Oxygen Transmitter

OXY-ProXT / OXY-ProXT2

User Manual

Revision History

Issue No.	Description	Date	Author Initials
00	New document	09/2025	PS
01	standard output 4-20mA	09/2025	PS
02	Add order codes	10/2025	PS
03	Add OXY-ProXT2	02/2026	PS

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Before using your OXY-ProXT or OXY-ProXT2

OXY-ProXT is a one channel system, while OXY-ProXT2 has 2 channels. Many illustrations in the user manual will show 2 channels, for one channel systems just ignore the instructions for the 2nd channel. OXY-ProXT2 features some dual channel function which will not be present on the OXY-ProXT, see section 2.6

Safety Information

Necessary safety precautions are described in the following chapters and also highlighted using pictographic warnings on yellow background (as above).

The OXY-ProXT and OXY-ProXT2 must not be used for safety critical applications.

For integration into a larger system, the system developer must ensure the correct installation according to this manual and verify the sensor function under application conditions. Installation, initial commissioning, inspection, maintenance, and servicing must be carried out by trained specialists.

Abbreviations

AC	Alternating Current
AM	Additive Manufacturing
Ar	Argon
ch	channel
CO_2	Carbon Dioxide
DC	Direct Current
^oC	Degrees Celsius
^oF	Degrees Fahrenheit
EEPROM	Electrically Erasable Programmable Read-only Memory
ESD	Electrostatic Discharge
g	Grams
GND	Ground
kg	Kilogram
LED	Light Emitting Diode
mA	Milliamp
N2	Nitrogen
PPM	Parts per Million
PELV	Protective Extra Low Voltage
SELV	Safety Extra Low Voltage
ZrO2	Zirconium Dioxide

Contents

1 Introduction

The OXY-ProXT oxygen transmitter measures oxygen (O_2) by means of amperometric zirconium dioxide (ZrO_2) sensors where the volumetric O_2 concentration in gas mixtures is determined. The alarm relay contact will be switched based on a user programmable threshold value.

1.1 Scope of Use

OXY-ProXT is ideal for use in the following applications:

Laboratory / Measuring instrumentation:

- Oxygen meter
- Measurements under controlled O2 content
- Inert gas processing cabinets (glove boxes)
- Incubators (controlled bacterial growth)

Food industry:

- Packaging and controlled food testing

Medical:

- Oxygen concentrators

Industry:

- Nitrogen/Oxygen concentrators
- Additive Manufacturing (AM)
- Inert gas processing machines and cabinets
- Inert gas welding monitoring
- Storage with increased N2 atmosphere (oxidation prevention)
- Drying units

NOTE: The sensors are calibrated and specified for nitrogen balance gas. Argon can also be used as a balance gas; this will slightly affect the system accuracy.

Application limitations are listed below:

- The system must not be used in safety critical applications
- The system is not ATEX-approved because its internal sensor achieves elevated temperatures during normal use (up to ca. 600 °C)
- The use in deviating balance gases e.g. carbon dioxide (CO2) is possible, but potential cross-sensitivities must be considered, please contact SENSORE for more information.
- The sensor is not recommended for use in flammable gases, as local combustion can cause inaccurate (reduced) O_2 concentration readings. If used in flammable gases, the concentration of combustible gases must be negligible to the O_2 concentration.
- The sensor is not suitable for measuring O_2 concentrations in liquids.
- The sensor is not suitable for use with AM plastic powders or filaments.
- The sensor is not suitable for conditions with condensing humidity, and therefore not suitable for outdoor use.

1.2 Feature Overview

- The current-limiting zirconia sensor ensures high accuracy over long-life.
- Smart Sensor with M12 connection
  - Sensor calibration and parameter data are stored in the memory chip of the sensor
  - Upon connection of the sensor the setup is uploaded to the OXY-ProXT transmitter
  - Available with various housing options and measurement ranges
  - Plug and play approach for easy sensor replacement in the end application
- OXY-ProXT transmitter
  - DIN rail mounting for installation inside a control cabinet.
  - Supply via external 24 V DC SELV (safety extra-low voltage) LPS (limited power supply), e.g. NEC Class 2 power supply.
  - Maximum current consumption: 250 mA
- Sensor control circuits
  - Active control of the sensor chip temperature, to compensate for external influences in a temperature range of +10…+100 °C (+50...+212 °F)
  - Sensor current limitation in case of overrange operation, to extend the sensor lifetime
- Diagnostic features to detect possible fault conditions, e.g.:
  - Detection of external wiring issues
  - Monitoring external supply voltage and the internal circuit temperature
- Several signal output options
  - digital: RS485 (Modbus)
  - analog: 4…20 mA output (recommended analog output option)
  - analog: 0…5 V output (fallback option)
  - potential-free relay contact
    alarm level and switching directions can be programmed via RS485

1.3 System Overview based on the two-channel version OXY-ProXT2

For the one channel version OXY-ProXT please ignore the 2nd channel

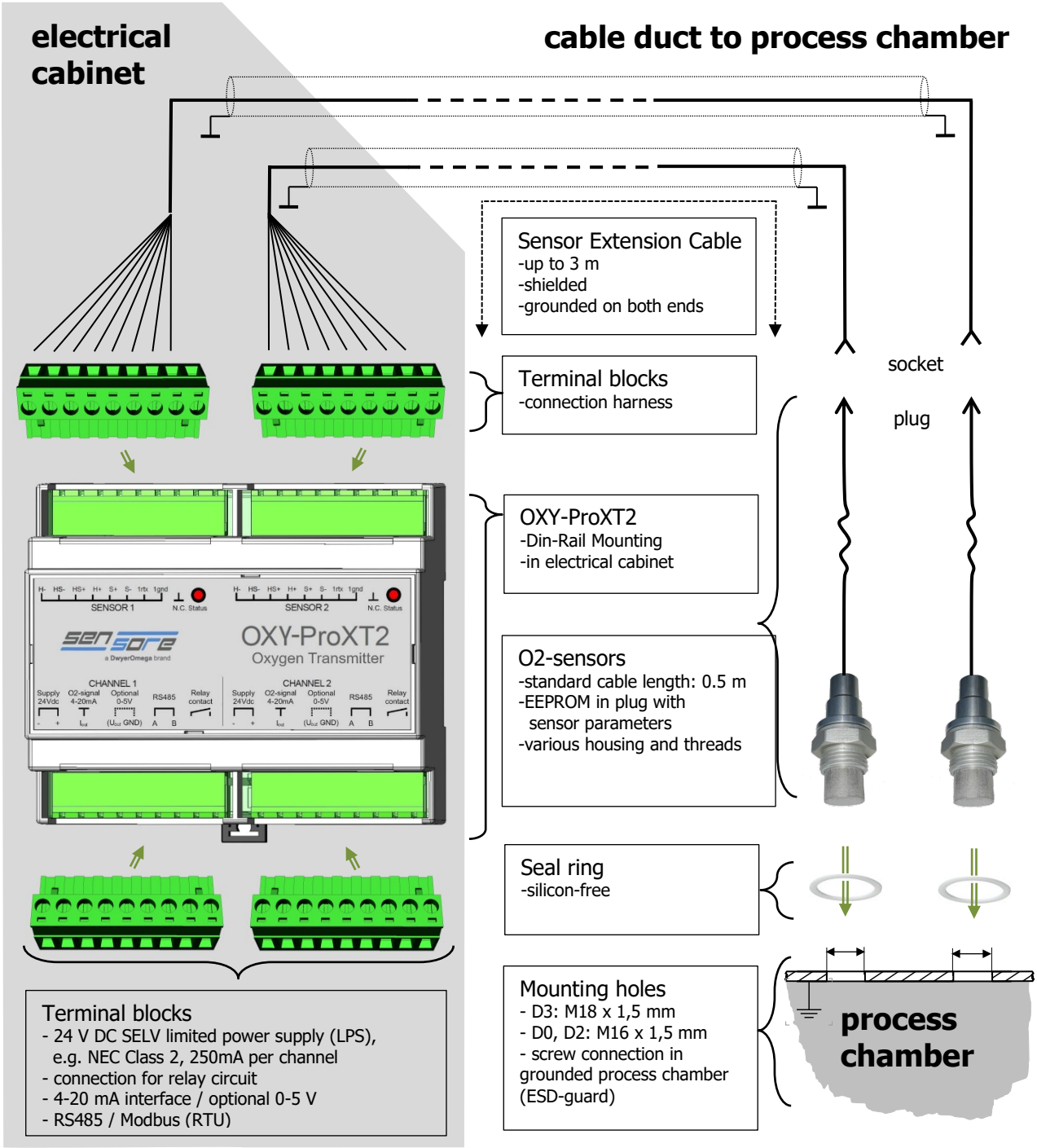


Figure 1. Larger System schematic

The specification for the O_2 measurement is determined by the sensor.

