Oxygen Detector O_2 025

User Manual

Feb. 2013

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1 General overview

The O_2 analog/digital transmitter ADT-93-1195 with digital processing of the measuring values and temperature compensation is used for the continuous monitoring of the ambient air to detect the presence of oxygen concentrations. Main application ranges are laboratories, food production etc. where changes of the oxygen concentrations might be possible.

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 O_2 analog/digital transmitter must not be used in potentially explosive atmospheres. The transmitter must only be employed in areas within the environmental conditions as specified in the Technical Data.

2 Functional Description

2.1 Control Mode

In addition to the analog output the transmitter is equipped with a serial interface RS-485 and ModBus protocol.

Analog mode:
The analog output can be selected as current signal with (0)4-20 mA or as voltage signal (0)2-10 V. In the 4-20 mA mode and without any supplementary options, the O_2 detector also works in the 2-wire technique.

M DGC-05 Bus Mode:
The transmitter can be connected to the GCD-05 system via the RS-485 interface. In this mode there is an analog input for the connection of an additional 4-20 mA transmitter. The two measuring values are transmitted via the RS-485 interface / ModBus protocol.

The cable topology for the RS-485 bus can be taken from the “Guidelines for wiring and commissioning of the GCD-05 hardware”.

The two control modes are available in parallel.

2.2 Sensor

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 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.

Caution: 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.

3 Installation

Note: Avoid any force (e.g. by thumb) on the sensor element during operation or installation. 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 DIN EN100015).

3.1 Mounting Instructions

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

- The specific weight of oxygen O_2 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 process. Consult AP website for other mounting heights.
- Choose mounting location of the sensor according to the 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.

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 probe openings are in line with the airflow.

3.2 Installation

- Open the cover. Unplug basic PCB carefully from the bottom part.
- Fix bottom part by screws vertically to the wall (terminal blocks to the ground).
- Replug the basic PCB at X4 and X5 with care. Replace the cover.

4 Electrical Connection

Consider static electricity! See 3. Mounting

- Installation of the electrical wiring should only be executed by a trained specialist and 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 shielded cables for the signal line, but do not connect the shield.
- Recommended cable for analog mode: J-Y(St)Y 2x2yx0,8 LG (20 AWG), max. resistance 73 Ω/km (20.8 Ω/1000 ft).
- It is important to ensure that the wire shields or any bare wires do not short the mounted PCB.
- Serial Interface Mode:
  Required cable for RS-485 mode: J-Y(St)Y 2x2x0,8 LG (20 AWG), max. res. 73 Ω/km (20.8 Ω/1000 ft) When selecting and installing the cables you have to comply with the regulations concerning the RS 485 bus installation. The installations have to be executed in line topology. Cable length and type have to be considered as well.
- It is important to ensure that the wire shields or any bare wires do not short the mounted PCB.

4.1 Wiring Connection

- Open the cover. Unplug basic PCB carefully from terminal blocks X4 and X5.
- Insert the cable and connect cable leads to terminal blocks. See fig. 1 and 2.
- Replug the PCB in the terminal blocks X4, X5. Replace the cover.

Note: The connection of the power supply at the output signal (X4 pin 4) can destroy the transmitter.

5 Commissioning

Consider commissioning instructions at any exchange of the sensor elements. Only trained technicians should perform the following:

- Check mounting location.
- Select output signal form: Current or voltage, and starting point 0 or 20%. See fig. 4.
- Check power voltage.
- Check PCB AT03 for correct mounting at X4 and X5.
- Check the sensor for proper mounting at the connectors X3 of the PCB AT03.
- Addressing of the transmitter in the Bus mode.
- Calibrate the transmitter (if not already factory-calibrated).

