

Electrochemical Oxygen Transmitter

LO₂, MO₂



User Manual

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Table of contents

1 General overview	3
2 Functional Description	3
3 Installation	4
3.1 Mounting Instructions	4
3.2 Installation	4
4 Electrical Connection	5
4.1 Wiring Connection	5
4.2 Output Signal	5
5 Commissioning	6
5.1 Calibration Zero Point (Output Signal 4 mA)	6
5.2 Calibration Span	6
5.3 Calculation of Control Span Voltage	7
6 Inspection and Service	8
6.1 Inspection	8
6.2 Service and Calibration	8
6.3 Exchange of Sensor Element	8
7 Troubleshooting	9
7.1 Diagnostics at the transmitter	9
8 Cross-sensitivity Data	9
9 Specifications	10
10 Calibration Adapter	11
11 Spare Parts List	11
12 Part Disposal	11
13 Notes and General Information	12
13.1 Intended Product Application	12
13.2 Installers` Responsibilities	12
13.3 Maintenance	12
13.4 Limited Warranty	12
14 Appendix Enclosure A and 5	14
14.1 Enclosure Type A	14
14.2 Enclosure Type 5	14
14.3 Installation Work	15
14.4 Connection Work	15
14.5 Calibration	15
14.6 Specifications	15
14.7 Exchange of Sensor Element	16
14.8 Opening of the Enclosure Type 5	16



1 General overview

The O₂ analog transmitter with 4 – 20 mA / 2- 10 V output is used for the continuous monitoring to detect the presence of oxygen concentrations in the ambient air. Main application ranges are laboratories, food production etc. with the possibility to change the oxygen content.

The intended sites within the ambient conditions defined in the Specifications are all areas being directly connected to the public low voltage supply, e.g. residential, commercial and industrial ranges as well as small enterprises (according to EN50 082).

The transmitter must not be used in potentially explosive atmospheres.

2 Functional Description

The chemical process of the measurement is based on the principle of a galvanic micro-fuel cell. The gas or the ambient air to be monitored diffuses through a membrane filter into the measuring cell towards the cathode. Cathode and anode are electrically contacted, therefore due to the oxidation there is an electric current proportional to the oxygen partial pressure. This current signal is linear to the oxygen concentration. The current is evaluated by the connected amplifier and transformed into a linear output signal.

The diffusion through the membrane and the thin electrolytic coat are complex, temperature dependant, electrochemical processes influencing the ion current of the sensor. Therefore the sensor is temperature-compensated within the specified temperature range.

The electrolyte, the catholyte and the composition of the anode are designed in a way that the oxygen diffusing towards the cathode is electrochemically reduced.

The electrolyte is used up by the electrochemical process. So the sensor life time is limited to two years. Calibration during sensor life time is not necessary.

- There is a small quantity of corrosive liquid in the sensor element. If in case of damage persons or objects touch the liquid, you have to clean the affected areas as fast and carefully as possible with tap water. Out of use sensors must be disposed in the same way as batteries.
- Silicon leads to an undesirable chemical reaction in the sensor and so causes a drift of the zero-point to the positive side. Prolonged exposure leads to an important reduction of the sensor sensibility. After exposure to silicone the sensor has to be replaced in order to provide for the functional reliability furthermore.
- Electronics can be destroyed by static electricity. Therefore, do not touch the equipment without a wrist strap connected to ground or without standing on a conductive floor (acc. to EN 61340-5-1).