- The design of the sensor chip defines the O_2 measuring range.
- The calibration information is stored in the sensor connector (EEPROM).

2 OXY-ProXT Oxygen Monitoring Functions

The essential operating parameters for the sensors are in a non-volatile memory (EEPROM) on the sensor connector, i.e. there is no need to calibrate the sensors with or match them to a specific monitor.

2.1 O_2 Threshold Detection (Alarm Levels)

It is possible to program an O_2 threshold value to control the potential-free contact pair (relay). The switching direction defines if the relay will close on a rising edge or a falling edge. To avoid unnecessary switching a switching hysteresis must be defined. See section 9.4.4 on how to program the threshold levels / hysteresis via RS485/Modbus.

- Closing on falling edge
  - Activation threshold: If the O2-signal falls below, the contacts will close
  - Deactivation threshold: If the O2-signal rises above, the contacts will open
- Closing on rising edge
  - Activation threshold: If the O2-signal rises above, the contacts will close
  - Deactivation threshold: If the O2-signal falls below, the contacts will open

2.2 Analog Output (4...20mA)

The analog output configuration is a combination of analog O2 signal output 4...20 mA and the analog indication of special conditions (20…20.5 mA). The table below summarizes the scaling of the 4…20 mA for different nominal sensor ranges. By using the digital RS 485 output it is possible to avoid the restrictions of the analog output.

Available sensor ranges	O2 concentration in volumetric % or ppm						
Nominal sensor range*	1000 ppm	1.00 %	2.00 %	5 %	25 %	40.0 %	96.0 %
full scale output (20mA/5V/RS 485)	1200 ppm	1.25 %	2.5 %	6.25 %	25 %	50 %	100 %
Typical Accuracy (nominal range)	20 ppm	100 ppm	200 ppm	500 ppm	0.25 %	0.40 %	1.0 %
Output Resolution (4...20 mA)	< 1 ppm	< 10 ppm	< 20 ppm	< 50 ppm	< 0.025 %	< 0.04 %	<0.1 %
Lower Detection Limit	10 ppm	50 ppm	100 ppm	500 ppm	0.1 %	0.2 %	1.0 %

*Nominal sensor range is the specified maximal O2 concentration, overrange operation should be avoided

Note: full-scale output is usually slightly higher than the nominal sensor range, to provide sufficient overrange when referenced against gas cylinders with roughly nominal O2 concentration. Only 25%-sensors differ as these are usually referenced against (dry) air or 20.9% O2 references mixtures.

Calculation:

$$\text{Measured } O2 = \frac{Iout\ [mA] - 4mA}{16mA} \times \text{full scale output}$$

- Iout is the measuring current of the 4…20 mA current loop
- Current values slightly above 20mA are used to indicate special states and faults
- Special state indication:
  - 20.15 mA Heat up
  - ≥20.2 mA Error
  - ~0.5 mA Over-temperature shutdown (special fault mode).

2.3 Further analog output options (0…5 V, 4…19mA)

Instead of using 4…20 mA for analog signal and using 20…20.5 mA for special conditions, it is also possible to use 4…19 mA for analog signal and 19…20 mA for special conditions/errors, see also section 9.4.5 on how to change this via MODBUS or contact SENSORE to order a customized Smart Sensor. The calculation for 4…19mA output is the same as for 4…20mA, the analog signal will just be cutoff at 19mA, i.e. the actual full-scale range is reduced.

The OXY-ProXT also features a 0…5 V output. To avoid ground loop issues, the 0…5 V should be connected to an isolated analog input. In case of special conditions or errors, the output will be 5 V.

Calculation for 0…5V:

$$\text{Measured } O2 = \frac{Uout\ [V]}{5\text{V}} \times \text{full scale output}$$

- Uout is the measuring current of the 0…5 V voltage output

2.4 Digital Output (RS485/Modbus)

$$\text{Measured } O2 = \frac{O2norm}{1000} \times \text{full scale output}$$

- The digital value "O2norm" is read out via register 0x0002
- The digital value range is cut off at 1250, i.e. an O_2 measurement value is transmitted digitally even if the measuring range is slightly exceeded
- Special states can be read via registers 0x0000
- Further details on RS485/Modbus communication can be found in section 9.

2.5 Status LEDs/System States

Stable (Measurement) States	
LED permanently on	O_2 measurement mode
Temporary States (during start-up)	
LED 0.5s on, 0.5s off	Contact check of the sensors (usually imperceptible 1…2 s)
LED 0.2s on, 0.8s off	Heating phase of the sensors (typically 60-70s s)
Error States that may resolve without intervention	
LED flashing (10 Hz)	Error mode (restart the sensor after 60s)
LED off	Temporary complete extinction of the LED, followed by failure mode, occurs when overtemperature protection mode is activated. => check installation situation / check ambient temperature
Error States that require intervention	
LED 0.5s on, 0.5s off	System gets stuck in contact test => check the connection of the sensors
LED flashing (10 Hz) longer than 60s	No reboot from error mode, after repeated error => see 8.2

2.6 OXY-ProXT2 dual channel functions

Exposing oxygen sensors to a permanent overrange condition will stress the sensor and might reduce the sensor lifetime. This could lead to problems with fine range sensors like 1.25%-range in inertization chambers which are regularly vented with air (~20.9% O2). The OXY-ProXT2 offers a solution to avoid such overrange conditions by activating / deactivating a fine range sensor on channel 2 based on the reading of a coarse range sensor (typically 25% range) on channel 1.

That is why the OXY-ProXT2 is offered in two configurations, which will enable different operation modes:

- **Configuration A**: two independent 25% sensors
  - In this configuration the OXY-ProXT2 will act just like two OXY-ProXT in parallel, without any interaction between the channels.
- **Configuration B**: a 25% sensor (ch 1) will activate/deactivate a 1.25% sensor on ch 2
  - The 1.25% sensor will only be heated up when channel 1 detects an oxygen concentration <1.25% O2 and will be deactivated at higher O2 concentrations. This will reduce stress on the sensor and will improve lifetime.

The system configuration and hence the behavior of the two channels is stored in the **sensor EEPROM** and must be defined upon the ordering of sensors. The standard configurations for the OXY-ProXT2 are listed above, for customized dual range systems it is important to define the following parameters:

Dual range sensor selection:

- Ch1 is usually equipped with a 25% sensor
- For Ch2 the following options are feasible
  - 1% sensor utilized for 0.005-1.25% like in **configuration B**
  - 2% sensor utilized for 0.01-2.5%
  - 5% sensor utilized for 0.05-6.25%

dual range operation parameter:

- 0..independent sensor (dual range function deactivated)
  - Sensors delivered with an OXY-ProXT (single channel) are always configured as independent sensors
  - Will also run on an OXY-ProXT2 but without any dual channel control functionality
- 1…primary sensor for channel 1 (will control a secondary sensor)
  - E.g. a 25% sensor
  - A primary sensor will also work without a connected secondary sensor, and it will also run on an OXY-ProXT
- 2…secondary sensor for channel 2 (will be controlled by a primary sensor)
  - E.g. a 1.25% sensor
  - A secondary sensor connected to an OXY-ProXT2, will only operate on ch2 in parallel with a matching primary sensor on ch1.

Primary sensor – activation/deactivation threshold parameter for the secondary sensor:

- Activation threshold is the O2-level where the sensor on channel 2 is activated.
  - It is typically <1.25% for a 1.25% sensor
  - feasible range for the activation level is 0.25% to 6.25%
- Deactivation threshold is the O2-level where the sensor on channel 2 is deactivated.
  - It is typically >1.5% for a 1.25% sensor, the hysteresis should prevent avoidable activation/deactivation cycles
  - feasible range for the deactivation level is 0.3% to 7.5 %

Please contact SENSORE for customized dual range configurations

3 Installation

Only assemble and install the transmitter when it is powered off and disconnected from the electricity supply.

3.1 Sensor Installation in a Process Chamber

- Silicone-free materials must be provided for sealing.
- The system has been evaluated for applications within gas temperatures ranging from 10…100 °C (50...212 °F). Monitoring oxygen at higher gas temperatures is feasible, but should be discussed with the application engineering team, please contact SENSORE.

Positioning the sensors incorrectly in the process chamber can negatively impact measurement. To avoid this:

- Do not mount sensors in the immediate vicinity of gas inlets or outlets
- Do not place them near heaters/fans or in direct airflow
- Mount on surfaces that will not vibrate.

For oxygen measurement, the gas must pass the sensor's porous sinter cap/disc or the inlet mesh. To facilitate this:

- The sinter cap/disc or the mesh should protrude into the process chamber as much as possible
- Contamination/encrustation of the sinter cap/disc or the inlet mesh must be avoided
- Mounting the sensor upside down should reduce contamination risks.

