relay.

⚠ WARNING
Ambiguous readings at over range measuring values
Latching over range alarms are not supported with LC sensors.
For safe operation in accordance with BVS 13 ATEX G 001 X, operate the transmitter when connected to a control unit that has a latching over range indication. Do not use internal alarm relays of the transmitter.

► Make sure that over range latching is active at the control unit.

After over range measuring values, verify that the gas concentration is below 100 %LEL (e.g. using a portable instrument).

ℹ For detailed information see Instruction for use.

ℹ For further information see: "Safety relevant parameters", page 9.

Parameters related to the above safety function

Diagnostic test interval	24 h
Hardware Fault Tolerance (HFT)	0
Component type	Type B
SIL capability	SIL 2
Description of the safe state	Fault relay will be de-energized
Architecture	1oo1
MTBF	48 years
Useful lifetime (maximum, 10.3.2)	10 years

Failure rate relay operation

Failure category	Failure rates (in FIT)
λ_{SD} Fail safe detected	0
λ_{SU} Fail safe undetected	441
λ_{DD} Fail dangerous detected	995
λ_{DU} Fail dangerous undetected	124
λ_{AU} Fail annunciation undetected	115
Safe failure fraction (SFF)	92,0 %
DC_D	88 %
PFD_{AVG} (T[Proof] = 1 year)	1,06E-03

11 Reference documents

Document	Order no
Instructions for Use (en) Dräger Polytron 8xx0 Series	90 33 828
Technical Manual (en) Dräger Polytron 8xx0 Series Ex e version	90 33 345
Technical Manual (en) Dräger Polytron 8xx0 Series Ex d version	90 33 848
Instructions for Use (en) Dräger Polytron 8900 UGLD	90 33 826

12 List of Abbreviations

AU, Annunciation undetected (failure)	An annunciation failure (AU) is defined as a failure that does not directly impact safety but does impact the ability to detect a future fault (such as a fault in a diagnostic circuit). For the calculation of the SFF it is treated as no effect failure and has not been taken into account.
DC_D	Diagnostic Coverage of dangerous failures $DC_D = \lambda_{DD} / (\lambda_{DD} + \lambda_{DU})$
DU	Dangerous Undetected (failure)
FMEDA	Failure Modes, Effects, and Diagnostic Analysis
HART	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
IR	Infrared
Low demand mode	Mode, where the frequency of demands for operation made on a safety-related system is no greater than one per year and no greater than twice the proof test frequency.
MTBF	Mean time Between Failure
MTTR	Mean time To Restoration
PFD	Probability of Failure on Demand
PFH	Probability of dangerous Failure per Hour. The term “Probability” is misleading, as IEC 61508 defines a Rate.
PLC	Programmable Logic Controller
SFF	Safe Failure Fraction; summarises the fraction of failures, which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action. $SFF = (\lambda_S + \lambda_{DD}) / (\lambda_S + \lambda_D)$ $\lambda_S = \lambda_{SD} + \lambda_{SU}$ $\lambda_D = \lambda_{DD} + \lambda_{DU}$
SIL	Safety Integrity Level
SIS	Safety Instrumented System
Type B component	“Complex” component (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2
T[Proof]	Proof test interval
UGLD	Ultrasonic Gas Leak Detection

Manufacturer
Dräger Safety AG & Co. KGaA
Revalstraße 1
D-23560 Lübeck
Germany
+49 451 8 82-0

9033307 – 4683.601 enUS
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