3 Installation

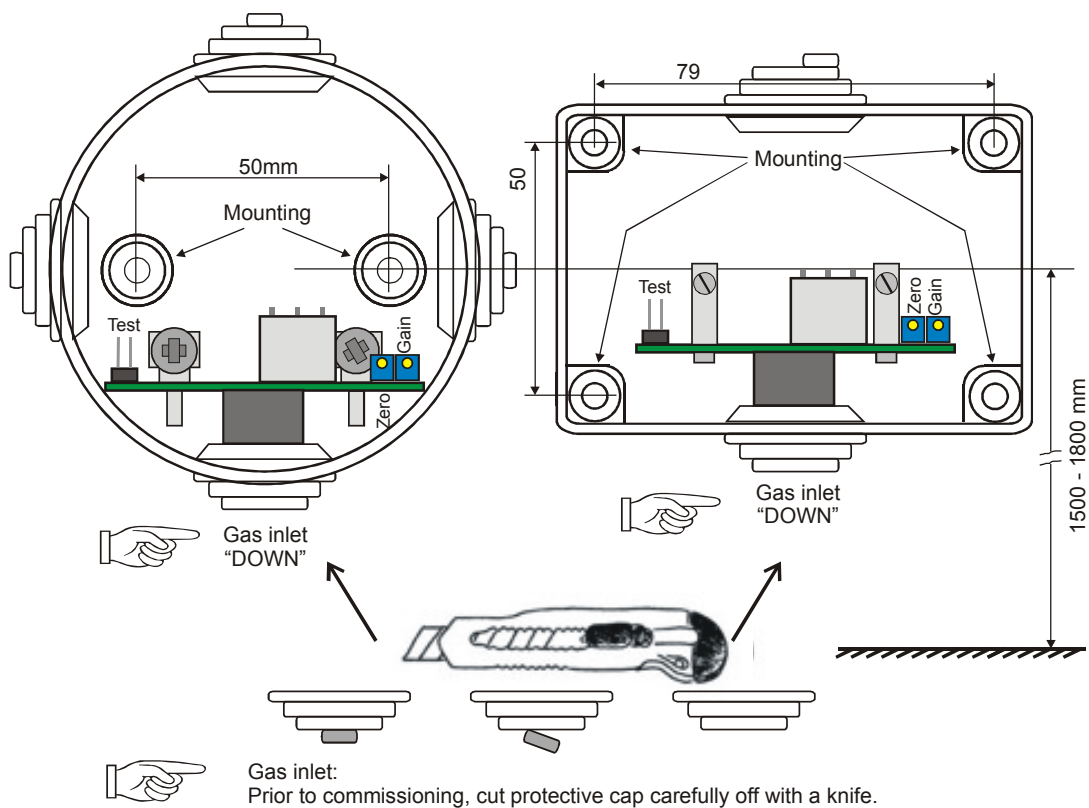
3.1 Mounting Instructions

When choosing the mounting site please pay attention to the following:

- The specific weight of oxygen O₂ is higher than that of air (factor 1.10).
Recommended mounting height is 1.5 m (5 feet) to 1.8 m (6 feet) above floor for combustial applications.
- Consider the ventilation conditions! Do not mount the transmitter in the centre of the airflow (air passages, suction holes).
- Mount the transmitter at a location with minimum vibration and minimum variation in temperature (avoid direct sunlight).
- Avoid locations where water, oil etc. may influence proper operation and where mechanical damage might be possible.
- Provide adequate space around the sensor for maintenance and calibration work.

3.2 Installation

- Open cover of enclosure.
- Fix the enclosure by the 2 screws (gas inlet to the ground).
- Replace the cover.



4 Electrical Connection

Installation of the electrical wiring should only be performed by a trained specialist according to the connection diagram, without any power applied to conductors and according to the corresponding regulations!

Avoid any influence of external interference by using a shielded cable.

Recommended cable: J-Y(St)Y 2x2x0.8LG (18 AWG), maximum resistance 73 Ω/1000 m (20.8 Ω/1000 ft)

When the PCB is mounted, it is important to ensure that the wire shields or any bare wires do not short the PCB.

4.1 Wiring Connection

- Open cover of enclosure.
- Insert cable and strip it off.
- Remove triple-pole socket board and connect the cable according to the wiring diagram.
- Replug the socket board correctly at the multi-pin connector.
- Close the cover.