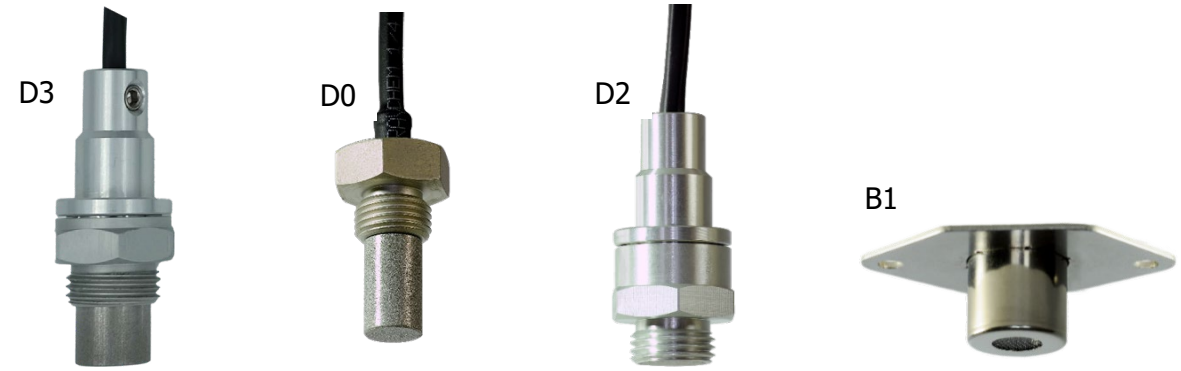


Figure 2. Sensor's porous sinter cap/disc or inlet mesh

If the sensor is located so that its housing is easily accessible to end-users, please note the following:

- During operation, the sensor housing's temperature might exceed 60 °C (140 °F)
  - Sensor housing temperature depends on the selected sensor head design (Figure 2) and the thermal connection to the process chamber.
- Use appropriate warning labels, e.g. "hot surface"

- When the sensor's metal housing is screwed directly into the grounded metal wall of the process chamber, it provides adequate protection against electrostatic discharge (ESD). Refer to Figure 1 for guidance.

3.2 Connection in a Control Cabinet based on OXY-ProXT2

For the one channel version OXY-ProXT please ignore the 2nd channel

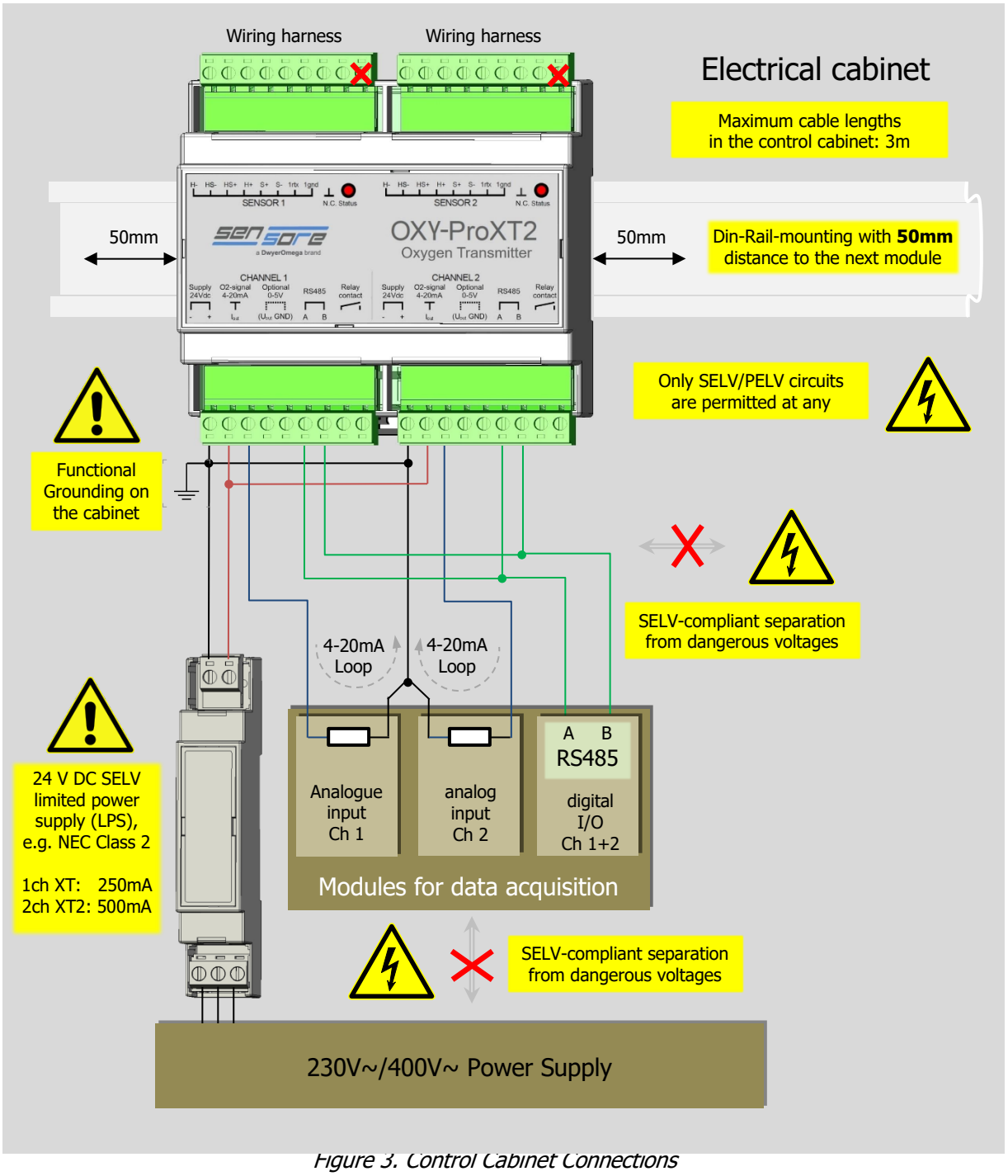


Figure 3. Control Cabinet Connections

NOTE: Installation must be carried out by trained specialists.

- OXY-ProXT can be mounted on a DIN rail in a control cabinet.
- Functional Grounding must take place at one point, in the immediate vicinity of the transmitter. Due to the grounding the resulting circuit will be PELV (Protective Extra Low Voltage)

