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## Electrochemical Hydrogen Sulphide Transmitter

### 1 Intended Use

The H<sub>2</sub>S analog/digital gas detector 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 hydrogen sulphide gas. Main application ranges are **waterworks and wastewater treatment systems**.

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 H<sub>2</sub>S analog/digital detector must not be used in potentially explosive atmospheres. The detector 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 detector is equipped with a serial interface RS-485 for the connection to the system.

##### **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 H<sub>2</sub>S also works in the 2-wire technique.

##### **GCD-05\_Bus mode:**

The detector 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 to the gas controller.

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 sensor portion of the detector is a sealed electro-chemical cell with three electrodes, sensing, counter and reference. 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 reduction 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 sensing and reference 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 output signal.

Electrochemical processes always lead by and by to a loss of sensitivity. Therefore regular calibration of zero-point



and gain is obligatory. See also section 6.

### 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 hydrogen sulphide H<sub>2</sub>S is marginally higher than that of air (**factor 1.19**). Recommended **mounting height is 0.2 m (0.6 ft) to 0.3 m (1 ft) above floor**.
- Choose mounting location of the sensor according to the local regulations.
- Consider the ventilation conditions! Do not mount the detector in the centre of the airflow (air passages, suction holes).
- Mount the detector 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 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 2x2x0.8 LG (20 AWG), max. loop resistance 73 Ω/km (20.8 Ω/1000 ft).
- Serial Interface Mode:
- Required cable for RS-485 mode: J-Y(St)Y 2x2x0.8 LG (20 AWG), max. loop resistance 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 with care. 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 element as well.

*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 X7 of the PCB AT03.
- Addressing of the transmitter in the GCD-05\_Bus mode.
- Calibrate the detector (if not already factory-calibrated).

Required instruments for commissioning (calibration) of the transmitter:

- Test gas bottle with **synthetic air (20 % O<sub>2</sub>, 80 % N)** or **H<sub>2</sub>S-free ambient air**.
- Test gas bottle with H<sub>2</sub>S (ppm) in the range of 30 – 70 % of the measuring range. Rest is synthetic air.
- 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).
- Configuration and calibration software GCD05 EasyConf 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 6 hours without interruption**.

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

**Attention:** H<sub>2</sub>S calibration gas is toxic, never inhale the gas!  
Symptoms: Dizziness, headache and nausea.  
Procedure if exposed: Take the victim into fresh air at once, call a doctor.

## 5.1 Correction 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:





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

$$\text{Control voltage (mV)} = 160 \text{ (mV)} \times \text{test gas concentration H}_2\text{S (ppm)} + 40 \text{ (mV)}$$

measuring range

H<sub>2</sub>S (ppm)

Signal start 0 V / 0 mA

$$\text{Control voltage (mV)} = 200 \text{ (mV)} \times \frac{\text{test gas concentration H}_2\text{S (ppm)}}{\text{measuring range H}_2\text{S (ppm)}}$$

**Example:**

Measuring range	100 ppm	100 ppm
Test gas concentration	55 ppm H <sub>2</sub> S	55 ppm H <sub>2</sub> S
Control voltage: Signal start 2 V / 4 mA	128 mV	128 mV
Control voltage: Signal start 0 V / 0 mA	110 mV	110 mV

Signal start 2 V / 4 mA	Signal start 0 V / 0 mA
$160 \text{ (mV)} \times \frac{55 \text{ (ppm)}}{100 \text{ (ppm)}} + 40 \text{ (mV)} = 128 \text{ mV}$	$200 \text{ (mV)} \times \frac{55 \text{ (ppm)}}{100 \text{ (ppm)}} = 110 \text{ mV}$

### 5.4 Calibration with GCD-05 Service Tool

- Connect the GCD-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 synthetic air (150 ml/min; 1 Bar (14.5 psi) ± 10%), or hydrogen sulphide H<sub>2</sub>S -free ambient air.
- Wait until the measuring value is stable, and then perform automatic zero calibration.
- Apply calibration test gas H<sub>2</sub>S (150 ml/min; 1 Bar (14.5 psi) ± 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 GCD-05 Service Tool.

### 5.5 Calibration with GCD05\_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 synthetic air (150 ml/min; 1 Bar (14.5 psi) ± 10%), or H<sub>2</sub>S -free ambient air.
- Wait until the measuring value is stable, and then perform automatic zero calibration.
- Apply calibration test gas H<sub>2</sub>S (150 ml/min; 1 Bar (14.5 psi) ± 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 GCD-05 Configuration and Calibration Software.