Required instruments for commissioning (calibration) of the transmitter:

- Test gas bottle with test gas O_2 in the range of 20,9 vol. % or ambient air 20,9 vol. % O_2.
- Gas pressure regulator with flow meter to control the gas flow to 150 ml/min.
- Calibration adapter with tube. Calibration set, see fig. 5.
- Digital voltmeter with range 0 – 300 mV, accuracy 1%.
- Small screwdriver.
- Calibration tool GCD-05 STL (only for calibration with service tool GCD-05).
- DGC05 Configuration and Calibration Software incl. USB/RS-485 communication set (only for software calibration mode).

Note: Prior to calibration the sensor must be connected to the power supply and fully stabilised for at least 1 hour without interruption. Please observe proper handling procedures for test gas bottles (regulations TRGS 220)!

Please observe proper handling procedures for test gas bottles (regulations TRGS 220)!

5.1 Calibration of the Zero-point at the Analog Output Signal

The analog output signal is factory set to the zero-point. If necessary, a manual adaptation of the analog signal is possible within 10 sec. after having applied the supply voltage.

- Jumper 0-20 % for signal start has to be set (= 4 mA or 2 V).
- Connect digital voltmeter (300 mV) at test pint “Test” (measuring signal ~ 40 mV = 4.0 mA).
- Switch on the operating voltage.
- Each pressing on the “Zero” push-button increases the signal by + 0.5 mV (0.05 mA). Press the button repeatedly until the measuring signal reaches 40 ± 0.2 mV. After 44mV the signal starts again at 36 mV. The correction is only possible within the 10 seconds after having switched on the power supply. An impulse pause of more than 10 sec. cancels the release of the correction function.

5.2 Calibration

Depending on the version and the control mode there are three different possibilities to calibrate the transmitter:

Manual calibration
Manual calibration is only possible if the transmitter is equipped with the push-button “Zero” and the potentiometer “Gain” (= version for manual calibration).

Manual calibration is possible both in analog mode and in GCD-05_Bus mode.

In the GCD-05_Bus mode the jumper V-A has to be set before manual calibration. Only by doing so the control voltage is available at the test pins X6. Remove the jumper after calibration.

Calibration with the DGC-05 Service Tool

In the standard version (equipped with the communication connector X12) the transmitter is delivered for tool and/or software calibration.
In the analog mode the service tool calibration is only possible with the 3-wire technique of the transmitter!
In the DGC-05_Bus mode calibration is always possible.

Software calibration via PC with Software GCD05_EasyConf
In the standard version (equipped with the communication connector X12) calibration can also be done by means of the DGC05 Configuration and Calibration Software DGC-05_EasyConf.

Software calibration is possible for both control modes.

5.3 Manual calibration

5.3.1 Zero-point
The zero-point is factory-set; therefore zero calibration is not necessary.

5.3.2 Gain
- Connect digital voltmeter to pin “Test”.
- Connect calibration adapter carefully to the sensor element.
- Apply calibration test gas O2 (150 ml/min; 1 Bar (14.5 psi) ± 10%).
- Wait two minutes until the signal is stable, adjust control voltage with potentiometer ”Gain” until the signal corresponds to the calculated value, see “5.3.3 Calculation of Control Voltage”.
- Remove calibration adapter with a careful light turn. Check the sensor for correct mounting!
- By limiting the gain factor, calibration will not be possible any more when the sensitivity of the sensor reaches a residual sensitivity of 30 %. Then the sensor has to be replaced.

5.3.3 Calculation of Control Voltage

Signal start 2 V / 4 mA

$$\text{Control voltage (mV)} = \frac{160\ (\text{mV}) \times \text{test gas concentration } O_2\ (\text{vol. \%})}{\text{measuring range } O_2\ (\text{vol. \%})} + 40\ (\text{mV})$$

Signal start 0 V / 0 mA

$$\text{Control voltage (mV)} = \frac{200\ (\text{mV}) \times \text{test gas concentration } O_2\ (\text{vol. \%})}{\text{measuring range } O_2\ (\text{vol. \%})}$$

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

Signal start 2 V / 4 mA

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

Signal start 0 V / 0 mA

$$\frac{200\ (\text{mV}) \times 20.9\ (\text{vol. \%})}{25\ (\text{vol. \%})} + 40\ (\text{mV}) = 167.2\ \text{mV}$$