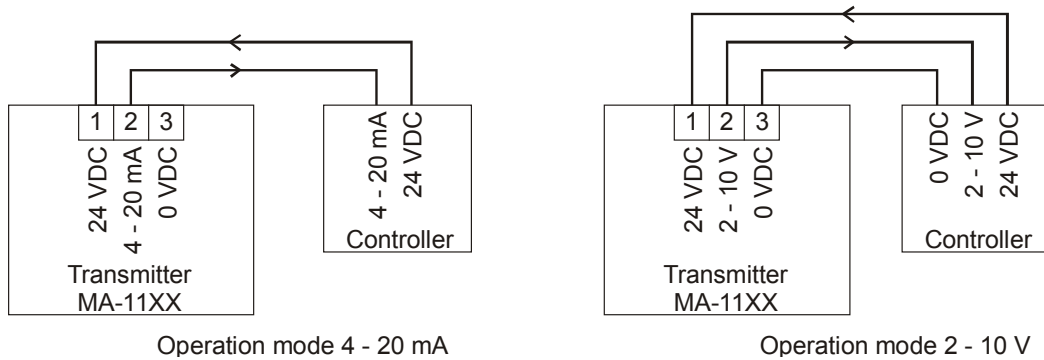


Fig. 2 Wiring Diagram

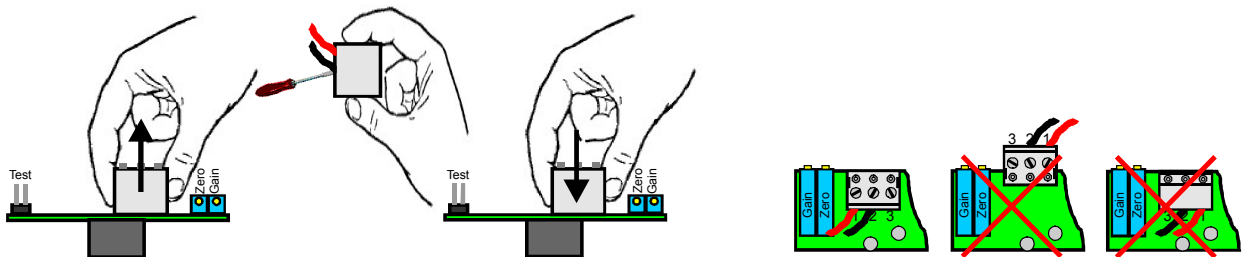


Fig. 3 Electric connection

4.2 Output Signal

Operation mode 4- 20 mA:
The transmitter is always current source.
Only 2-wire connection.

Operation mode 2 – 10 V:
Remove R40 by using a wire cutter.
Always 3-wire connection.

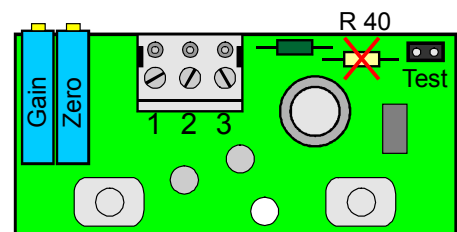


Fig. 4 Board



5 Commissioning

Please observe proper handling procedures for test gas bottles and the regulations according to TRGS 220!

- Prior to calibration the sensor element must be powered and fully stabilized for at least 1 hour without interruption.
- Calibration must only be performed under operation typical ambient conditions.

Always consider the commissioning instructions when exchanging the sensor element.

Only trained technicians should perform the following:

- Cut the protective cap at the gas inlet carefully off by using a knife (only for enclosure D / F).
See fig.1.
- Check mounting location.
- Check power voltage.
- Calibrate the transmitter (if not factory calibrated).

Required instruments to commission/ calibrate the transmitter:

- Test gas bottle with test gas O₂ with 20.9 vol.% or with ambient air 20.9 vol.% O₂.
- Gas pressure regulator with flow meter.
- Calibration adapter with tubing. Type: XXXXX See Fig. 6.
- Digital voltmeter with range 0 – 10 VDC, accuracy 1%
- Small screwdriver.

5.1 Calibration Zero Point (Output Signal 4 mA)

- The zero point is factory-calibrated. Further zero calibration is not necessary.

5.2 Calibration Span

- Connect calibration adapter to the sensor element.
- Connect digital voltmeter to pin "Test".
- Apply test gas O₂, 150 ml/min; 1 Bar (14.5 psi).
- Wait two minutes until the signal is stable, adjust signal with potentiometer "Gain" until the signal corresponds to the calculated value, see calculation for control voltage.

At a loss of sensitivity of more than 70% caused by ageing, operational or climatic influences, calibration will not be possible any more. Then the sensor has to be replaced.

