



**LCO MCO PCO**

**Electrochemical Carbon Monoxide Transmitter**

## **User Manual**

August, 2010

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## Electrochemical Carbon Monoxide Transmitter

### 1 Intended Use

The CO analogue gas transmitter LCO, MCO and PCO with 4 – 20 mA / 2- 10 V output is used for the continuous monitoring of the ambient air to detect the presence of carbon monoxide (CO) gas concentrations within the ambient conditions defined in the Specifications.

Main application ranges are underground car parks, tunnels, engine test stations, shelters, loading areas etc.

The intended sites 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 CO analogue transmitter must not be used in potentially explosive atmospheres.

### 2 Functional Description

The sensor portion of the transmitter is a micro-fuel cell, which is completely sealed.

The ambient air to be monitored diffuses through a membrane filter into the liquid electrolyte of the sensor.

The chemical process of the measurement is one of oxidation where one molecule of the target gas is exchanged for one molecule of oxygen.

The reaction drives the oxygen molecule to the counter electrode, generating a current signal (mA) between the two electrodes.

This signal is linear to the volume concentration of the sensed gas.

The signal is evaluated by the connected amplifier and transformed into a linear 4 to 20 mA / 2 – 10 V output signal.

Electrochemical processes always lead by-and-by to a loss of sensitivity.

Therefore regular calibration of zero-point and gain with the potentiometers Zero and Gain is 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 carbon monoxide CO is smaller than that of air (factor 0.967). Recommended mounting height is 1.5 m (5 feet) to 1.8 m (6 feet) above floor.
- Choose mounting location of the sensor according to local regulations.
- 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.
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### 3.2 Installation