5.4 Calibration with GCD-05 Service Tool

- Connect the DGC-05 Service Tool to the transmitter, open menu “Calibration”.
- Enter measuring range and test gas concentration.
- Connect calibration adapter carefully to the sensor element
- Apply test gas O2 (150 ml/min; 1 Bar ± 10%).
- Wait until the measuring value is stable, and then perform automatic gain calibration.
- Remove calibration adapter carefully by turning lightly. Check the sensor for correct mounting!
  By limiting the gain factor, calibration will not be possible any more when the sensitivity of the sensor reaches a residual sensitivity of 30 %. In this case the sensor has to be replaced.

Further information can be taken from the user manual of the DGC-05 Service Tool.

5.5 Calibration with GCD_EasyConf

- Connect the PC via USB/RS-485 communication set to the transmitter, open menu “Calibration”.
- Enter measuring range and test gas concentration.
- Connect calibration adapter carefully to the sensor element
- Apply test gas O2 (150 ml/min; 1 Bar ± 10%).
- Wait until the measuring value is stable, and then perform automatic gain calibration.
- Remove calibration adapter carefully by turning lightly. Check the sensor for correct mounting!
  By limiting the gain factor, calibration will not be possible any more when the sensitivity of the sensor reaches a residual sensitivity of 30 %. In this case the sensor has to be replaced.

Further information can be taken from the user manual of the DGC-05 Configuration and Calibration Software.

5.6 ModBus Mode

In the GCD-05_Bus mode each transmitter gets its communication address.

In the standard version with the communication connector X12, addressing is done by means of the DGC-05 Service Tool or by the DGC-05 Configuration and Calibration Software. See user manual of the Service Tool or of the Configuration and Calibration Software.

In the manual addressing version which can be identified by the address switch being equipped, there is a maximum of 60 addresses to be selected. See fig. 3.

The jumper is responsible to define the address group and the switch to define the address according to the following table.

Switch position	Jumper pos. 01 = address	Jumper pos. 02 = address	Jumper pos. 03 = address	Jumper pos. 04 = address
0	inactive	inactive	inactive	inactive
1	01	16	31	46
2	02	17	32	47
3	03	18	33	48
4	04	19	34	49
5	05	20	35	50
6	06	21	36	51
7	07	22	37	52
8	08	23	38	53
9	09	24	39	54
A	10	25	40	55
B	11	26	41	56
C	12	27	42	57
D	13	28	43	58
E	14	29	44	59
F	15	30	45	60

5.7 Option Relay Output

The two relays are activated in dependence of the gas concentration. If the gas concentration exceeds the adjusted alarm threshold, the corresponding relay switches on. If the gas concentration falls below the threshold minus hysteresis, the relay switches off again.

The contact function for relay 2, NC (normally closed) or NO (normally open), can be selected via the jumper NO/NC. See fig 1 and 3. Relay 1 is equipped with a change-over contact.

Via the ModBus interface the two alarm thresholds and the hysteresis are freely adjustable at the PC within the measuring range. The procedure can be read from the user manual “ModBus Software”.

The following parameters are factory-set.

Alarm threshold 1 = Relay 1: 19 (vol. %)
Alarm threshold 2 = Relay 2: 17 (vol. %)
Switching hysteresis: 1 (vol. %)

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 PolyGard 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 PolyGard 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.
- 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

- Consider static electricity! See point 3.
- Sensor should always be installed without power applied:
- Unplug basic PCB AT03 carefully from the bottom part.
- Unplug old sensor element from the PCB.
- Take the new sensor out of the original packing.
- Plug the sensor element in the PCB at X7.
- Replug the PCB AT03 in the terminal blocks X4, X5 carefully.
- Calibrate according to section 5.