3.2.1 Connection Assignment - Control Cabinet Side

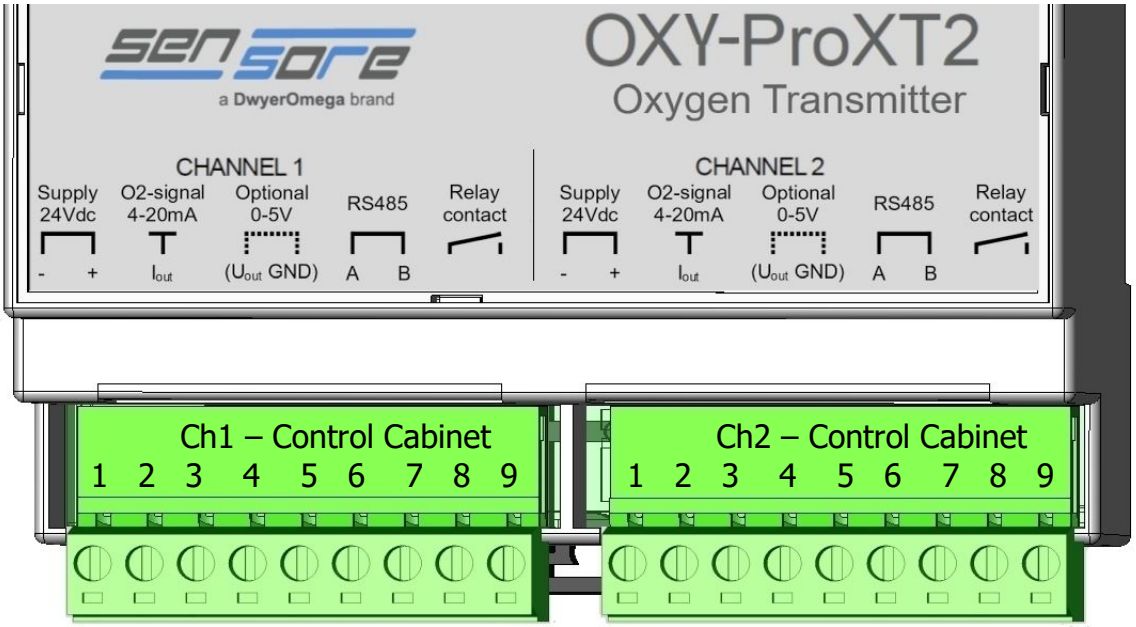


Figure 4. Cabinet side connections

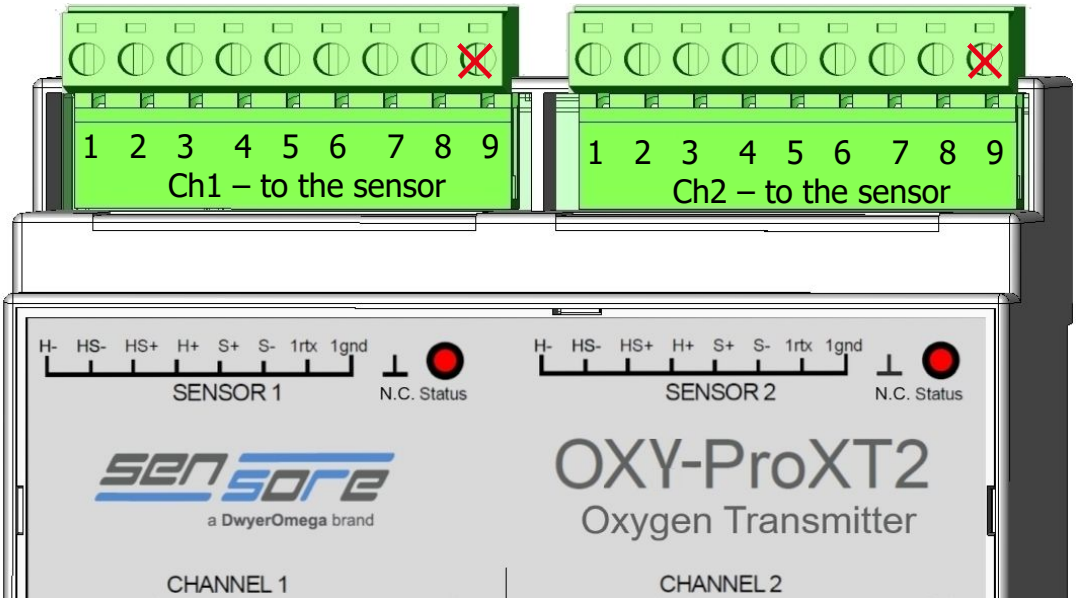
POs	Function	Information
1	Power supply 24 V - (Earth)	To be connected to SELV power supply
2	Power supply 24 V +	
3	Iout (4…20 mA)	Current loop output for the O_2 reading, must be traced back to pin 1 (see section 3.2)
4	Uout (0-5 V)	4…20 mA is the recommended analog output, 0…5 V output might cause GND-loop issues. Use a high impedance differential input for 0…5 V signal.
5	GND (0-5 V)	
6	RS485 A	Connection to RS485 only SELV/PELV compliant circuits
7	RS485 B	
8	Relay contact/Potential free contact pair	Only SELV/PELV compliant circuits, rating 24Vdc / 100mA user configurable alarm levels
9		

- Optional voltage output 0…5 V, Uout and GND (pins 4 and 5).
  It is recommended to use the 4…20 mA instead of 0…5 V to avoid the following issues:
  - The analog voltage output will not indicate certain faults (e.g. cable breakage, power loss). A 0 V output due to a fault condition might be falsely interpreted as 0% O2.
  - The analog voltage output could create GND-loop issues
- RS485
  - Ground reference for the RS485 signals is pin 1. This means that a possible RS485 ground connection must be made to pin 1 (not pin 5)

3.2.2 Wire the Sensors

The electronics and sensors are connected to each other via cable harnesses, permanently installed in the system. These along with short sensor cables (50 cm), facilitate easy sensor installation.

3.2.3 Connection Assignment - Sensor Side



= No connections in these terminals

Figure 5. Sensor Side Connections

POs	Function	Information
1	Sensor H-	To be connected to sensor cabling
2	Sensor HS-	To be connected to sensor cabling
3	Sensor HS+	To be connected to sensor cabling
4	Sensor H+	To be connected to sensor cabling
5	Sensor S-	To be connected to sensor cabling
6	Sensor S-	To be connected to sensor cabling
7	1rtx (1-Wire-EEPROM)	To be connected to sensor cabling
8	1gnd (1-Wire-GND)	To be connected to sensor cabling
9	N.C.	Not connected (reserved for alternative grounding)

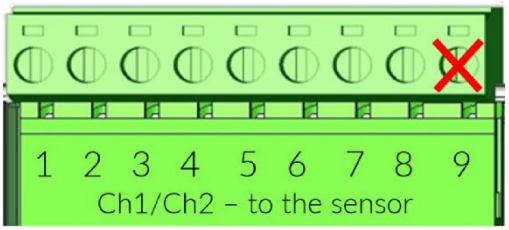
3.3 Sensor Connection

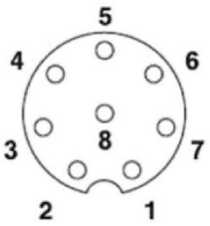
3.3.1 Connection via M12 cable extension (maximum 3 m)

The M12 extension cables must meet the following requirements:

- Sensor direction: M12 female, 8-pin, A-coding
- Cable: AWG24/0.25 mm², shielded, maximum length 3 m
- Direction electronics: open end of cable for screw terminal connection, or a fitting 9-pol socket

- Correct mapping of the M12 pins with electronic terminal positions:





Sensor Side		DIN 47100 Color Code	M12 Pin No.
POs	Function		
6	Sensor S-	White	1
5	Sensor S-	Brown	2
8	1gnd	Green	3
7	1rtx	Yellow	4
2	Sensor HS-	Grey	5
3	Sensor HS+	Pink	6
1	Sensor H-	Blue	7
4	Sensor H+	Red	8

NOTE: The Color code may differ from DIN 47100.

3.4 Route Cables and Shielding Grounding

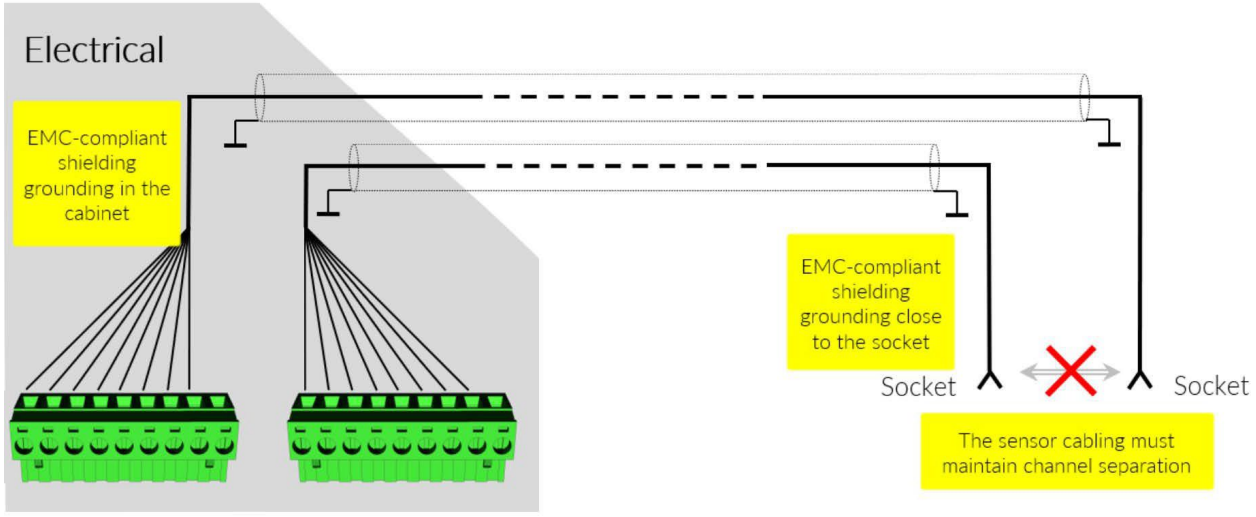


Figure 6. Shielding Grounding

4 Commissioning

A basic function test should be carried out before using the OXY-ProXT (see 5.2).

4.1 Initial Power-up

- The system will power-up as soon as the supply voltage is connected.
- After initial power-up, the basic function test (see 5.2) should be carried out

4.2 Power-up after Maintenance

- After power-up following maintenance, the basic function test (see 5.2) should be carried out

4.3 Decommissioning

- The system can be safely powered-down by disconnecting the supply voltage.

4.4 Recommissioning

- The system will restart as soon as the supply voltage is connected.
- For recommissioning after a malfunction, please refer to section 8.2.