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

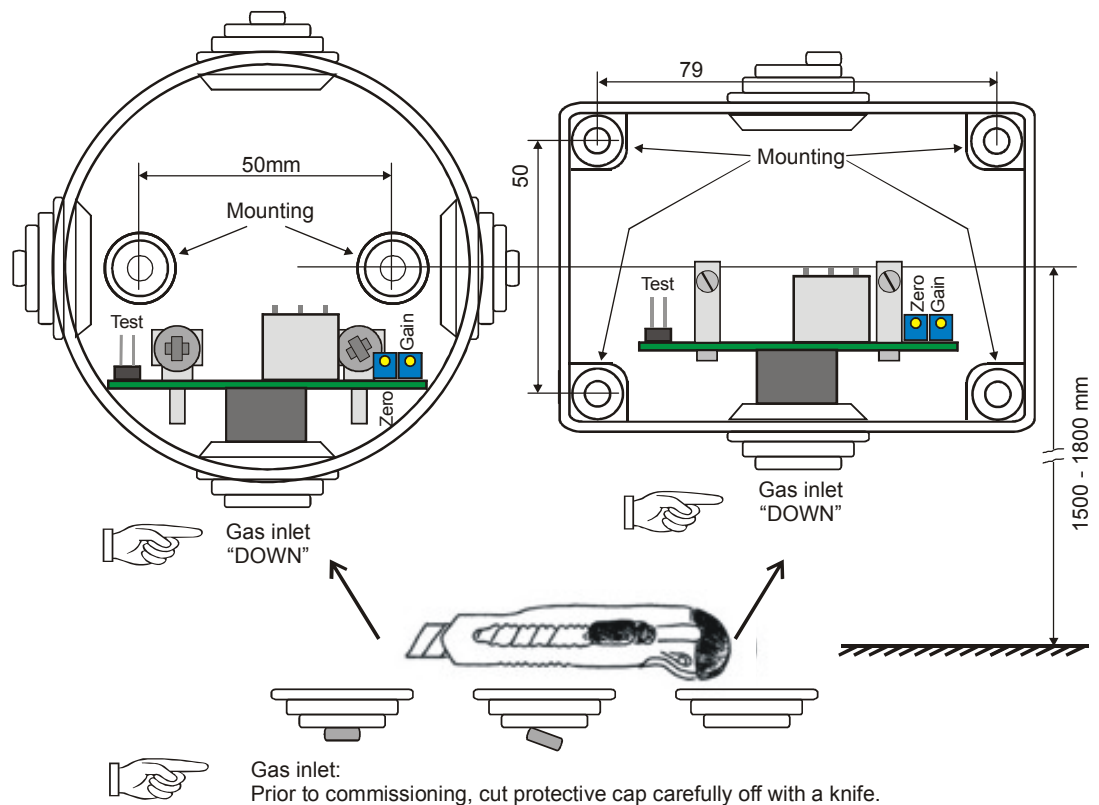


Fig.1 Mounting

## 4Electrical 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  $\Omega$ /1000 m (20.8  $\Omega$ /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.

### 4.1Wiring 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.

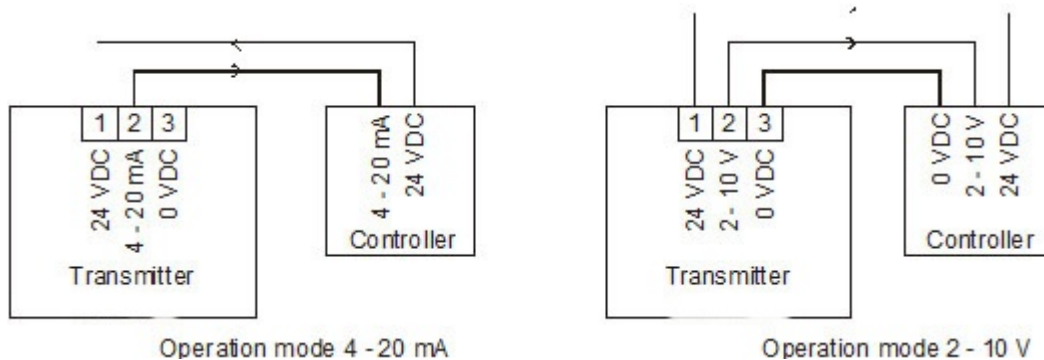


Fig.2 Wiring Diagram

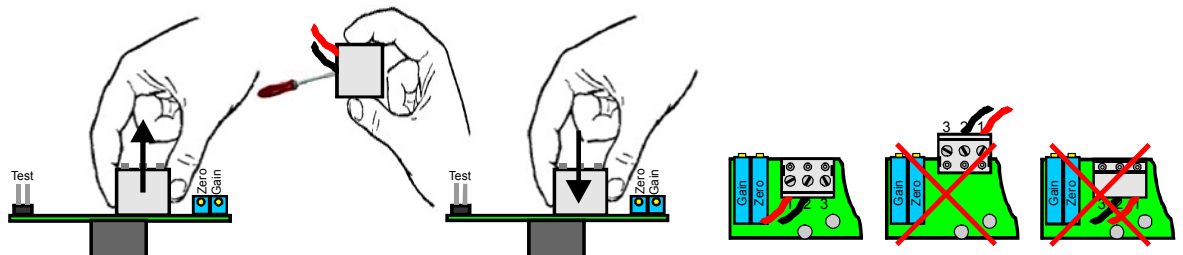


Fig.3 Electric Connection

### 4.2Output 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.

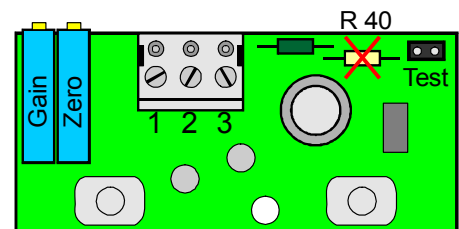


Fig.4 Board

## 5. Commissioning



CO calibration gas is toxic, never inhale the gas!

Symptoms: Dizziness, headache and nausea.

Procedure if exposed: Bring into fresh air at once, consult a doctor.