7 Trubleshooting

7.1 Analog Mode

Trouble	Cause	Solution
Output signal < 3 mA / 1,5 V and/or control voltage < 30 mV only for starting signal 2V/4 mA	Jumper 0-20 % not set	Check jumper position
	Power voltage not applied	Measure voltage at X4: Two-wire: Pin 1 (+) and 4 (-) Three-wire: Pin 1 (+) and 2 (-)
	PCB AT03 not plugged in correctly at X4 and X5	Replug PCB correctly
	Wire break	Check the wiring
Output signal > 22 mA /220 mV	Short-circuit	Check the wiring
Control voltage does not reach the calculated value	Sensor element not calibrated Sensor sensitivity < 30 %	Calibrate sensor element Replace sensor element
No reaction of the output signal in spite of gas concentration	Power voltage not applied	Measure voltage at X4
	Signal (Pin 4) not wired correctly	Check the wiring

Trouble	Cause	Solution
Yellow LED not shining	Power voltage not applied	Measure tension at X4: Pin 1 (+) and 2 (-)
	PCB not plugged in correctly at X4/ X5	Replug PCB correctly
	Wire break	Check wiring
Yellow LED not flashing	No communication at the transmitter	Transmitter not addressed, check bus wiring incl. topology and termination Voltage < 16 V
No control voltage at calibration	Jumper V-A not set	Set the jumper. Remove it after calibration!

8 Cross-sensitivity Data

The cross sensitivity can be read from the table Technical Data (see section 9.). The table doesn't 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.

9 Technical Data

General sensor performances		
Gas type	Oxygen (O_2)	
Sensor element	Electrochemical, diffusion	
Measuring range	0 – 25 vol. %	
Temperature range	- 10 °C to + 50 °C (14 °F to 122°F)	
Pressure range	Atmosphere ± 15 %	
Humidity	0 – 95 % RH non condensing	
Storage temperature range	5 °C to 30 °C (41 °F to 86 °F)	
Storage time	Max. 6 months	
Mounting height	1.5 to 1.8 m (5 to 6 ft.). See also AP webpage.	
Accuracy	± 0,1 vol. %	
Long-term output drift	< 4% signal loss/year	
Response time	t_{90} < 15 sec.	
Life expectancy	2 years/normal operating environment	
Cross sensitivity[1]	Concentration (ppm)	Reaction (vol. %O_2)
Carbon dioxide, CO_2	5 vol. %	2
Electrical		
Power supply	18 - 28 VDC/AC, reverse polarity protected (2-wire modeonly VDC)	
Power consumption (without options) - Analog mode - Bus mode	22 mA, max. (0,6 VA) 12 mA, max. (0,3 VA)	
Output signal		
Analog output signal Selectable: - Current / voltage - Starting point 0 / 20 %	(0) 4 – 20 mA, load ≤ 500 Ω, (0) 2 - 10 V; load ≥ 50 k Ω proportional, overload and short-circuit proof	
Serial interface		
Transceiver	RS-485 / Baud 9600	
Protocol	ModBus	
Enclosure[2]	Stainless steel V2A	
Enclosure colour[2]	Natural, brushed	
Dimensions[2] (H x W x D)	113 x 135 x 45 mm /(5.35 x 4.5 x 1.8 in.)	
Weight[2]	Approx. 0,5 kg (1.1 Ibs.)	
Protection class[2]	IP 55	
Mounting[2]	Wall mounting, pillar mounting	
Cable entry	Standard 1 x M 20	
Wire connection	Screw-type terminal min. 0,25, to. 2,5 mm² 24 to 14 AWG	
Wire distance (analog mode)	Current signal ca. 500 m (1500 ft.) Voltage signal ca. 200 m (600 ft.)	

[1] The table doesn't claim to be complete. Other gases, too, can have an influence on the sensitivity. The mentioned cross sensitivity data are only reference values valid for new sensors.