## 5.6 Addressing, only for GCD-05\_Bus 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 GCD-05 Service Tool or by the GCD-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	59
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: 10 ppm**

**Alarm threshold 2 = Relay 2: 20 ppm**

**Switching hysteresis: 2 ppm**

## 6 Inspection and Service

Inspection, service and calibration of the detectors 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 detector 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 detector 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 Troubleshooting

### 7.1 Analog Mode

Trouble	Cause	Solution
Output signal < 3 mA / 1,5 V	Jumper 0-20 % not set	Check jumper position
	Power voltage not applied	Measure tension 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 tension at X4
	Signal (Pin 4) not wired correctly	Check the wiring



## 7.2 GCD-05\_Bus Mode

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	Hydrogen sulphide (H <sub>2</sub> S)	
Sensor element	Electrochemical, diffusion	
Measuring range (standard, other ranges according to the data sheet)	0 - 100 ppm or 0-200 (factory set) others on request	
Temperature range	- 10 °C to + 50 °C (14 °F to 122°F)	
Pressure range	Atmosphere ± 15 %	
Humidity	15 – 95 % RH non condensing	
Storage temperature range	5 °C to 30 °C (41 °F to 86 °F)	
Storage time	Max. 6 months	
Mounting height	0.2 to 0.3 m (0.6 to 1 ft.)	
Stability & resolution	± 0,2 ppm	
Repeatability	± 2 % of reading	
Long-term output drift	< 2% signal loss/year	
Response time	t <sub>90</sub> < 60 sec.	
Life expectancy	> 2 years/normal operating environment	
Cross sensitivity <sup>1</sup>	Concentration (ppm)	Reaction (ppm H <sub>2</sub> S)
Carbon monoxide, CO	100	< 2
Sulphur dioxide, SO <sub>2</sub>	100	~ 20
Nitrogen dioxide, NO <sub>2</sub>	5	- 1,0
Nitric oxide, NO	35	< 2
Hydrogen, H <sub>2</sub>	300	20
<b>Electrical</b>		
Power supply	18 - 28 VDC/AC, reverse polarity protected (2-wire mode only VDC)	
Power consumption (without options) - Analog mode - GCD-05_Bus mode	22 mA, max. (0.6 VA) 12 mA, max. (0.3 VA)	
<b>Output signal</b>		
Analog output signal Selectable: Current / tension 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	
<b>Serial interface</b>		
Transceiver	RS-485 / 19200 Baud (9600 ModBus)	
Protocol, depending on version	AP_GCD05 or ModBus	

<sup>1</sup> 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.



<b>Physical</b>	
Enclosure stainless steel Type 5	Stainless steel V2A
Enclosure colour	Natural, brushed
Dimensions (W x H x D)	113 x 135 x 45 mm (5.35 x 4.5 x 1.8 in.)
Weight	Approx. 0.5 kg (1.1 lb.)
Protection class	IP 55
Mounting	Wall mounting, pillar mounting
Enclosure Plastic, Type A	Polycarbonate
Flammability	UL 94 V2
Enclosure colour	Light grey RAL 7032
Dimensions (W x H x D)	94 x 130 x 57 mm (3.7 x 5.12 x 2.24 in.)
Weight	Approx. 0.3 kg (0.6 lb.)
Protection class	IP 65
Mounting	Wall mounting
Cable entry	Standard 1 x M 20
Wire connection	Screw-type terminal: 0.25 to 2.5 mm <sup>2</sup> 24 to 14 AWG
Wire distance	Current signal ca. 500 m (1500 ft.) Voltage signal ca. 200 m (500 ft.)
<b>Guidelines</b>	EMC Directive 2004 / 108 / EEC
<b>Approvals</b>	
Enclosure Type A	CE UL 508A
<b>Warranty</b>	1 year on material (without sensor)
<b>Options</b>	
<b>Relay output</b>	
Alarm relay 1 (switching threshold 5 ppm)	30 VAC/DC 0.5 A, potential-free, SPDT
Alarm relay 2 (switching threshold 8 ppm)	30 VAC/DC 0.5 A, potential-free SPNO/SPNC
Power consumption	30 mA, (max. 0.8 VA)
<b>Warning buzzer</b>	
Acoustic pressure	85 dB (distance 300 mm) (1 ft.)
Frequency	3.5 kHz
Power consumption	30 mA, (max. 0.8 VA)
<b>LCD display</b>	
LCD	Two lines, 16 characters each, not illuminated
Power consumption	10 mA, (max. 0.3 VA)
<b>LED indicator</b>	
Green, yellow, red	Power supply, Low- Alarm, High- Alarm
Power consumption	10 mA, (max. 0.3 VA)