4.5 System Behavior During Commissioning for an OXY-ProXT

Commissioning In dry air (20.9%) with a 25 % sensor						
System states	Duration (secs)	Analog output		Digital output / LED		
		4…20 mA	0…5 V	state	O2norm	LED
Contact Check	< 1	-	-	2	-	-
Heating up	~ 30	~ 20.15 mA	~ 5.00V	4	na	Flashing
Stabilizing	~ 30-40	~ 20.15 mA	~ 5.00V	4	na	Flashing
Measuring O2	Continuous	~ 17.38 mA (~ 20.9 %)	~4.18 V (~ 20.9 %)	5	~836 (~ 20.9 %)	On

4.6 System Behavior During Commissioning for an OXY-ProXT2

If an OXY-ProXT2 is operated with 2 independent 25% sensors the behavior is equivalent to the OXY-ProXT. In the case of a 25% sensor on channel 1, which controls e.g. a 1.25% sensor on channel 2, the behavior will depend on the environmental oxygen concentration.

The exemplary behavior shown in the tables below, does only include LED and 4-20mA signals, the digital signal and the 0-5V would show the equivalent data to 4-20mA.

Commissioning In dry air (20.9%) with a 25 % sensor (ch1) and a 1.25% sensor (ch2)					
Channel States	Duration (secs)	Channel 1		Channel 2	
		4.. 20 mA	LED	4...20 mA	LED
Contact Check	<1		-		-
Ch1: Heating up | Ch2: Standby	~30	~20.15 mA	Flashing	~20.10 mA	On with Standby flickering*
Ch1: Stabilizing | Ch2: Standby	~30-40	~20.15 mA	Flashing	~20.10 mA	
Ch1: Measuring O_2 | Ch2: Standby	Continuous	~17.38 mA (~20.9 %)	On	~20.10 mA	

* In standby mode, the LED is always on but flickers every 5 seconds.

Commissioning at 1% with a 25 % sensor (ch1) and a 1.25% sensor (ch2)					
Channel States	Duration (secs)	Channel 1		Channel 2	
		4...20 mA	LED	4...20 mA	LED
Contact Check	<1		-		-
Ch1: Heating up | Ch2: Standby	~30	~20.15 mA	Flashing	~20.10 mA	On with Standby flickering*
Ch1: Stabilizing | Ch2: Standby	~30-40	~20.15 mA	Flashing	~20.10 mA	
Ch1: Measuring O_2 | Ch2: Heating up	~30	~4.64 mA (~1.0 %)	On	~20.15 mA	Flashing
Ch1: Measuring O_2 | Ch2: Stabilizing	~30-40	~4.64 mA (~1.0 %)	On	~20.15 mA	Flashing
Ch1: Measuring O_2 | Ch2: Measuring O_2	Continuous	~4.64 mA (~1.0 %)	On	~16.8 mA (~1.0 %)	On

* In standby mode, the LED is always on but flickers every 5 seconds.

5 Maintenance

5.1 Inspect Your Sensors/Sensor Cleaning

The sinter caps of the sensor must be checked for visible contamination.

The sensors must only be cleaned mechanically (brushing), no chemical cleaning agents or water may be used for cleaning.

5.2 Inspect Your OXY-ProXT(2) – Basic Function Test

The basic function test is a plausibility check of the complete system by exposing the sensor to air.

- 25% and 96% sensor are supposed to show a value around 20.7 vol % O2
- Sensors with lower ranges are supposed to show full-scale reading. Remark: lower range sensors should not be permanently exposed to air (20.7 vol % O2) as this will accelerate sensor aging. Short-time exposure (hours) to air to check signal plausibility is ok.

5.3 Process Measurement Accuracy

Hardware self-monitoring and basic function test (5.2) will detect significant fault conditions of the system. Further measures may be required to monitor process accuracy, e.g. expose the sensor to reference gas concentrations to verify the process measurement accuracy.

6 Repairs and Replacements

6.1 Replace the Sensor

The typical sensor replacement interval depends on several external factors:

- Application conditions, especially:
  - Contamination load and type (e.g.: VOCs, some chemicals/gases)
  - Mechanical and thermal stress (vibrations, ambient temperature)
  - Other environmental factors (e.g. operating pressure, condensation risks)
- Use case:
  - Sensor operating parameters
  - Operating hours (e.g., continuous 24/7 vs. intermittent use)
- Customer-specific requirements:
  - Desired accuracy at a given O_2 level, sensors should be replaced either at the end of the maximum service life (5 years) or if they are defective.

Procedure for sensor replacement:

- Before replacing the sensor, the OXY-ProXT(2) must be powered down.
- If the sensor is replaced during operation, the transmitter may switch to a fault mode for approximately 60 seconds. If faults are triggered repeatedly over a short period of time, the system may switch into a permanent fault mode. This can be resolved by a power cycle.
- Ensure general practice ESD precautions are adhered to while changing the sensor.
- During sensor replacement ensure that the new sensor is:
  - Sealed to the process chamber
  - Relocked at its connector.
- After the sensor has been replaced, the transmitter can be powered up.
- Once replaced, carry out a function test of the system (see 5.2).

6.2 Replace the OXY-ProXT(2) transmitter

If the transmitter must be replaced, the sensor(s) do not need to be replaced if they are still performing well.

After replacing the transmitter, a function test should be carried out (see 5.2).

6.3 Installation Changes

- If the transmitter's wiring is altered during a repair, a basic function test (see 5.2) must be carried out afterwards.
- If transmitter components (e.g. power supply) are replaced, a basic function test (see 5.2) must be carried out afterwards.

7 Disposal and Recycling

Dismantling the OXY-ProXT(2) must be carried out when it is powered off.

The system must be disposed of appropriately, and sensors must be disposed of as electronic waste.

8 Troubleshooting

If the system detects a fault condition, it will initiate the following:

- Open relay contacts
- Switch into a failure mode, indicated with flashing LEDs and >20.2 mA analog output, see also section 9.5
- After 1 minute in failure mode, the system will initiate an automatic restart
- Following repeated automatic restarts, the system will enter a permanent error state, see section 9.5

To recover from a permanent error state, see section 8.2

8.1 Error Codes

No.	Error State	Description	Troubleshooting/Cause
0	No error		
1	Channel	Fault detected on the other channel	Will not apply to OXY-ProXT (only 1 channel)
2	Heating	Failure during the heat-up phase	Occasional errors are automatically resolved by restarting the heating process For persistent heat-up errors, check sensor wiring or replace sensor
3	Heater open circuit	Fault with sensor heater	Check sensor wiring or replace sensor
4	Heater short circuit	Fault with sensor heater	Check sensor wiring or replace sensor
5	Heater control	Incorrect sensor temperature	Check sensor wiring or replace sensor
6	Sensor cell	Implausible sensor current/voltage	Check sensor wiring or replace sensor
7	24 V	Incorrect or faulty supply voltage	Check external supply voltage
8	3V3	Internal voltage fault	Check the external supply voltage. If persistent or repetitive, replace the transmitter
9	1V1		
10	Overtemperature	Over-temperature of electronics	Check the temperature near the transmitter. If persistent or repetitive, replace the transmitter
11	Watchdog	Internal electronics monitoring errors	If persistent or repetitive, replace the transmitter.
12	Relay		
13	Reserved		
14	Error on Uout	Faulty connection of Uout	Check Uout terminal and connection
15	EE Error External	Fault with the EEPROM of the sensor	Check sensor wiring or replace sensor
16	EE Error Internal	Fault at the sensor EEPROM	Invalid EEPROM data. If parameter data is corrupted, contact SENSORE.
17	Flash	Self-monitoring error detection	If persistent or repetitive, replace the transmitter.
18	RAM		
19	System		
20	Parameter	Invalid sensor parameters	Sensor memory error, replace sensor
21	Watchdog	Critical error in the SW sequence	If persistent or repetitive, replace the transmitter.

8.2 Recovering from (Permanent) Fault Conditions

8.2.1 Via RS232/Modbus

To restart switch to programming mode then initiate measurement mode, see 9.4.3

8.2.2 Disconnect (and reconnect) Power Supply

- Disconnect the power supply for at least 5 seconds.
- Reconnecting the power supply.

8.2.3 Disconnect (and reconnect) Sensors

Disconnecting/ and reconnecting the sensors will also restart the system without requiring a power cycle. Reconnecting a sensor when the system is powered up may trigger a new fault condition, in this case it is important to wait approximately 60 seconds until the system recovers automatically.

8.3 Interference with O2 Measurement

The OXY-ProXT is designed for measurement in O_2/N_2 or O_2/Ar atmospheres, i.e. it is assumed that other gases only occur in trace amounts (< 1000 ppm).

8.3.1 Temporary Impairment of O_2 Measurement

- Rapid pressure fluctuations can lead to a short-term disturbance of the O_2 measurement, such influences can be reduced by averaging the output measured analog signal over time
- Operating below the specified measuring range increases the cross-sensitivity to oxygen containing gases such as H_2O (water vapor) or CO_2, which leads to an increase in the O_2 measurement signal.
- Traces of flammable gases can lead to a reduction in the O_2 measurement signal if present in a high enough concentration.

