Gas Detector for Ammonia, S-NH_3

User Manual

April, 2013

Transmitter with Semi-conductor Sensor for Ammonia

1 Intended Use

The 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 ammonia gases.

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 analog/digtal 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 Function

2.1 Control Mode

In addition to the analog output the transmitter is equipped with a serial interface RS-485 for the connection to the CGD-05 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.

CGD-05_Bus mode:

The detector can be connected to the CGD-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 CGD-05 hardware”.

The two control modes are available in parallel.

2.2 Sensor

A semi-conductor sensor is integrated in the S-NH_3. The ambient air being monitored diffuses through a metal grid into the sensor. The gas oxidises at the heated sensor element (metallic oxide) and changes the conductivity in dependence of the gas concentration. This non-linear alteration of the conductivity is evaluated by the internal sensor electronics and linearised by the micro-processor. The temperature compensation is also integrated in the detector.

Oxidation processes lead by-and-by to an unwanted influence on the alteration of the conductivity. **Therefore regular calibrations of zero-point (Zero) and gain are necessary. See section 6.**

Caution:

Certain substances and gases in the atmosphere being monitored can affect the sensitivity of the gas sensor element and/or poison the sensor completely.

The following are currently known:

- Silicones.
- Corrosive substances, like H_2S, SO_x, Cl_2, HCl, etc. can lead to corrosion and damage of the sensor.
- Alkaline metals cause a considerable drift of the sensor.

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 ammonia, NH_3, is lower than that of air (factor 0.59).
  The recommended mounting height is at the highest point possible with a distance of 200 - 300 mm (1 ft.) to the ceiling.
- Choose mounting location of the detector according to the local regulations.
- Consider ventilation conditions! Do not mount the transmitter 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).
- Plug in the basic PCB at X4 and X5 with care. Replace the cover.

4 Electric Connection

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 shielded cables for the signal line, but do not connect the shield.
- Recommended cable 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 Connectiong

- Open the cover. Unplug basic PCB carefully from terminal blocks at X4 and X5.
- Insert the cable, connect cable leads to terminal blocks. See fig. 1 and 2.
- Replug the PCB in the terminal blocks X4, X5. Replace 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 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 ET03-00X for proper mounting at X4 and X5.
- Addressing of the transmitter in the CGD-05_Bus mode.
- Calibrate the transmitter (if not already factory-calibrated).

Required instruments for commissioning (calibration) of the transmitter:

- Test gas bottle with ammonia test gas* depending on the measuring range:
  - Measuring range 30 – 300 ppm = Test gas concentration 100 ppm
  - Measuring range 30 – 1000 ppm = Test gas concentration 500 ppm
  - Measuring range 30 – 3000 ppm = Test gas concentration 1000 ppm
- Gas pressure regulator with flow meter to control the gas flow to 300 ml/min.
- Calibration adapter with tube, (silicon-free, e.g. Viton). Calibration set AT 1110S02. See fig. 5.
- Digital voltmeter with range 0 – 10 VDC, accuracy 1%
- A small screwdriver.
- Calibration tool CGD-05 STL (only for addressing in CGD-05_Bus mode).

Attention: Ammonia 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.

Prior to calibration the sensor element must be fully stabilized by applying power voltage for at least 8 days without interruption.

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

5.1 Correction of the Zero-point at the Analog Output 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

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

In the CGD-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

5.3 Manual Calibration

5.3.1 Zero-point

The zero-point calibration of the sensor is not necessary, because the zero-point of the output signal has already been factory-calibrated.

5.3.2 Gain

- Connect digital voltmeter to pin “Bridge” (-) and ground (X4 pin 2). See fig. 3.
- Connect calibration adapter carefully to the sensor element.
- Apply calibration test gas (300 ml/min; 1 Bar (14.5 psi) ± 10%).
- Wait three minutes until the value is stable; adjust bridge voltage with potentiometer ”Zero” according to the table “Calibration”.
- Connect digital voltmeter to pin “Test”, then adjust test voltage with potentiometer ”Gain” according to the table “Calibration”.
- 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.