5.3 Calculation of Control Span Voltage

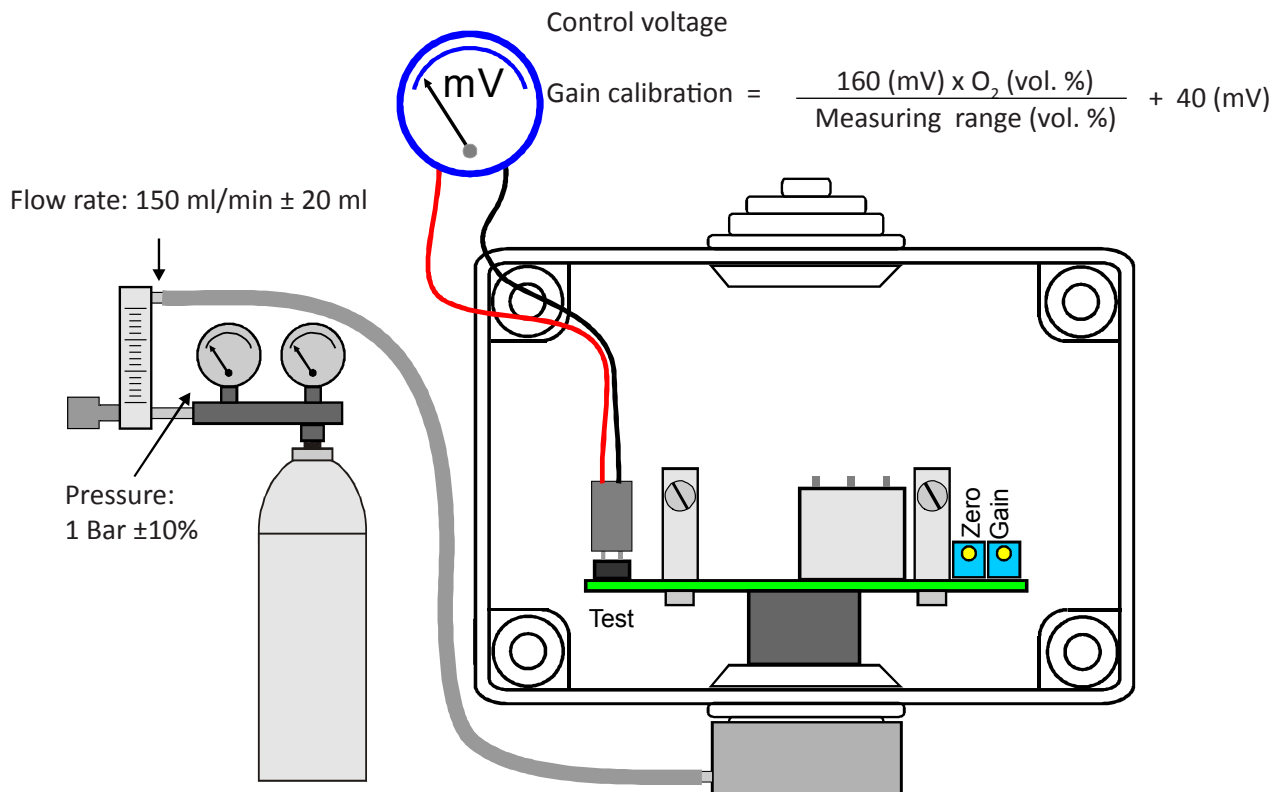
The control voltage at the pin "Test" simulates the 4 – 20 mA signal at a 10 Ohm measuring resistance.

$$\text{Control span voltage (mV)} = \frac{160 \text{ (mV)} \times \text{test gas concentration O}_2 \text{ (vol. \%)}}{\text{measuring range O}_2 \text{ (vol. \%)}} + 40 \text{ (mV)}$$

Example:

Measuring range	25 vol. %
Test gas concentration	20,9 vol. % O ₂
Control voltage: Signal start 2 V / 4 mA	173,7 mV
Control voltage: Signal start 0 V / 0 mA	67,2 mV

$$\frac{160 \text{ (mV)} \times 20.9 \text{ (vol. \%)}}{25 \text{ (vol. \%)}} + 40 \text{ (mV)} = 173.7 \text{ mV}$$



Test gas:
Gain calibration: O₂ (vol %) with a concentration of 20,9 vol %.

Fig. 5 Calibration



6 Inspection and Service

Inspection, service and calibration of the transmitters should be done by trained technicians and executed at regular intervals. We therefore recommend concluding a service contract with Automatikprodukter or one of their authorized partners.

According to EN 45544-4, inspection and service has to be executed at regular intervals. The maximum intervals have to be determined by the person responsible for the gas warning system according to the legal requirements. Automatikprodukter recommends checking the O₂ transmitter every three months and maintaining it every 12 months. If different intervals are indicated, always consider the shortest interval.

Inspections and services must be documented. The date for the next maintenance has to be affixed to the transmitter.

6.1 Inspection

The O₂ Transmitter should be controlled regularly by a competent person according to EN 45544-4. The following has to be checked in particular:

- Maintenance/ calibration interval not exceeded.
- Visual inspection of the transmitter including cable for damage etc.
- Remove dust deposits, especially at the gas inlet.
- For enclosure type A: The filter at the gas inlet has to be replaced if extremely dirty.

6.2 Service and Calibration

When performing the maintenance you have to do the calibration and the functional test in addition to the inspection.

- Calibration: See section 5.
- Functional test: Check the output signal at the test pins during calibration

6.3 Exchange of Sensor Element

Sensor should always be exchanged without power applied (remove the socket board):

- Unscrew the two fixing bolts.
- Remove the board with the sensor upwards out of the sensor cup.
- Unplug old sensor element from the PCB, plug in new original sensor element.
- Plug in the PCB with the sensor into sensor cup and tighten it by the screws.
- Plug in the socket board correctly. See fig.3.
- Calibrate the sensor (see section 5.).