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 calibrate the transmitter:

- Test gas bottle with synthetic air or CO-free ambient air.
- Test gas bottle with CO. Concentration 30 – 70 % of the measuring range. The rest is synthetic air.
- 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)

- Open cover of enclosure.
- Connect digital voltmeter to pin "Test" for zero-point calibration.
- Connect the calibration adapter to the sensor element.
- Apply zero calibration gas, 150 ml/min; 1 Bar (14.5 psi), or other CO-free air source.
- Wait one minute until the signal is stable, adjust signal with potentiometer "Zero" until the signal is  $40 \text{ mV} \pm 1 \text{ mV}$  and stable (= 4 mA / 2V).

### 5.2 Calibration Span

- Connect calibration adapter to the sensor element.
- Connect digital voltmeter to pin "Test".
- Apply span calibration gas (30 – 70 % CO of measuring range), 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 5.3,  $\pm 1 \text{ mV}$  and is stable.
- 



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

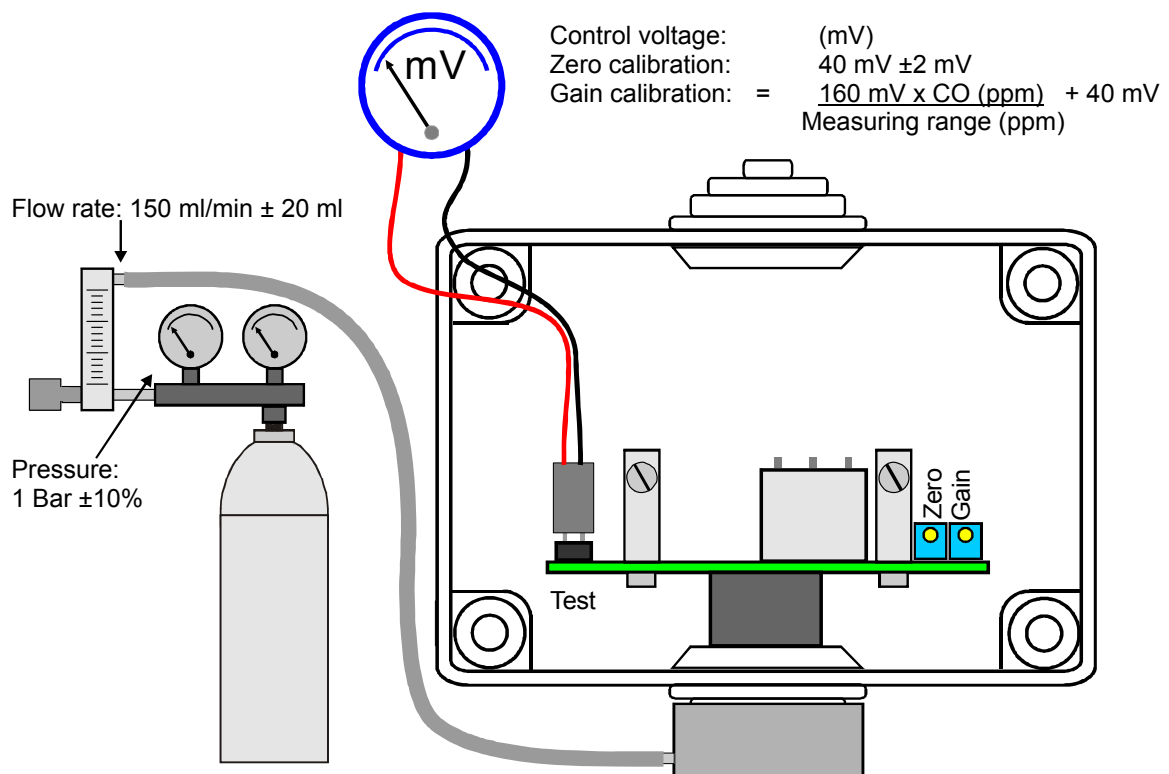
The control voltage at the pin "Test" simulates the 4 – 20 mA signal at a 10 Ohm measuring resistance.

$$\text{Control span voltage (mV)} = \frac{160 \text{ (mV)} \times \text{test gas concentration CO (ppm)}}{\text{measuring range CO (ppm)}} + 40 \text{ (mV)}$$

#### Example:

Measuring range CO	300 ppm
Test gas concentration	200 ppm CO
Control voltage	146,7 mV

$$\frac{160 \text{ (mV)} \times 200 \text{ (ppm)}}{300 \text{ (ppm)}} + 40 \text{ (mV)} = 146,7 \text{ mV}$$



Test gas:  
 Zero calibration: Synthetic air  
 Gain calibration: CO (ppm) with 30 – 70 % concentration of the measuring range, rest is synthetic air.