8.3.2 Permanent Impairment of O_2 Measurement

- When the Pt-ZrO_2 electrode is damaged by chemical substances, the sensor aging may accelerate, leading to permanent reduction in the O_2 measurement signal.
  - Volatile silicone compounds (silanes), e.g. generated by the out-gassing of silicone seals, are particularly harmful to the sensors' measurement performance
- When used in chemically aggressive environments, a damaged glass seal of the sensor cell can cause leakages, leading to a permanent increase in the O_2 measurement signal.
  - e.g. environments that try to reduce O_2 by chemical means.
- Condensing environments can lead to destruction of the sensor cell.
- The function test is used to detect a permanent impairment (see 5.2).

9 RS485 Modbus Interface

9.1 RS485 Parameters

Baud Rate	19200
Start Bits	1
Data Bits	8
Stop Bits	1
Parity	None

9.2 Modbus Functions

To limit the impact on the measurement performance a maximum of one addressed transmission per second is recommended, see also table below for the recommended multiple register access.

	Read Only Register	**Read/write Registers**		
	fct 0x04 (Read)	**fct 0x03 (Read)**	**fct 0x06 (Write)**	**fct 0x16 (Write)**
O2 Measurement	Max. 4 registers	Max. 4 registers	not recommended	not recommended
PRG Mode	Multiple registers	Multiple registers	1 register	Multiple registers

General remarks regarding writing to the OXY-ProXT via Modbus:

- Writing via MODBUS could potentially corrupt the EEPROM data of the OXY-ProXT. So, writing commands should be only used during the initial setup or maintenance of the OXY-ProXT.
- The writing should be limited to the registers documented in this manual.
- Other register values are protected by a checksum, i.e. in the event of inadmissible changes, the system will switch to error mode. Please contact SENSORE in such a case to restore the EEPROM data integrity.

Modbus addresses:

- Standard address OXY-ProXT: 101
- Standard addresses OXY-ProXT2: 101 (ch1), 102 (ch2)
- Please also check the ID-Label of the OXY-ProXT(2) for possible customized addresses

9.3 Modbus Communication Examples

9.3.1 Readout of the status register via Modbus function 0x04 (Read Only register)

Hexadecimal data packet sent:

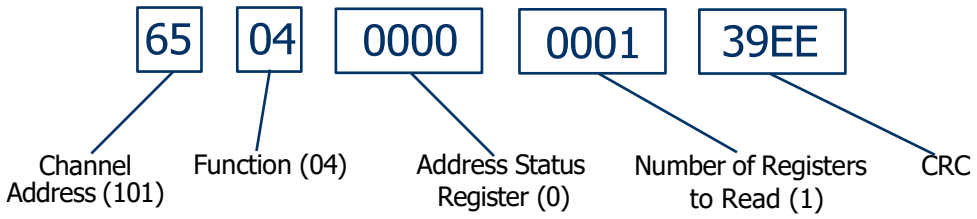


Figure 7. Hexadecimal data packet sent

CRC Calculation:

- For the above hexadecimal data sequence 0x650400000001
  - Seed value 0xFFFF
  - Polynomial 0x8005
- Provides 0xEE39 => Modbus protocol LSB/MSB => 0x39EE

Received hexadecimal data packet:

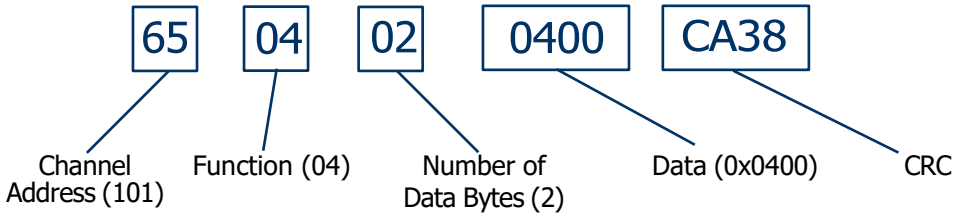


Figure 8. Received hexadecimal data packet via Modbus function 0x04

Modbus data is based on the "big endian" representation i.e. 0400 corresponds to 0x0400:

- MSB 0x04 => b 0000 0100 => measurement mode active; relay contact open
- LSB 0x00 => no error

9.3.2 Readout of status and O2 level via Modbus function 04 (Read Only register)

Hexadecimal data packet sent:

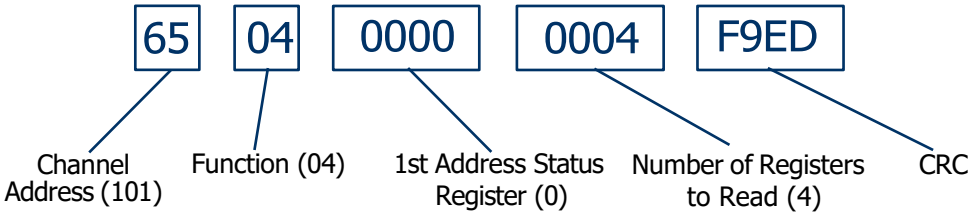


Figure 9. Hexadecimal data packet sent via Modbus function 04 (ppm)

Received hexadecimal data packet:

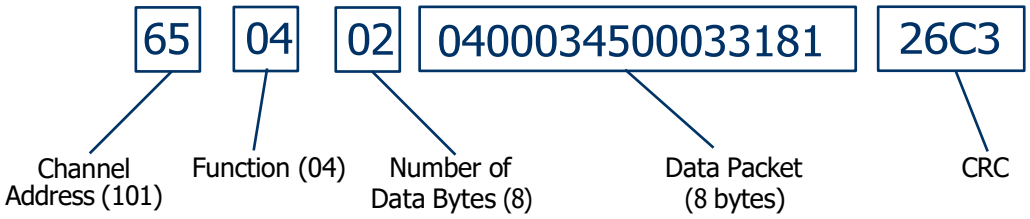


Figure 10. Received hexadecimal data packet

Breakdown of the data package:

- 2-byte status register: 0x0400 see 9.5
- 2-byte O_2 normalized: 0x0345 => 837 Dec.
  - In this example, normalized to 25 % O_2, i.e. 837/1000*25% O_2 => 20.925 % O_2
- 4-byte O_2 and ppm: 0x00033181 => 209.281 ppm O_2

9.4 Modbus Register Overview

The following tables provide an overview of the most important registers

9.4.1 Modbus function code 0x04 (useful in measurement mode) "Read" register

Modbus Address	Data Type	Description
0x0000	unsigned int16	Status register LSB (least significant bits 1...8) 0 ... no error, >0 ... error code when the error state is active (see section 8.1)
		Status register MSB (most significant bits 9…16) Status Flags (see section 9.5)
0x0002	unsigned int16	O_2 value (digital) normalized
0x0004-6	unsigned int32	O_2 value absolute (in ppm O_2)

Modbus Address	Data Type	Description
0x0008	unsigned int16	Current sensor current (in 0.1 uA)
0x000A	unsigned int16	Current sensor temperature (in °C)
0x000C	unsigned int16	Current sensor voltage (in mV)
0x000E	unsigned int16	Current heater voltage (in mV)
0x0010	unsigned int16	Current heater current (in 0.1 mA)
0x0012	unsigned int16	Adjusted cold heater resistance
0x0014	unsigned int16	Current heater resistance during operation
0x0016	unsigned int16	Digital system states (0…7) (see 0)
0x0022	unsigned int16	Last error code encountered since powering on
0x007C	unsigned in16	FW Rev (120 => v1.20)
0x007E	unsigned in16	Reading this address will switch to Programming Mode (PRG) from Measuring Mode

9.4.2 Modbus function code 0x03/0x06 (usable in PRG mode) "Write"/"Read" tabs

Modbus Address	Data Type	Description
0x1012	unsigned int16	Registry contains Modbus address

9.4.3 Modbus function code 0x06 "Write" register to execute commands

Modbus Address	Data Type	Description
0x0102	unsigned int16	Switch to programming mode
0x0104	unsigned int16	Initiation of measurement mode (from programming mode)

To quit a permanent error mode, apply the following command sequence:

- Switch to programming mode (0x0102), writing any value into the register will trigger the command
- Switching to measurement mode (0x0104), writing any value into the register will trigger the command

9.4.4 Modbus function code 0x06 "Write" registers for customized threshold setting

Modbus Address	Data Type	Description
0x1322	signed int16	Threshold value normalized (1000 … full scale) negative sign … open when exceeding positive sign … open when fall below
0x1324	unsigned int16	optional 2nd threshold value for range switching, otherwise 0
0x1326	unsigned int16	Hysteresis value (also scaled with 1000 … full scale)
0x1328	signed int16	Checksum values [0x1322] + [0x1324] + [0x1326]

Preset value of registers 0x1322 – 0x1328 is 0, which will deactivate the customized threshold settings. If the checksum in 0x1328 is incorrect the settings will be ignored.