7 Troubleshooting

7.1 Diagnostics at the transmitter

Trouble	Cause	Solution
Output signal 0 mA and control voltage 0 V	Power voltage not applied or not connected correctly.	Measure power voltage at terminal block 1 (+) and 2 (-) (16 – 28 VDC)
	Socket board not plugged in correctly	Plug in the socket board acc. to fig.3.
Output signal < 3 mA and/or control voltage < 30 mV	Transmitter not calibrated	Calibrate transmitter
Control voltage doesn't reach the calculated value	Sensor sensitivity < 30 %	Replace sensor element

If faults cannot be eliminated by the above mentioned actions or if other faults not described in this table occur, please contact the service

8 Cross-sensitivity Data

See Specifications



9 Specifications

Electrical		
Power supply	16 - 28 VDC (reverse polarity protected), 2 - 10Vdc, 24Vac/dc	
Power consumption (without options)	22 mA, (0.6 VA), max.	
Sensor Performance		
Type of gas	Oxygen (O ₂)	
Sensor element	Electrochemical, diffusion	
Measuring range	0 – 25 vol %	
Accuracy	± 0,1 vol %	
Long term drift output	< 4 % reading/year	
Response time	t ₉₀ ≤ 15 sec.	
Sensor life expectancy	2 years, normal operating environment	
Cross sensitivity	Concentration	Reaction (vol % O ₂)
Carbon dioxide, CO ₂	5 vol %	2
Mounting height	1.5 to 1.8 m (5 to 6 ft.) above floor for combustial applications	
Type of Control		
Analog output signal	4 – 20 mA, load Ω 500 Ω 2 -10 V, load ≥ 50 k Ω Proportional, overload and short-circuit protected	
Operating Environment		
Humidity	0 to 90 % RH non-condensing	
Working temperature	-10 °C to + 50 °C (14 °F to 122 °F)	
Storage temperature	+ 5 °C to + 30 °C (41 °F to 86 °F)	
Pressure range	Atmospheric ±10%	
Physical characteristics		
Enclosure	Type D	Type F
Enclosure material	Polycarbonate	GW Plast 75 GWT
Flammability	UL 94 V2	UL 94 V0
Enclosure colour	RAL 7032 (light grey)	RAL 7032 (light grey)
Dimensions (W x H x D)	94 x 65 x 57 mm	Round: (d x H) 87 x 45.5 mm
Weight	0.3 kg	0.2 kg
Protection class	IP 43	IP 43
Mounting	Wall mounting, pillar mounting	
Cable entry	1 x M 20	
Wire connection	Screw type terminal, min. 24 AWG (0.25 mm ²), max. 14 AWG (2.5 mm ²)	
Wire distance	Max. loop resist. 500 Ω (= wire resistor + controller input resistor)	
Directives	EMC Directive 2004/108/EEC	
	EC	
Warranty	One year material (without sensor)	



10 Calibration Adapter

Enclosure Type A and 5
Type: Calibr-set



Fig. 6 Calibration Adapter

11 Spare Parts List

Description	Order No.
Sensor	Sense09-1195
PCB without sensor	
Connector triple-pole	MA_25..600.2353.0

12 Part Disposal

Since August 2005 there are EC-wide directives defined in the EC Directive 2002/96/EC and in national codes concerning the waste electrical and electronic equipment and also regarding this device.

For private households there are special collecting and recycling possibilities. For this device isn't registered for the use in private households, it mustn't be disposed this way. You can send it back to your national sales organisation for disposal. If there are any questions concerning disposal please contact your national sales organisation.

Outside the EC, you have to consider the corresponding directives.



13 Notes and General Information

It is important to read this user manual thoroughly and clearly in order to understand the information and instructions. The O₂ transmitters must be used within product specification capabilities. The appropriate operating and maintenance instructions and recommendations must be followed.

Due to on-going product development, Automatikprodukter reserves the right to change specifications without notice. The information contained herein is based upon data considered to be accurate. However, no guarantee is expressed or implied regarding the accuracy of this data.

13.1 Intended Product Application

The transmitters are designed and manufactured for control applications and air quality compliance in commercial buildings and manufacturing plants.