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 AP 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.

AP recommends checking the 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 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

The table does not claim to be complete.

Other gases can have an influence on the sensitivity, too.

The indicated sensitivity data are only standard values referring to new sensor elements.

Gas	Chemical formula	Gas concentration	Exposure Time (min)	Influence on the reading (ppm CO)
Acetone	$(CH_3)CO(CH_3)$	1000 ppm	5	0 ppm
Acetylene	$C_2H_2$	40 ppm	5	80 ppm
Ammonia	$NH_3$	100 ppm	5	0 ppm
Carbon dioxide	$CO_2$	5000 ppm	5	0 ppm
Chlorine	$Cl_2$	2 ppm	5	0 ppm
Ethanol	$C_2H_5OH$	2000 ppm	30	5 ppm
Hydrogen	$H_2$	100 ppm	5	20 ppm
Hydrogen sulphide	$H_2S$	25 ppm	5	0 ppm
Iso Propanol	$C_3H_7OH$	200 ppm	120	0 ppm
Nitric oxide	$NO$	50 ppm	5	8 ppm
Nitrogen dioxide	$NO_2$	50 ppm	900	1 ppm
Sulphur dioxide	$SO_2$	50 ppm	600	< 0.5 ppm

## 9 Specifications

<b>Electrical</b>		
Power supply:	16 - 28 VDC (reverse polarity protected)	
Power consumption:	22 mA, (0.6 VA), max.	
<b>Sensor Performance</b>		
Type of gas	Carbon monoxide (CO)	
Sensor element	Electrochemical, diffusion	
Measuring range	0 – 300 ppm factory set, 0 - 200 to 0 – 300 ppm adjustable	
Accuracy	± 3 ppm	
Repeatability	± 3 % of reading	
Long term drift zero-point	< 5 % signal loss/year	
Response time	t <sub>90</sub> ≤ 50 sec.	
Sensor life expectancy	5 years, normal operating environment	
Mounting height	1.5 to 1.8 m (5 to 6 ft.) above floor	
<b>Type of Control</b>		
Analog output signal	4 – 20 mA, load ≤ 500 Ω 2 -10 V, load ≥ 50 k Ω Proportional, overload and short-circuit protected	
<b>Operating Environment</b>		
Humidity Range: Continuous	15 to 90 % RH non-condensing	
Intermittent	0 to 99 % RH non-condensing	
Working temp.: Continuous	-10 °C to + 50 °C (14 °F to 122 °F)	
Intermittent	-20 °C to + 50 °C (-4 °F to 122 °F)	
Storage temperature	5 °C to + 30 °C (41 °F to 86 °F)	
Pressure range	Atmospheric ±10%	
<b>Physical characteristics</b>		
Enclosure	Type MCO PCO	Type LCO
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 54	IP 44
Mounting	Wall mounting, pillar mounting	
Cable entry	1 x M 20	
Wire connection	Screw type terminal, min. 24 AWG (0.25 mm <sup>2</sup> ), max. 14 AWG (2.5 mm <sup>2</sup> )	
Wire distance	Max. loop resist. 500 Ω (= wire resistor + controller input resistor)	
<b>Approvals/Listings</b>		
	VDI 2053, Air Treatment Systems for Garages and Tunnels (in preparation)	
	Sensor: UL recognized	
<b>Directives</b>		
	EMC Directive 2004/108/EEC	
	CE	
<b>Warranty</b>		
	One year material (without sensor)	

## 10 Calibration Adapter

Enclosure Type PCO and Stainless;