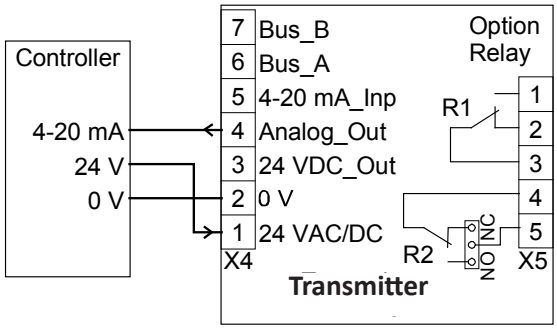
[2] Indications only for option "stainless steel", for further types see datasheet enclosure.

Guidelines	EMC Directive 2004 / 108 / EWG
	CE
Warranty	1 year on material (without sensor)
Options	
Relay output	
Alarm relay 1	30 VAC/DC 0,5 A, potential-free, SPDT
Alarm relay 2	30 VAC/DC 0,5 A, potential-free SPNO/SPNC
Power consumption	30 mA, (max. 0,8 VA)
Warning buzzer	
Acoustic pressure	85 dB (distance 300 mm) (1 ft.)
Frequency	3.5 kHz
Power consumption	30 mA, (max. 0,8 VA)
Heating	
Temperature controlled	3 °C ±2°C (37.5 °F ± 35.5 °F)
Ambient temperature	- 30 °C
Power supply	18 - 28 VDC/AC
Power consumption	0.3 A; 7.5 VA
Analog input	
Only for RS-485 mode	4 – 20 mA overload and short-circuit proof, input resistance 200 Ω
Power supply for external transmitter	24 VDC max. 50 mA

10 Figures

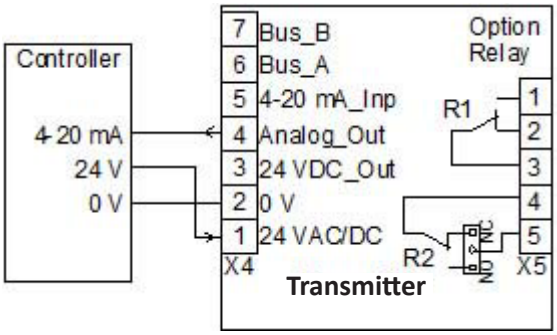
Application: Analog mode

Fig. 1



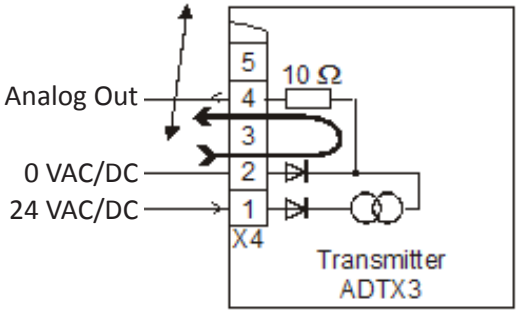
Two-wire connection
4 - 20 mA output signal
without options

Do not connect power supply at this pin!
0VDC, 24 VAC, or 0 VAC will destroy the detector!



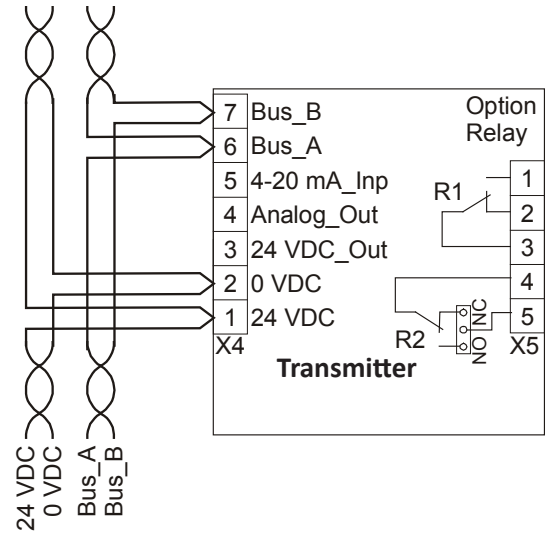
Three-wire connection
- VCD output signal
- 0 - 20 mA output signal
- Relay output
- Heating

Do not connect 24 VAC at pin 2 and pin 4 or +24 VDC at pin 2 and 0 VDC at pin 4!!
Short Circuit = R10 Ohm will burn!