13.2 Installers` Responsibilities

It is the installer's responsibility to ensure that all transmitters are installed in compliance with all national and local codes and OSHA requirements. Installation should be implemented only by technicians familiar with proper installation techniques and with codes, standards and proper safety procedures for control installations and the latest edition of the National Electrical Code (ANSI/NFPA70). It is also essential to follow strictly all instructions as provided in the user manual.

13.3 Maintenance

It is recommended to check the transmitter regularly. Due to regular maintenance any performance deviations may easily be corrected. Re-calibration and part replacement in the field may be implemented by a qualified technician and with the appropriate tools. Alternatively, the easily removable plug-in transmitter card with the sensor may be returned for service to Automatikprodukter.

13.4 Limited Warranty

Automatikprodukter warrants the transmitters for a period of one (1) year from the date of shipment against defects in material or workmanship. Should any evidence of defects in material or workmanship occur during the warranty period, Automatikprodukter will repair or replace the product at their own discretion, without charge.

This warranty does not apply to units that have been altered, had attempted repair, or been subject to abuse, accidental or otherwise. The warranty also does not apply to units in which the sensor element has been overexposed or gas poisoned. The above warranty is in lieu of all other express warranties, obligations or liabilities.

This warranty applies only to the transmitter. Automatikprodukter shall not be liable for any incidental or consequential damages arising out of or related to the use of the O₂ transmitters.