Type: Calibr-set-AT



Enclosure Type MCO and LCO

Type: Calibr-set MA



Fig.6 Calibration Adapter

## 11 Spare Parts List

Description	Order No.	
Sensor	Sense00-1110	
PCB without sensor	MA-1110-003	
Connector triple-pole	MA_25..600.2353.0	
Enclosure type MCO	GMA_D-001	
Enclosure type LCO	GMA_F-001	
Enclosure type PCO	GMA_A-001	
Enclosure type Stainless	GMA_5-001	
Filter set for enclosure type MCO	F_MA-10	

## 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 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, AP 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 CO 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.

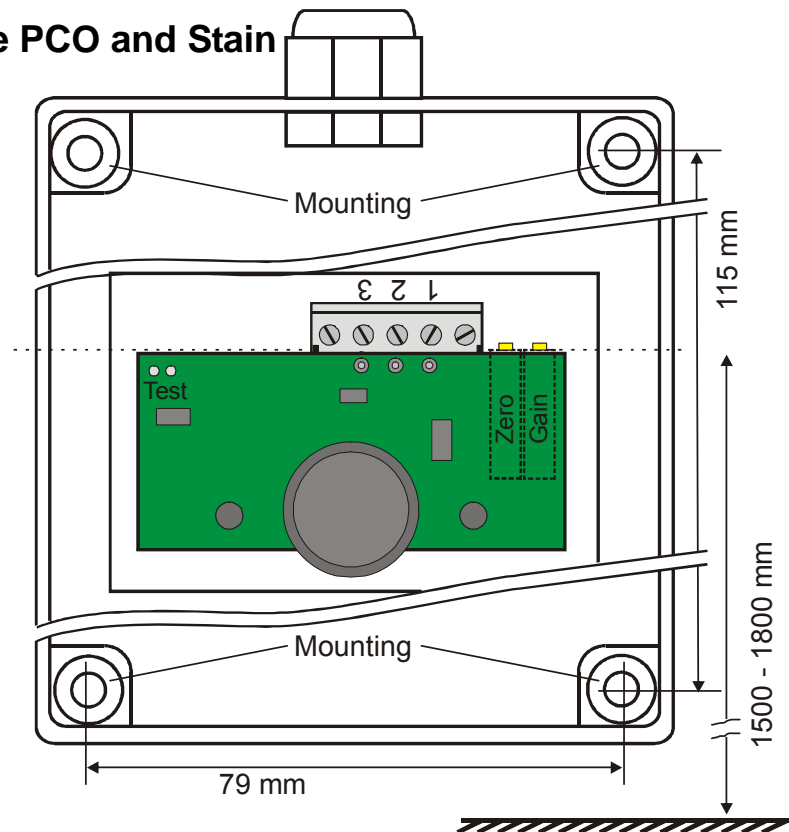
This warranty applies only to the transmitter.

Automatikprodukter shall not be liable for any incidental or consequential damages arising out of or related to the use of the transmitters.