Table Calibration

Starting point of output signal	Measuring range/ calibration gas (NH_3) ppm	Bridge voltage (mV)	Test voltage (mV)
= 0 % (0V or 0 mA)	300 / 100	3480	100
= 20 % (2V or 4 mA)	300 / 100	3480	120
= 0 % (0V or 0 mA)	1000 / 500	3970	100
= 20 % (2V or 4 mA)	1000 / 500	3970	120
= 0 % (0V or 0 mA)	3000 / 1000	4170	66,7
= 20 % (2V or 4 mA)	3000 / 1000	4170	93,4

5.4 Addressing, only for CGD-05_Bus mode

In the CGD-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 CGD-05 Service Tool or by the CGD-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

5.5 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: Depending on measuring range
Alarm threshold 2 = Relay 2: Depending on measuring range
Switching hysteresis: Depending on measuring range

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. Automatikprodukter 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 detector.

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 has to be replaced completely including the electronics. The replacement electronics with the new sensor is already factory-calibrated.

- Unplug basic PCB ET03 carefully from the bottom part.
- Plug in the new PCB including the new sensor at terminals X4, X5.

7 Troubleshooting

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 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	Calibrate sensor element
	Sensor sensitivity < 30 %	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 CGD-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 Technical Data

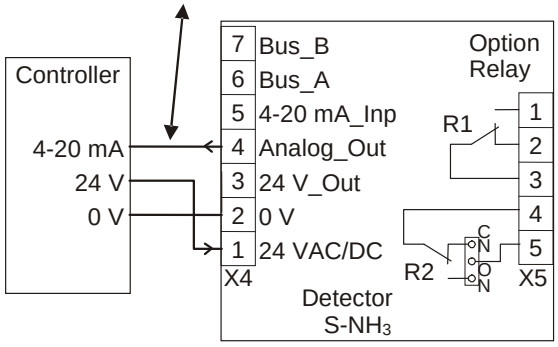
General sensor performances	
Gas type	Ammonia (NH_3)
Sensor element	Semi-conductor sensor
Measuring range	30 – 300 ppm/ 30 - 1000 ppm/ 30 - 3000 ppm
Repeatability	± 20 %
Response time	t_{90} < 100 sec.
Oxygen concentration	21 % (standard) 18 % minimum level
Life expectancy	> 5 years/normal operating environment
Temperature range	- 20 °C to + 50 °C (-4°F to 122 °F)
Humidity	15 – 95 % RH non condensing
Pressure range	Atmosphere ± 10 %
Storage temperature range	0 °C to 40 °C (32 °F to 104 °F)
Storage time	Max. 6 months
Mounting height	Under the ceiling
Electrical	
Power supply	16 - 28 VDC/AC, reverse polarity protected
Power consumption (without options)	40 mA, max. (1.00 VA)
Output signal	
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
Serial interface	
Transceiver	RS 485 / 19200 Baud
Protocol, depending on version	CGD05 or ModBus
Physical	
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^2 24 to 14 AWG
Wire distance	Current signal ca. 500 m (1500 ft.) Voltage signal ca. 200 m (500 ft.)
Guidelines	EMC Directive 2004 / 108 / EC, CE
Approvals	
Enclosure Type A	UL 508A
Warranty	1 year on material (without sensor)

Options	
Relay output	
Alarm relay 1 (switch threshold 10 % LEL)	30 VAC/DC 0.5 A, potential-free, SPDT
Alarm relay 2 (switch threshold 20 % LEL)	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)
LCD-Display	
LCD	Two lines, 16 characters each, not illuminated
Power consumption	10 mA, (max. 0.3 VA)
LED indicator	
Green, yellow, red	Power supply, Low- Alarm, High- Alarm
Power consumption	10 mA, (max. 0.3 VA)
Heating	
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
Analog input	
Only for RS-485 mode	4 – 20 mA overload and short-circuit proof, input resistance 200 Ω
Tension for external analog transmitter	24 VAC/DC depending on the power supply max. load 50 mA

