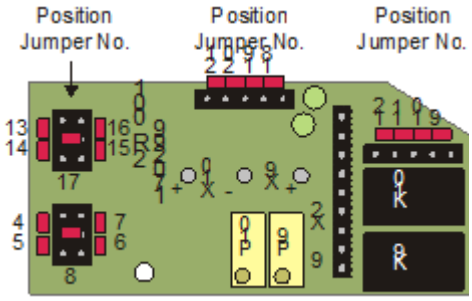


1 General Overview

The analog gas transmitter CMD wih 4 to 20mA output is used for the continuous monitoring of the ambient air to detect the presence of Carbon Monoxide gas.

2 Description

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

The measurement is a gas-in-liquid chemical reaction rather than a surface area measurement.

With no surface area to coat, this sensor retains its sensitivity to carbon monoxide even after prolonged exposure to clean air.

The cell consists of a diffusion barrier, O-ring seal, electrolyte reservoir and two electrodes.

The target gas, carbon monoxide, enters the cell through a diffusion barrier.

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 DC microampere signal between the counter electrodes.

This signal is linear to the volume concentration of the sensed gas rather than the partial pressure.

The integrated two-wire transformer converts this DC microampere signal to a standard 4-20mA signal

Most sensors produce a small amount of baseline current in clean air.

This is adjusted with the zero potentiometer on the transmitter.

The oxidation at the electrodes causes the wear of the sensor.

Typical lifetime of the sensor is approximately five years in normal operation.

Lifetime can vary a bit with some sensors working less than five years and some more than 5 years.

The wear also changes the characteristics of the sensor, requiring periodic re-calibration.

The sensor accuracy is recommended to be verified every six months and recalibrated if necessary.

Option relay package 2R:

With the 2R relay package two potential-free contacts are available for the connection to external devices.

The switching thresholds of these relays are selectable via potentiometer in the range of 10 - 90 % of the CO concentration.

The hysteresis is programmable via jumpers.

Additionally the relay mode, open-circuit or closed circuit, is selectable.

The status of the two relays is displayed via LED.

Caution:

Avoid any force (e.g. by thumb) on the sensor element during operation or installation.

This could destroy the sensor element.

There is a small quantity of corrosive liquid in the sensor element.

If in case of damage persons or objects encounter 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.

3 Installation

Note:
Avoid any force (e.g. by thumb) on the sensor element during operation or installation.
This could destroy the sensor element.
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.

3.1 Mounting instructions

- The specific weight of carbon monoxide is almost the same as that of air (factor 0.967).
  Mounting height is 1.5 m (5 feet) above floor (max. 1.8 m, 6 feet).
- Location of the sensor must conform to the layout of the area being monitored.
- Consider the ventilation conditions!
  Do not mount the transmitter in the center of the airflow (air passages, suction holes)
- Mount the transmitter in vertical position (sensor with its diffusion area to the ground) 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.

Duct mounting

- Mount only in a straight section of duct with minimum air vortex.

  Keep a minimum distance of 1 m (3,5 feet) from any curve or obstacle.
- Mount only in a duct system with a maximum air velocity of 10 m/s (2000 ft/min) or less.
- Mounting must be performed so that the airflow is in line with probe openings.

3.2 Installation

- Open cover of enclosure.
- Unplug basic PCB from terminal blocks.
- Fix bottom part by screws vertically to the wall (terminal blocks to the ground).
- Plug in the basic PCB at X4 and X5.
- Replace the cover.

4 Electrical Connection

4.1 Instruction

Consider static electricity! See 3. Mounting

- 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.

4.2 Wiring connection

- Unscrew cover of enclosure.
- Unplug basic PCB from terminal blocks.
- Connect cable leads to terminal block X4.
- Plug the PCB in the fixed terminal blocks on base.
- Screw cover on base

4.3 Mounting option relay package 2R.

Consider static electricity! See 3. Mounting.

- Unplug basic PCB from terminal blocks fixed on base.
- Plug in the relay package at the multipoint connector X2 to the basic PCB . See Fig. 2
- Secure by the enclosed screw M2,5x 6 at the back side of the PCB.
- Re-plug basic PCB in the terminal blocks X4, X5.

5 Commissioning

Only trained technicians should perform the following:

- Check mounting location.
- Check power voltage.
- Check PCB EC-S for proper mounting at X4 and X5.
- Check for correct sensor element at terminal X3 PCB EC-S.
- Verify transmitter operation (sensor/transmitter was factory calibrated).

Option relay package 2R:

- Check proper mounting of relay package 2R at board EC-S.
- Select the desired hysteresis and relay function.
- Adjust threshold values.

Note:

If calibration is necessary, the sensor element must be powered and fully stabilized for at least 1 hour.