14 Appendix Enclosure A and 5

14.1 Enclosure Type A

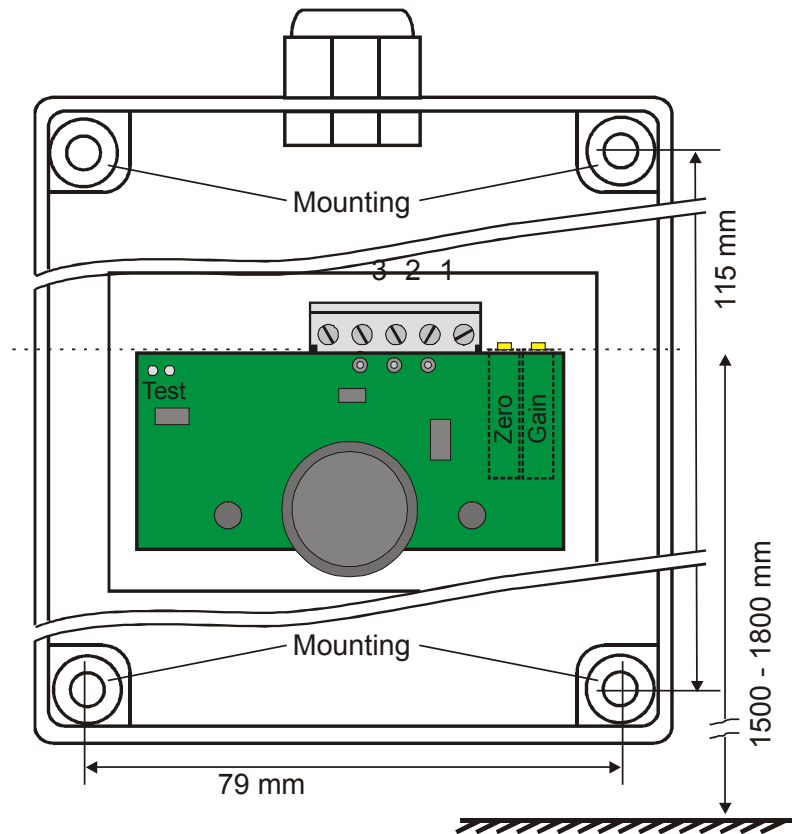


Fig.7 Enclosure type A

14.2 Enclosure Type 5

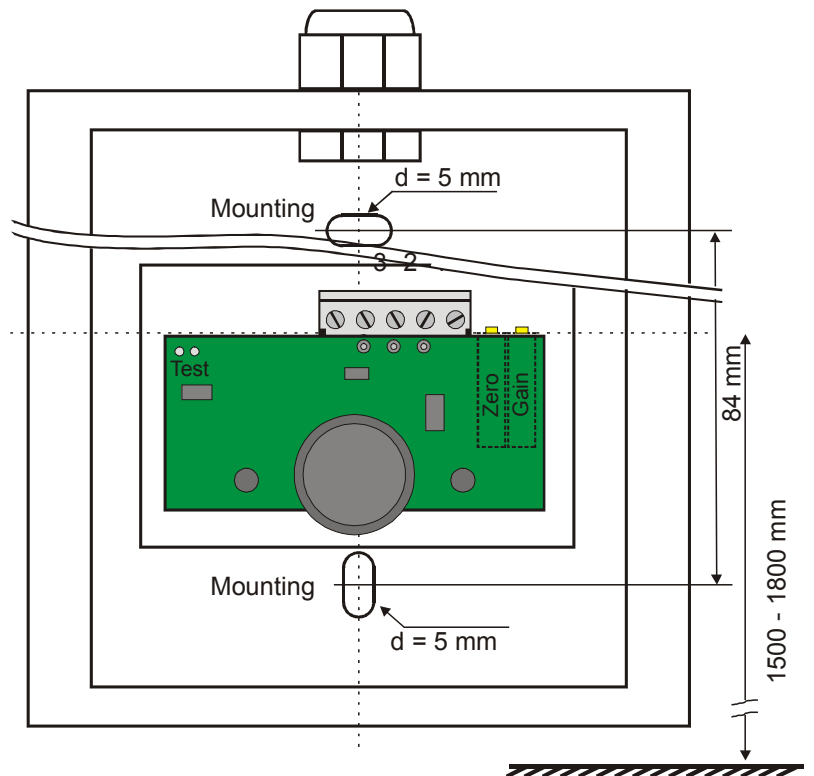


Fig.8 Enclosure type 5

14.3 Installation Work

- Open cover.
- Fix the enclosure by 2 screws (gas inlet always downwards).
- Close cover.

14.4 Connection Work

- Pay attention to the general information (section 4).
- Open cover.
- Insert cable, strip it off and connect it.
- Close cover.

14.5 Calibration

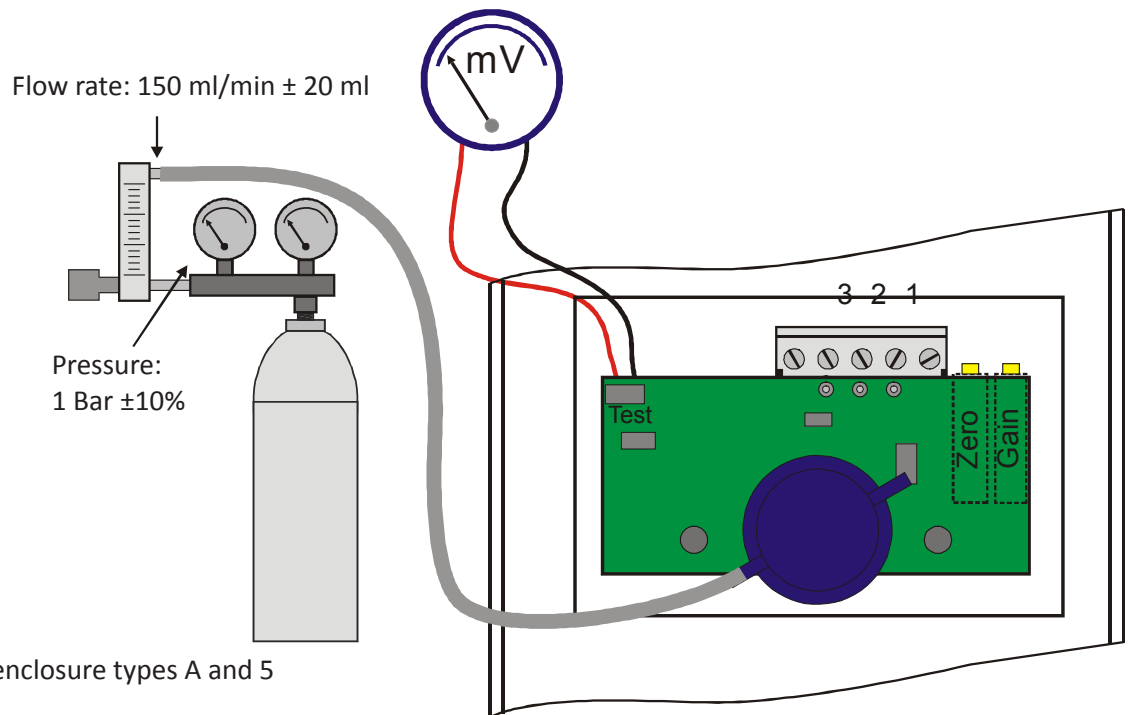


Fig.9 Calibration for enclosure types A and 5

15.6 Specifications

Physical characteristics		
Enclosure	Type A	Type 5
Enclosure material	Polycarbonate	V2A, 1mm, material 1.4301
Flammability	UL 94 V2	
Enclosure colour	RAL 7032 (light grey)	Natural, brushed
Dimensions (W x H x D)	94 x 130 x 57 mm	113 x 135 x 45 mm
Weight	0.3 kg	0.5 kg
Protection class	IP 65	IP 55
Mounting	Wall mounting, pillar mounting	
Cable entry	Standard 1 x M 20	

15.7 Exchange of Sensor Element

Sensor should always be exchanged without power applied (remove the PCB at the socket board):

- Unplug old sensor element from the PCB, plug in new original sensor element.
- Plug in the PCB at the socket board correctly. See fig.3.
- Calibrate the sensor (see section 5.).