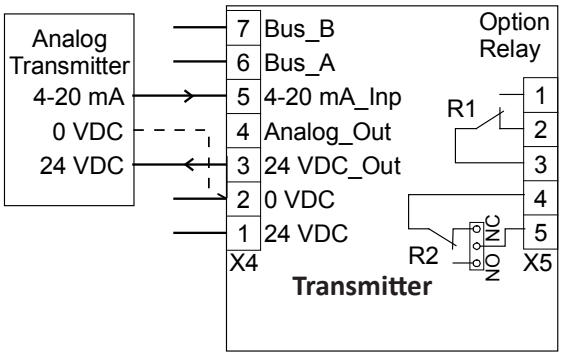


Application: GCD-05_Bus or ModBUS mode

Fig. 2

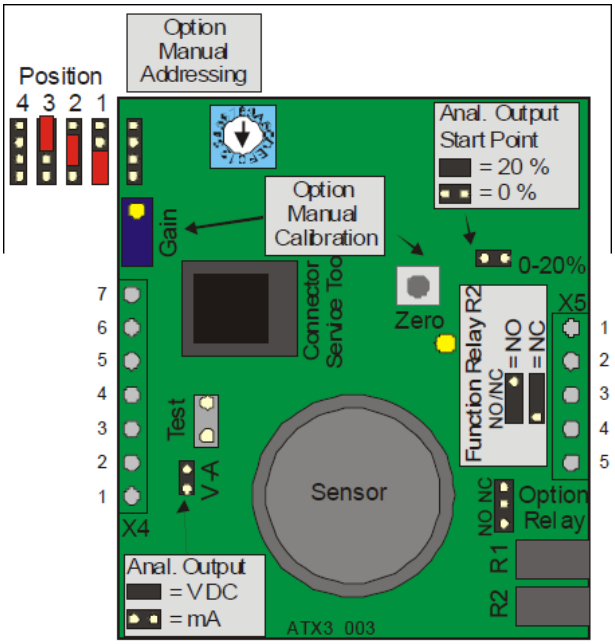


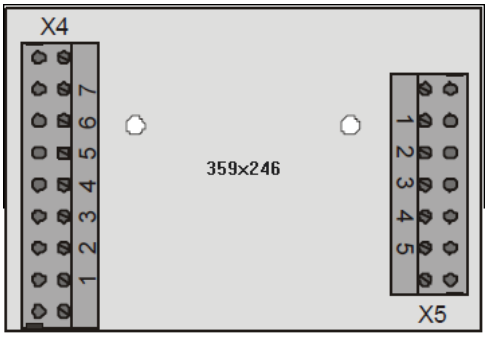
Connection field bus and voltage



Connection analog transmitter
- Two- or three-wire connection, depending on detector type

PCB AT03
Fig. 3





Selection analog output signal
Fig. 4

Jumper 0 20 %	Jumper V - A	Output signal
Not set	Not set	0 – 20 mA
Set	Not set	4 – 20 mA
Not set	Set	0 – 10 V
Set	Set	2 – 10 V

Calibration adapter
Fig. 5
Type: Calibr-set

11 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.

12 Notes and General Information

It is important to read this user manual thoroughly and clearly in order to understand the information and instructions. The O_2 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.

12.1 Intended Product Application

The O_2 transmitters are designed and manufactured for control applications and air quality compliance in commercial buildings and manufacturing plants.

12.2 Installers' Responsibilities

It is the installer's responsibility to ensure that all O_2 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.

12.3 Maintenance

It is recommended to check the O_2 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.

12.4 Limited Warranty

Automatikprodukter warrants the service 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 service transmitter. Automatikprodukter shall not be liable for any incidental or consequential damages arising out of or related to the use of the O_2 transmitters.