Required instruments to calibrate the transmitter:

- Test gas bottle with synthetic air.
- Test gas bottle with CO with a range of 150 – 270 ppm.
- Gas pressure regulator with flow meter to control the gas flow to 150 ml/min.
- Sensor head calibration adapter with tubing. Type: Calibr-set-S01 See Fig. 3
- Digital voltmeter with range 0 – 2Vdc, accuracy 1% and a small screwdriver.

Note:
Please observe proper handling procedures for test gas bottles!

5.1 Calibration Zero point (4 mA)

(After sensor warm-up)

- Connect digital voltmeter to test pins X6 – and + (with a range selected that will display 2Vdc max.).
- Connect the calibration adapter to sensor element.
- Apply sensor element zero calibration gas, 150 ml/min; 1 Bar (14.5 psi) ± 10%, or other clean air source.
- Wait two minutes until the signal is stable, adjust signal with zero potentiometer ”Zero” until the signal is 200 mV ± 1mV and stable.
- Remove calibration adapter carefully by turning lightly.

5.2 Calibration Span

Notes:
CO calibration gas is toxic, never inhale the gas!
Symptoms: Dizziness, headache and nausea.
Procedure if exposed: Bring into fresh air at once, consult doctor.

- Connect digital voltmeter to test pins X6 – and + (with a range selected that will display 2Vdc max.).
- Connect calibration adapter to the sensor element.
- Apply sensor element span calibration gas (150 - 270 ppm CO), 150 ml/min; 1 Bar (14.5 psi) ± 10%.
- Wait two minutes until the signal is stable, adjust signal with span potentiometer ”Gain” until the signal corresponds to the appropriate mVdc (± 3 mV, see calculation for control voltage 5.2) and is stable.
- Remove calibration adapter with a careful light turn. Inspect the correct mounting of the sensor element!

5.3 Calculation of control span voltage

$$\text{Control span voltage (mV)} = \frac{800\ (\text{mV}) \times \text{test gas concentration (ppm)}}{\text{measuring range CO (ppm)}} + 200\ (\text{mV})$$

Example:

Measuring range CO concentration 300 ppm
Test gas concentration 200 ppm CO
Control voltage 733 mV

$$\frac{800\ (\text{mV}) \times 200\ (\text{ppm})}{300\ (\text{ppm})} + 200\ (\text{mV}) = 733\ \text{mV}$$

5.4 Commissioning option relay package 2R

Note: Option relay package only possible in 3-wire technique.

5.4.1 Selection of open-circuit/closed-circuit current operation.

Each relay can be configured to open-circuit current operation or closed-circuit current operation (fail-safe) via jumper.

Take the position of the jumpers from the following table.

Operation	Relay R9 Jumper position	Relay R10 Jumper position
Closed-circuit mode	9 and 11	18 and 20
Open-circuit mode	10 and 12	19 and 21

Factory-set: Closed-circuit mode

5.4.2 Adjust switching threshold voltage

Required instruments:

- Digital multimeter with range 0 - 10Vdc, accuracy 1%.
- Screwdriver small.

Switching threshold voltage can be adjusted in the range of 1V – 9V, 10% - 90% of the measuring range.

Adjust switching voltage for relay R 9

- Connect digital multimeter to X9 + and -. Observe polarity!
- Adjust calculated switching voltage ± 10mV, see section 5.4.3. by potentiometer P9.

Adjust switching voltage for relay R 10

- Connect digital multimeter to X10 + and -X9. Observe polarity!
- Adjust calculated switching voltage ± 10mV, see section 5.4.3. by potentiometer P10.

5.4.3 Calculation of switching threshold voltage

$$\text{Switching voltage (mV)} = \frac{8000\text{(mV)} * \text{alarm threshold CO(ppm)}}{\text{range CO concentration (ppm)}} + 2000\text{ (mV)}$$

Example:

Range CO concentration	300 ppm
Alarm threshold CO	80 ppm
Switching voltage	4133 mV

$$\frac{8000\text{(mV)} \times 80\text{ (ppm)}}{300\text{ ppm}} + 2000\text{(mV)} = 4133\text{mV}.$$

5.4.4 Select switching hysteresis

The switch-off threshold is calculated according to the following formula:

$$U_{off} = U_{threshold} - U_{hysteresis}$$

the calculated switching voltage the jumpers have to be plugged into the correct position in order to select either 5% or 10% of the full range of the transmitter as switching differential.

See table for jumper positions.

Calculated threshold voltage (V)	Switching hysteresis (%)	Relay R9 Jumper pos.	Relay R10 Jumper pos.
1,00 – 3,50	5	7	16
	10	5	14
3,51 – 6,50	5	4	13
	10	6	15
6,51 – 9,00	5	5	14
	10	8	17

Note:

If the calculated voltage is below 1,50 V, it's not allowed to adjust a switching differential of 10%.
The triggered alarm relay would not reset.