15.8 Opening of the Enclosure Type 5

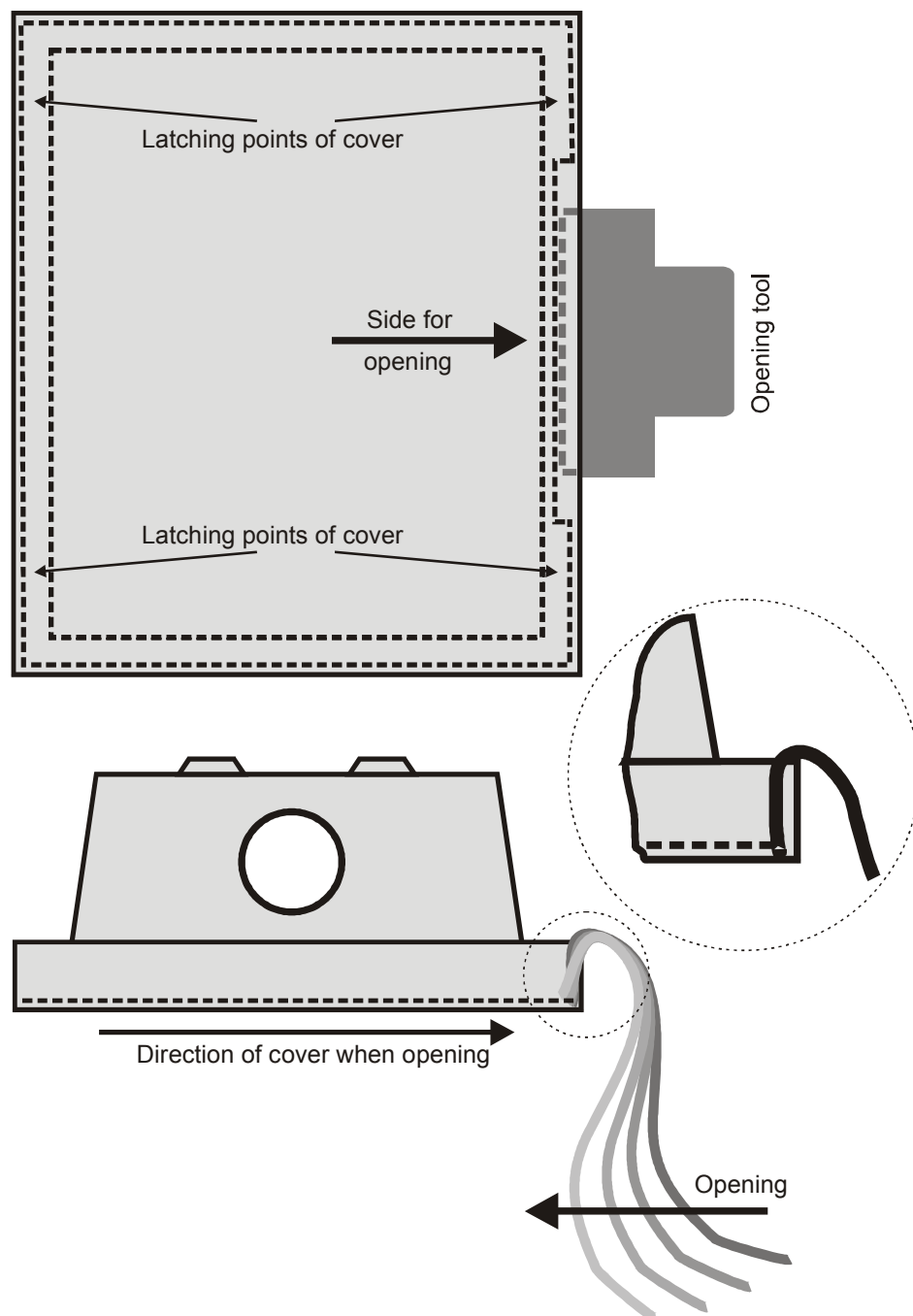


Fig. 10 Opening of the enclosure type 5