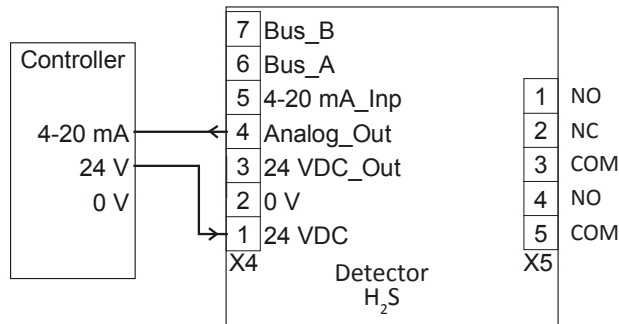


<b>Heating</b>	
Temperature controlled	3 °C ±2°C (37.5 °F ± 3.6 °F)
Ambient temperature	- 40 °C (- 40 °F)
Power consumption	0.3 A; 7.5 VA
<b>Analog input</b>	
Only for RS-485 mode	4 – 20 mA overload and short-circuit proof, input resistance 200 Ω
Voltage for external analog transmitter max. load 50 mA	24 VAC/DC depending on the power supply

## 10 Figures

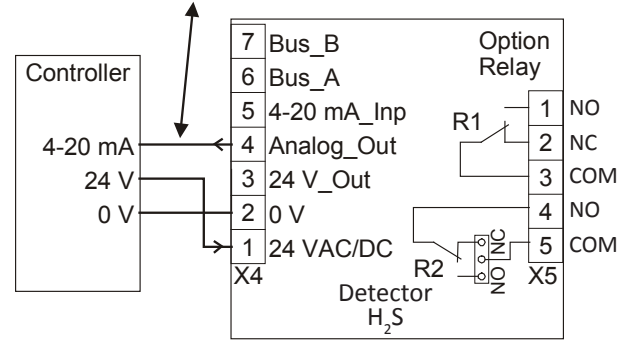
Application: Analog mode

Fig 1.



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

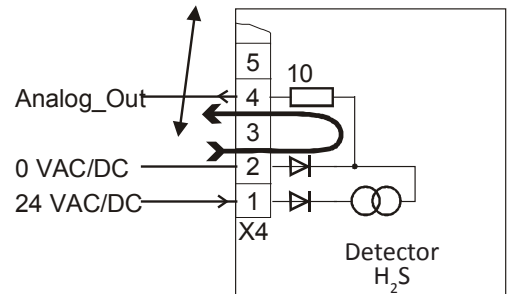
**Do not connect power supply at this pin.  
(0 VDC, 24 VAC or 0VAC will destroy the transmitter.)**



Three-wire connection  
- VDC output signal  
- 0 – 20 mA output signal  
- Relay output  
- LCD display  
- Heating

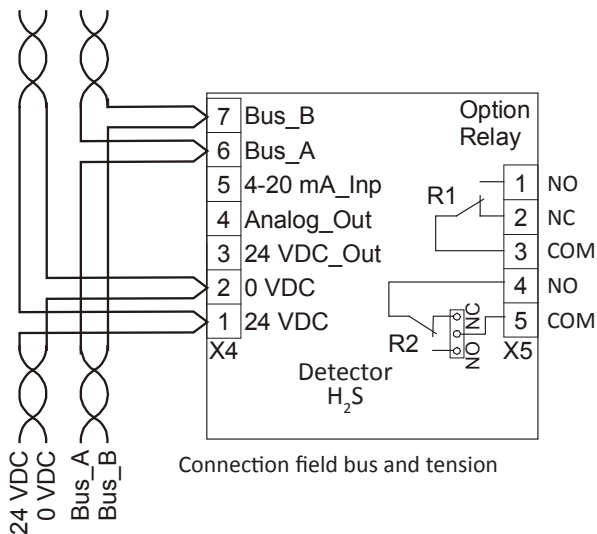


Do not connect 24 VAC at pin 2 and pin 4 or +24 VDC at pin 2 and 0 VDC at pin 4!!  
**Short-circuit = R 10 Ohm burns up!!**