6 Inspection and Service

6.1 Inspection

Inspection, service and calibration of the transmitters should be done by a trained technicians and executed at regular intervals.

We therefore recommend to conclude a service contract with AP or one of their authorized partners.

6.2 Calibration

(See part 5.1 and 5.2)

- At commissioning and at periodic intervals determined by the person responsible for the gas detection system **(recommendation every 6 months)**.
- **After** exchange of the sensor
- If in case of operational or climatic influences the sensitivity of the sensor **falls below 30 %** in operation, calibration will not be possible any more.

Then the sensor has to be changed.

6.3 Exchange of sensor element

Static electricity (see section 3).

Sensor should always be installed without power applied:

- Unplug basic PCB EC-S carefully from the terminal blocks on the base.
- Unplug old sensor element from the PCB EC-S.
- Plug in sensor element into the PCB EC-S.
- Plug in the PCB EC-S into terminal block X4, X5 carefully.
- Calibrate (see section 5.1).

7 Troubleshooting

7.1 Diagnostics of the transmitter

Trouble	Cause	Solution
Output signal 0mA and control voltage 0V	Power voltage not applied	Measure power voltage at terminal block X4 terminal 3 (+) and 4 for 18 – 28Vdc
	Basic PCB EC-S X4 and X5 not plugged in correctly	Plug in the basic PCB EC-S into X4 and X5 correctly
Output signal < 3mA and/or control voltage < 150mV	Sensor element not calibrated	Calibrate sensor element
Control current signal not correct	Sensor sensitivity < 30%	Replace sensor element

7.2 Diagnostics at option relay package 2R

Trouble	Cause	Solution
No relay switching	Board 2R not installed correctly Jumper JP 9 – 12 and/or 18 - 21 not installed	Plug in 2R correctly into board See Fig. 3 for correct setting
Incorrect relay switching	Jumper JP 9 – 12 and/or 18 - 21 not installed correctly	See Fig. 3 for correct setting
No relay switching at calculated threshold setting	Switching voltage adjusted and/or calculated incorrectly	Check switching voltage
Relay return differential too long	Differential jumper not correct	Check jumper position

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 shows the typical response to be expected from the sensor when exposed to the following gases.

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

The table does not claim to be complete.

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

Gas	Chemical mark	Gas concentration	ExposureTime (min)	Tolerance 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

Electrical

Power supply:	18 - 28Vdc (reverse polarity protected)
Power consumption:	22mA, (0.6VA), max.
- with relay package	35mA, max. (1,0VA)
RFI/EMI protection	5.0W @1ft. (0.31 m) radiated

Sensor Performance

Type of gas	Carbon monoxide (CO)
Sensor element	Electrochemical, diffusion
Measuring range	0 – 300 ppm factory set, 0 - 150 to 0 – 300 ppm, adjustable via calibration
Stability & resolution	± 3 ppm
Repeatability	± 3 % of reading
Long term output drift	< 5 % signal loss/year
Response time	t_{90} ≤ 50 sec.
Sensor life expectancy	5 years, normal operating environment
Sensor coverage	465 m^2, (5,000 sq.ft.), to 930 m^2 (10,000 sq.ft.) ”ideal conditions”
Mounting height	1.5 to 1.8 m (5 to 6 ft.) above floor

Type of Control

Analog output signal	Proportional, 4 – 20mA, load ≤ 500 Ωoverload and short-circuit protected.
Optional	2 x relay contacts, potential-free, max. 30Vac/dc, 0,5A

Operating Environment

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%

Physical characteristics

Enclosure material	Depending on type
Enclosure color	Depending on type
Dimensions (W x H x D)	Depending on type
Weight	Depending on type
Protection class	Depending on type
Mounting	Wall mounting, pilar mounting, depending on type
Cable entry	1 x M20
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)