The calculations for the threshold and hysteresis are based on the normalized digital output; see section 2.4. The normalization value is 1000, scaled over the usable digital range; refer to the table in section 2.2. See the examples below for how the calculation is performed. Please contact SENSORE if further assistance is needed.

Example 1: 25 % sensor, contacts should open when 2 % O2 is exceeded, hysteresis 0.2 % O2:

usable digital range is 25 % … 1000	=>	2 % ... 80
(-) to open when exceeded	=> -80	to be written into 0x1322
no 2nd threshold value needed	=> 0	to be written into 0x1324
hysteresis 0.2% … 8; hysteresis is always positive	=> 8	to be written into 0x1326
Checksum is -80 + 0 + 8 = 72	=> 72	to be written into 0x1328

Result: Relay contacts will open at > 2 % O2 and close at < 1.8 % O2

Example 2: 1000 ppm sensor, contacts should open when O2 falls below 600ppm, hysteresis 30ppm O2:

usable digital range is 1200ppm … 1000	=>	600ppm … 500
(+) to open when fall below	=> +500	to be written into 0x1322
no 2nd threshold value needed	=> 0	to be written into 0x1324
hysteresis 30ppm … 25; hysteresis is always a positive	=> 25	to be written into 0x1326
Checksum is 500 + 0 + 25 = 525	=> 525	to be written into 0x1328

Result: Relay contacts will open at < 600ppm O2 and close at > 630ppm O2

9.4.5 Modbus function code 0x06 "Write" registers for customized 19-20mA error output

Modbus Address	Data Type	Description
0x132A	unsigned int16	standard value 0 (customization disabled, setting is defined by sensor) customized value 1900…2000 (19…20 mA)

Usually, values > 20 mA are used to display special states and error conditions. This setting is stored in the memory chip of the Smart Sensor.

If the error and special state indication should start at 19mA, it is possible to shift the error indication range to 19 mA, by writing 1900 in the register 0x132A. It is necessary to restart the OXY-ProXT, so that the change will go into effect.

9.5 Digital Status Register 16Bit (Modbus Register 0x0000)

- Bits 1-8: 8-bit integer: 0 … no error or error code (see section 8.1).
- Bits 9-16: bitwise flags: 1 … state/phase is active or 0… state/phase is inactive

  The relay status flag will be 1 if the relay is closed, or 0 if it is open.

Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9
Permanent error state	Error over-temperature	Contact check	XT: not used XT2: standby	Heat-up mode	Measuring mode	Relay status flag	XT: not used XT2: ch2 active

Special states for OXY-ProXT2 with dependent channels (Channel configuration B):
- Channel 2 active can only be viewed by channel 1.
- Standby mode can only be viewed by channel 2.

9.6 Digital System States (Modbus Register 0x0016)

Number	Description of System State
0	Initializing
1	Not in use (customized option)
2	Contact check (and import of sensor EEPROM data)
3	Not in use (customized option)
4	Heating mode (and stabilization of the sensor signal)
5	Measuring mode
6	Programming mode
7	Failure mode (temporary or permanent)
8	Standby mode for channel 2 (only for OXY-ProXT2 with a dependent sensor on channel 2)

10 Appendices

Appendix A - Technical Specifications

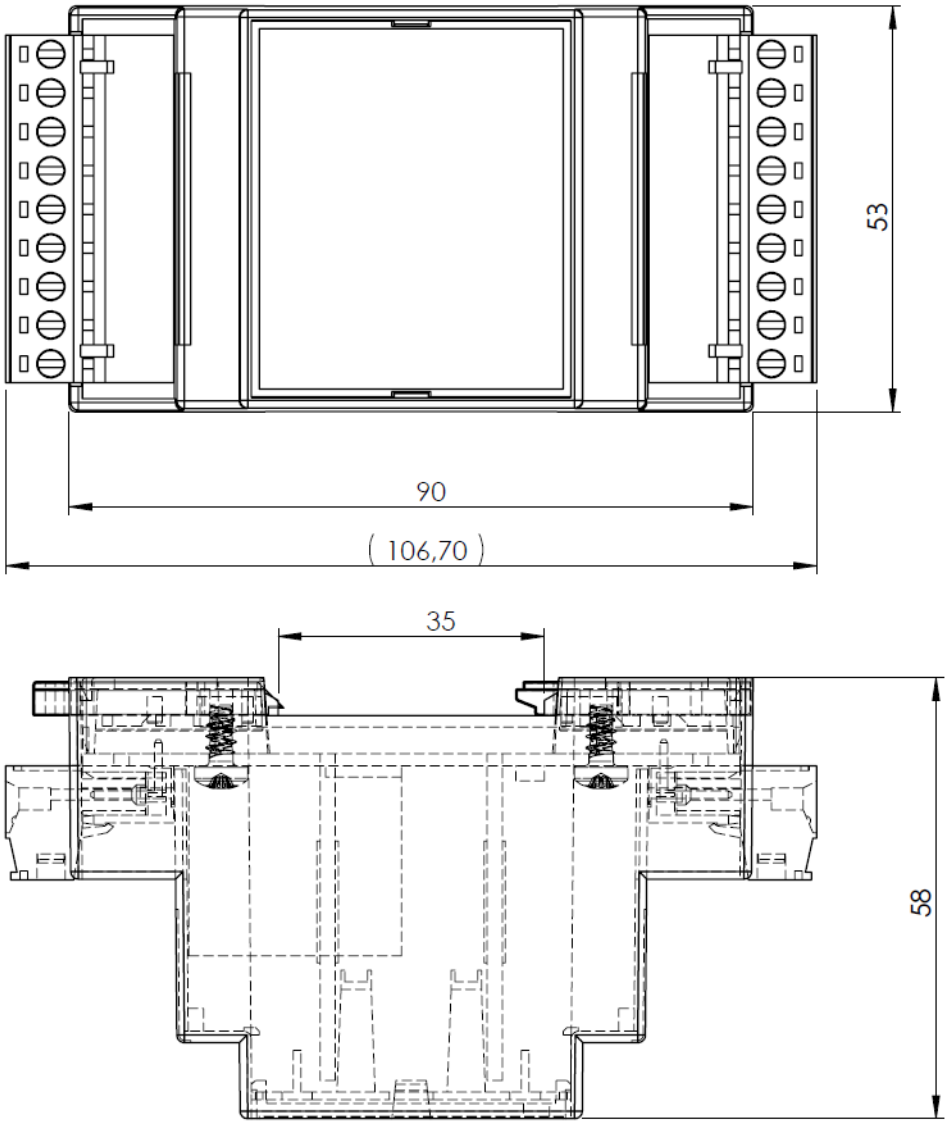
Sensors	**Zirconia (ZR)**						
Available measurement ranges	**O2 concentration in volumetric % or ppm**						
Nominal sensor range*	**1000 ppm**	**1.00 %**	**2.00 %**	**5 %**	**25 %**	**40.0 %**	**96.0 %**
full scale output (20mA/5V/RS 485)	1200 ppm	1.25 %	2.5 %	6.25 %	25 %	50 %	100 %
Typical Accuracy	20 ppm	100 ppm	200 ppm	500 ppm	0.25 %	0.40 %	1.0 %
Output Resolution (4...20 mA)	< 1 ppm	< 10 ppm	< 20 ppm	< 50 ppm	< 0.025 %	<0.04 %	<0.1 %
Lower Detection Limit	10 ppm	50 ppm	100 ppm	500 ppm	0.1 %	0.2 %	1.0 %
	*Nominal sensor range is the specified max. O2 level, overrange operation should be avoided						
General sensor specification							
Maximum flow velocity	6 m/s (19.7 ft/s)						
Pressure Range (Maximum Altitude)	700…1300 mbara (10...19 psia) (3000 m)						
Maximum Safe Pressure	1500 mbarg (21 psig)						
Response Time (T90)	depend on selected sensor housing (fastest option D0 < 5 seconds)						
Operating Temperature Range (Sensor head)	depend on sensor cable configuration, in any case +10...+100 °C (+50...+212 °F)						
Operating Temperature Range (Sensor plug)	+10...+75 °C (+50...+165 °F)						
Life Expectancy (application dependent)	Up to 5 years						
Humidity (with normal use)	0…90 %rh @ 40 °C (104 °F) non-condensing						
Available Housing configurations	D0 (M16 x 1.5 male), D2 (alu, M16 x 1.5 male), D3 (alu, M18 x 1.5 male), B1 (TO8 + flange)						
Shelf Life	Unlimited						
Calibration Interval	No calibration required. Calibration data stored in smart sensor.						
Analyzer (Monitor)							
Electrical							
Analog Output Signal	4...20 mA Optional: 0…5V						
Digital Communications	RS485 / Modbus RTU						
Relay Contact Output	to switch 24Vdc / 100mA, controlled by an O2-alarm-level (programmable via RS485)						
Electrical Interface	8-pin M12 on sensor, extension cable from sensor plug to screw terminal on monitor						
Operating Temperature Range (Monitor)	+10…+50 °C (+50…+122 °F)						
Power Supply	24 V DC ± 10%						
Maximum Power Consumption	6 W or 0.25 A						
Mechanical							
Ingress Protection	IP40 (Monitor), IP66 (Sensor plug)						
Housing Material	PC (UL 94 V-0)						
Mounting	DIN rail						
Sensor Cable Length	50 cm (19.6") with 8 pin M12 connector						
Extension Cable Length	1 m (3.28 ft) or 3 m (9.8 ft)						
Compliance							
CE: According to EU Machinery Directive EN ISO13849-1 Performance Level a / non-SIL applications only, also compliant with EN 61010-1							