## 14 Appendix Enclosure PCO and Stain

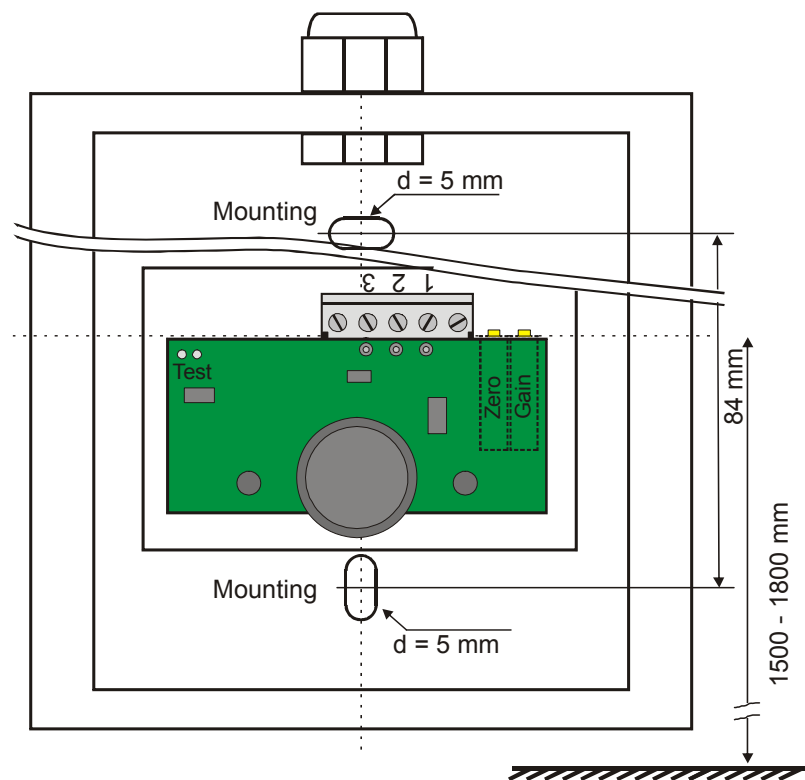
### 14.1 Enclosure Type PCO

Fig.7 Enclosure type PCO



### 14.2 Enclosure Type Stainless

Fig.8 Enclosure type Stainless



### 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

Description, see point 5.