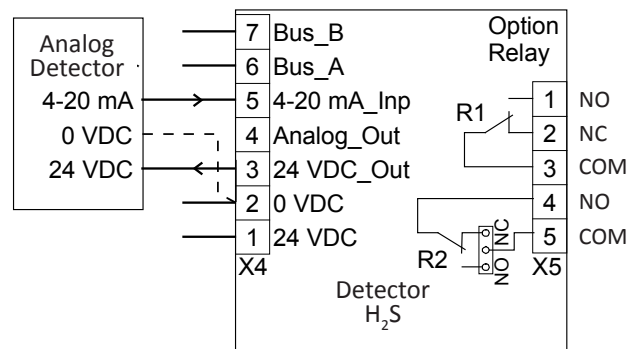


Application: GCD-05\_Bus or ModBus mode

Fig. 2



Connection field bus and tension

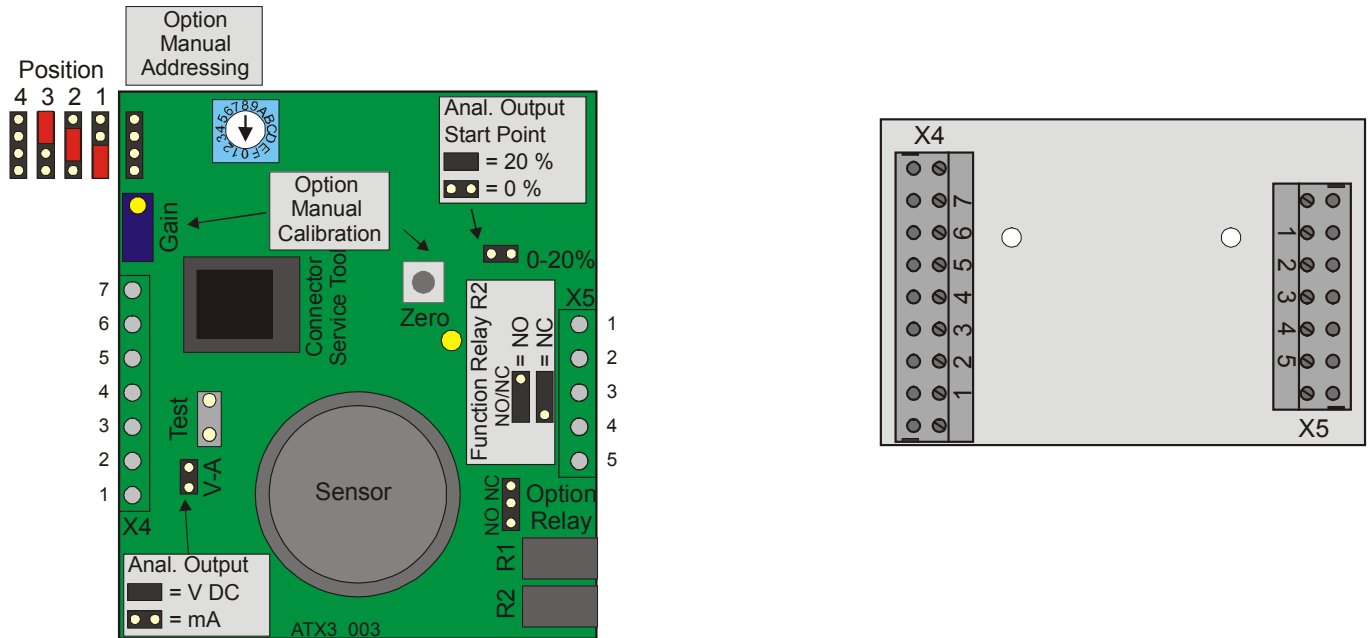


Connection analog transmitter  
- Two- or three-wire connection, depending on transmitter type



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 detector 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.

### 12.1 Intended Product Application

The H<sub>2</sub>S detectors 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 detectors 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 detector 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 detector card with the sensor may be returned for service to Automatikprodukter.

### 12.4 Limited Warranty

AP warrants the detectors 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, AP 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 detector. AP shall not be liable for any incidental or consequential damages arising out of or related to the use of the detectors.