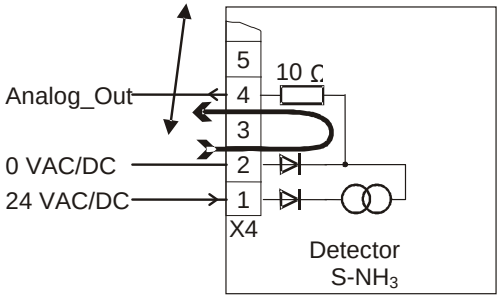
9 Figures

Application: Analog mode
Fig. 1

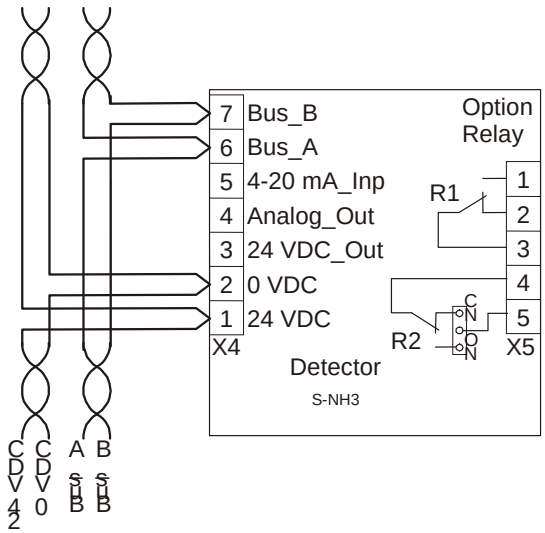
Do not connect power supply at this pin.
(0 VDC, 24 VAC or 0VAC will destroy the transmitter.)



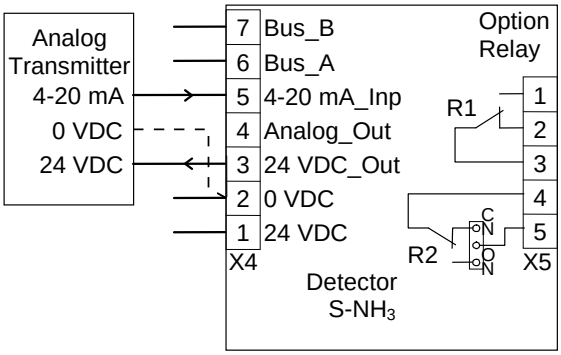
Do not connect 24 VAC at pin 2 and pin 4
or +24 VDC at pin 2 and 0 VDC at pin 4!!
Short-circuit = R 10 Ohm burns up!!



Application: CGD-05_Bus or ModBus mode
Fig. 2

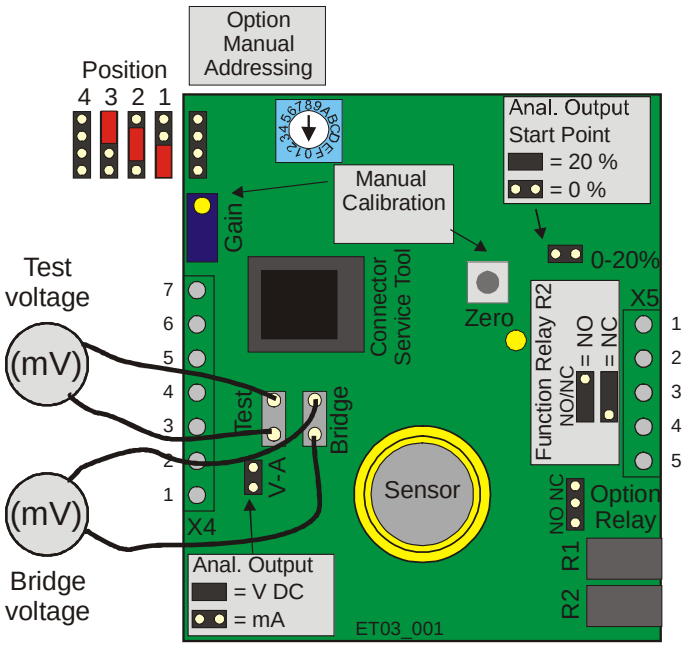


Connection field bus and tension

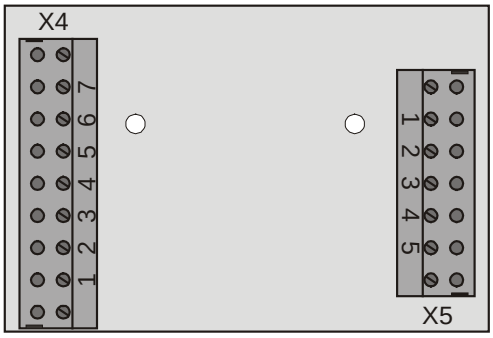


Connection analog transmitter
- Two- or three-wire connection, depending on transmitter type

PCB S-NH_3
Fig. 3



Terminal block



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. 6

Type: **Calibr-set-AT 1110S02**

10 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.

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 detectors 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.

11.1 Intended Product Application

The detectors 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 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.

11.3 Maintenance

It is recommended to check the AP 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 transmitter card with the sensor may be returned for service to Automatikprodukter.

11.4 Limited Warranty

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