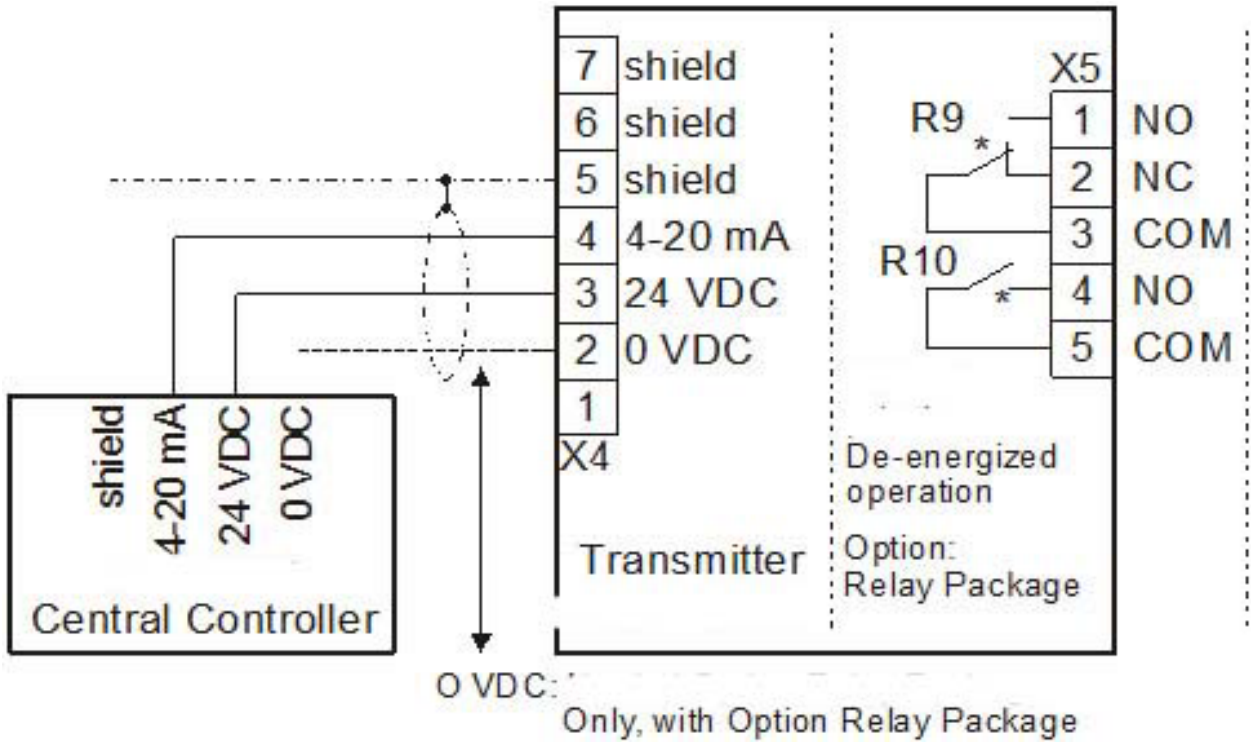
Approvals/Listings

VDI 2053, Air conditioning plants for Underground Parking
CE
EMV-directive 89/336/EWG

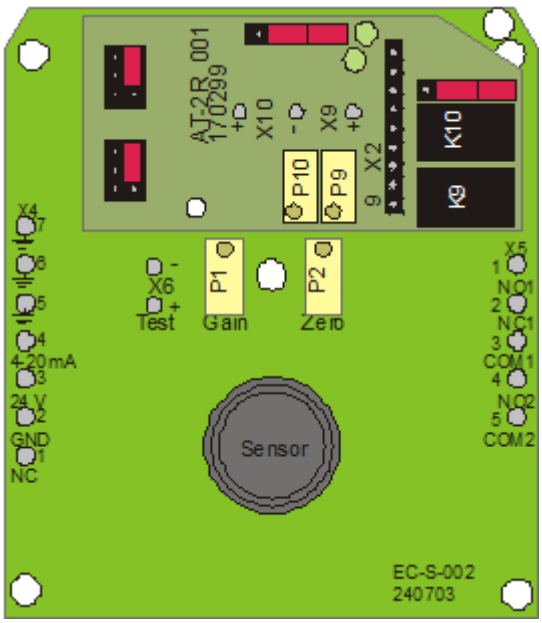
Warranty

One year material and workmanship (without sensor)

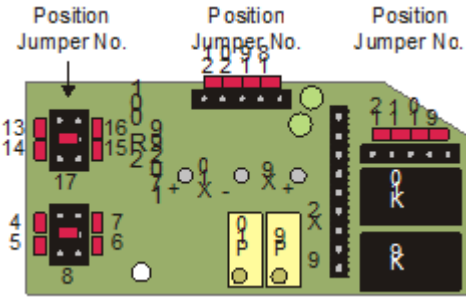
9 Wiring Configuration



PCB EC-S



Option relay package 2R



Calibrations Set

11 Notes and General Information

It is important to read this user manual thoroughly and clearly in order to understand the information and instructions.

The AP 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.

11.1 Intended product application

The CMD transmitters are designed and manufactured for control applications and air quality compliance in commercial buildings and manufacturing plants (i.e. detection and automatic exhaust fan control for automotive maintenance facilities, enclosed parking garages, engine repair shops, warehouses with forklifts, fire stations, tunnels, etc.).

11.2 Installers' responsibilities

It is the installer's responsibility to ensure that all AP 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.

11.3 Maintenance

It is recommended to check the AP 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 AP

11.4 Limited warranty

AP 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, APwill 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 AP transmitter.

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