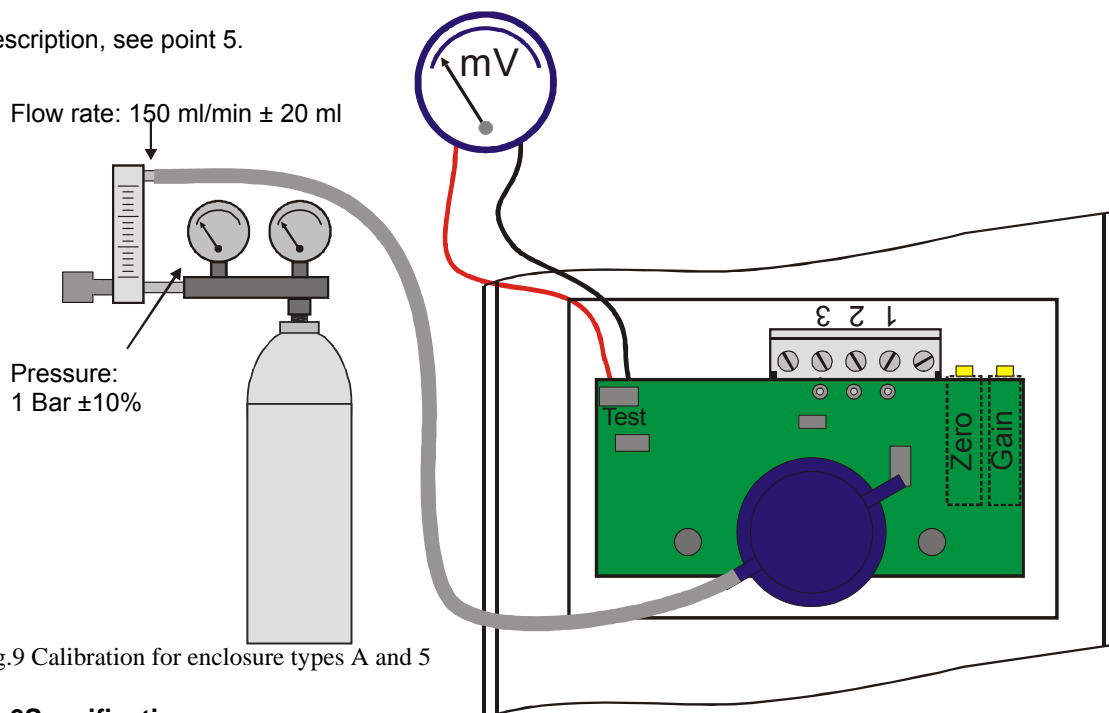


Fig.9 Calibration for enclosure types A and 5

### 14.6 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	

### 14.7 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.).
- 

### 14.8 Opening of the Enclosure Type Stainless steel

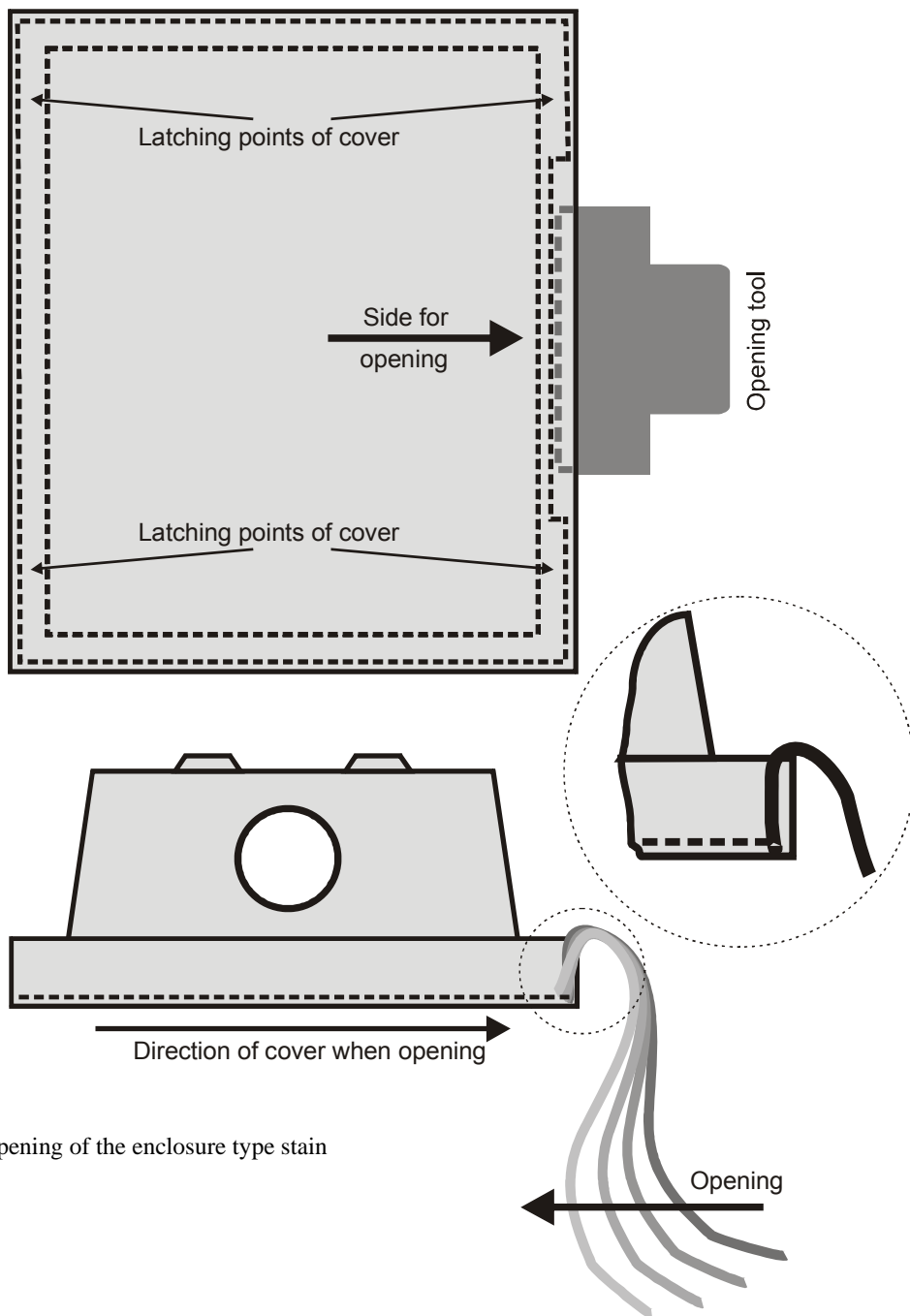


Fig.10 Opening of the enclosure type stain