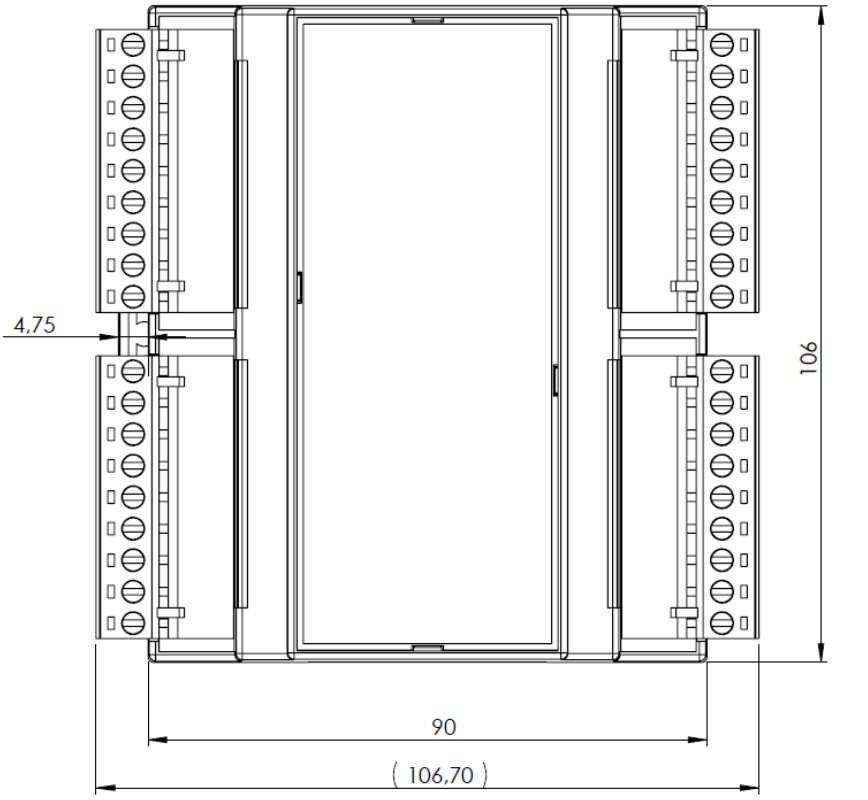
Appendix B - Technical Drawings (mm)

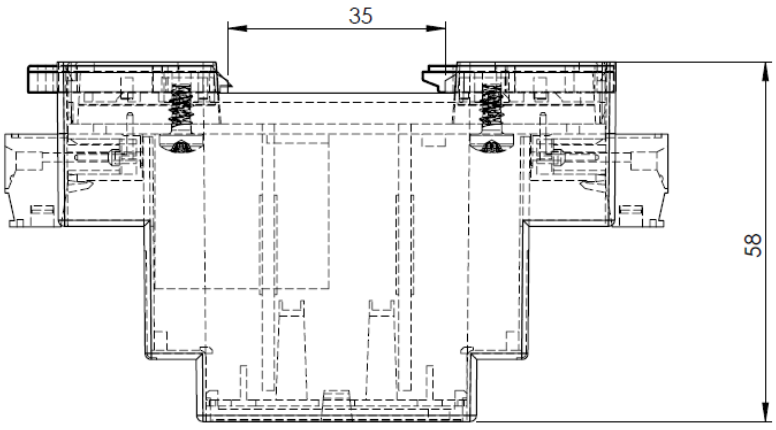
The OXY-ProXT uses DIN-Rail housings based on standard width units 1TE=18mm

OXY-ProXT (1channel) nominal width 3TE (54mm)
OXY-ProXT2 (2channel) nominal width 6TE (108mm)

The actual width is slightly smaller, see the drawing of the OXY-ProXT below




4,75
106
90
(106,70)


35
58

Appendix C - Quality, Recycling, and Warranty Information

SENSORE Electronic GmbH. is part of the DwyerOmega Group. and complies with applicable national and international standards and directives.

The following regulations have been considered:

- CE
- UKCA
- REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)
- Recycling policy
- RoHS (Restriction of Hazardous Substances in electrical and electronic equipment)
- WEEE (Waste Electrical and Electronic Equipment recycling)

Appendix D - Order Codes for systems, spare parts and accessories

Order Codes	Description
OPXT – XX – XXX – XXX	OXY-ProXT system (monitor, extension cable, 1 sensor)

Sensor Type
D0 (M16 x 1.5 Steel)
D2 (M16 x 1.5 Alu)
D3 (M18 x 1.5 Alu)
B1 (TO-8 Flange)

Nominal Sensor Range
960 (96%)
400 (40%)
250 (25%)
050 (5%)
020 (2%)
010 (1%)
001 (1000 ppm)

Ext Cable Length
100 (1m)
300 (3m)

Order Codes	Description
OPXT2 – XX – X – XXX	OXY-ProXT2 system (monitor, extension cables, 2 sensor)

Sensor Type
D0 (M16 x 1.5 Steel)
D2 (M16 x 1.5 Alu)
D3 (M18 x 1.5 Alu)
B1 (TO-8 Flange)

Channel Config. Range Selection
A (ch1:25% ch2:25%)
B (ch1: 25% ch2: 1.25%)
Contact SENSORE for customized configs

Ext Cable Length
100 (1m)
300 (3m)

SO – XX XXXX – A050M

Spare / Replacement sensors for OXY-ProXT system will only work as independent sensors on an OXY-ProXT2 please contact SENSORE for more information

Sensor Type
D0 (M16 x 1.5 Steel)
D2 (M16 x 1.5 Alu)
D3 (M18 x 1.5 Alu)
B1 (TO-8 Flange)

Nominal Sensor Range
-960 (96%)
e400 (40%)
e250 (25%)
e050 (5%)
e020 (2%)
e010 (1%)
e001 (1000 ppm)

OPXT – TML9 Spare / Replacement 9-pin screw terminals (Qty 2)

OPXT – SIC1 Spare / Replacement Sensor Interconnect Cable - 1m (Qty 1)

OPXT – SIC3 Spare / Replacement Sensor Interconnect Cable - 3m (Qty 1)

Appendix E – Product identification

The sensor ID label is on the M12 connector and contains:

Type: SO-D3e250-A050M
Param: xxxx--
S/N: C810132 - 001
date: 2026 week: 08

www.sensore-electronic.com

- O2-sensor-type (Type)
- O2-parameter (Param)
  - xxxx is an identifier for standard or customized parameters
- Batch / serial number (S/N)
- Manufacturing date respectively initial calibration date (date)

The monitor ID label is near the connector for the sensor:

Type: GPsa1012-000-0
S/N: C810412 - 001
date: 2026 week: 08
Modbus: 101

www.sensore-electronic.com

Type: GPda1012-000-0
S/N: C810413 - 001
date: 2026 week: 08
Modbus: 101, 102

www.sensore-electronic.com

- Monitor (Type)
  - OXY-ProXT: GPsa1012-000-0
  - OXY-ProXT2: GPda1012-000-0
- Batch / serial number (S/N)
- Manufacturing date respectively initial calibration date (date)
- Modbus Address(es)

The nameplate of the monitor is on the left side of the housing

OXY-ProXT, Oxygen Transmitter
Rating: 24Vdc / 250mA
Revision: HW 1v0 R2
Sensore-Electronic GmbH
Aufeldgasse 37-39
A-3400 Klosterneuburg
CE

OXY-ProXT2, Oxygen Transmitter
Rating: 24Vdc / 250mA (Ch1) + 250mA (Ch2)
Revision: HW 1v0 R2
Sensore-Electronic GmbH
Aufeldgasse 37-39
A-3400 Klosterneuburg
CE

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