User Manual

Gas Detector

Alpa EcoDet XT

Product code: PW-098-LPG

POD-043-ENG R03

Reliable and Innovative Gas Detection & Safety Systems

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Remarks and reservations

- Read and understand this manual prior to connection and operation of the device. Keep the User Manual with the device for future reference.
- The manufacturer shall not be held responsible for any errors, damage or defects caused by improper selection of suitable devices or cables, errors in installation of equipment or any misuse due to failure to understand the document content.
- Unauthorised repairs and modifications of the device are not allowed. The manufacturer shall discard any responsibility for consequences of such actions.
- Exposure of the device to the impact of excessive mechanical, electric or environmental factors may lead to damage of the device.
- Operation of damaged or incomplete devices in not allowed.
- Engineering of a gas safety system for any specific facilities to be safeguarded may need consideration of other requirements during the entire lifetime of the product.
- Use of unauthorized spare parts different from the ones listed in Table 7 is strictly forbidden.

How to use this manual?

- Important fragments of the text are highlighted in the following way:

Pay extreme attention to information provided in such framed boxes.

- This User Manual consists of a main text and attached appendices. The appendices are independent documents and can be used separately from this Manual. Page numbering of appendices starts anew with no relationship to pare numbering of the main document and appendices may have their own tables of contents. In the right bottom corner of each page you can find the name (symbol) of any document included into the User Manual package with its revision (issue) number.

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1 General information

1.1 Purpose

Alpa EcoDet XT is a 3-threshold gas detector for detecting the presence of hazardous concentrations of LPG (C_3H_8, C_4H_{10})[1] in the surrounding atmosphere, incl. in such facilities as garages, underground car parks, liquid gas boiler rooms or halls heated with gas radiators.

> The Alpa EcoDet XT Gas Detector is not designed for installation in areas with potentially explosive atmospheres.

The presence of a hazardous gas is detected by means of a catalytic sensor. Such a solution features with high insensitivity to variations of ambient conditions, such as temperature, humidity, pressure, etc. In addition, the Alpa EcoDet XT Gas Detector also demonstrates immunity to disturbing factors, which prevents from generation of false alarms.

More details about catalytic sensors can be found in Appendix [2].

Key features of the detector:

- safe, low voltage electric circuits,
- easy installation,
- possibility to arrange the components as a 'bus layout' or a 'star layout',
- option to directly connect the detector to the Alpa EcoWent XT detector, which makes up a pair of collaborating devices for detection of both LPG and CO,
- quick calibration of the detector by simple replacement of the MniPel Head (reduction of the calibration time),
- three alarm thresholds,
- indication of detector failures or interruption of the monitoring loop,
- long term operation with steady parameters.

These features, at an extremely attractive price, make Alpa EcoDet XT Gas Detector an ideal solution for low cost applications, e.g. in public construction.

1.2 Description of operation

The Alpa EcoDet XT Gas Detector is one of the elements of the gas detection system. It performs cyclical measurements of gas concentration in the air. Information about exceeding a certain threshold is transmitted using the controls located on the side of the enclosure (see Figure 2) and output current signal. In addition, if it works in an alarm loop system (see sections 6.2, 6.3), at its input (via an XT T-connector) a current signal can be passed from the next detector – Alpa EcoWent XT or Alpa EcoDet XT. This signal is compared with the local value and a signal corresponding to a status of a higher priority is transmitted to the output (see Table 1).

The Alpa EcoDet XT Gas Detector may directly collaborate with the Alpa EcoWent XT detector (owing to the interconnection via X2 terminal of the Alpa EcoWent XT unit). Such a combination makes up a pair of detectors that enables simultaneous monitoring of LPG emission (C_3H_8, C_4H_{10}) and carbon monoxide (CO).

1 Calibration gas – C_3H_8.

Priorities	State of operation
1 (highest)	Alarm threshold exceeded
2	Second warning threshold exceeded
3	First warning threshold exceeded
4	Failure of the detector, system bus, connection to the Alpa EcoWent XT detector or information about incorrect settings of the configuration switch
5 (lowest)	Regular operation of the detector (no errors)
	Warm-up in progress

Table 1: Priorities of output signals produced by the Alpa EcoDet XT Gas Detector

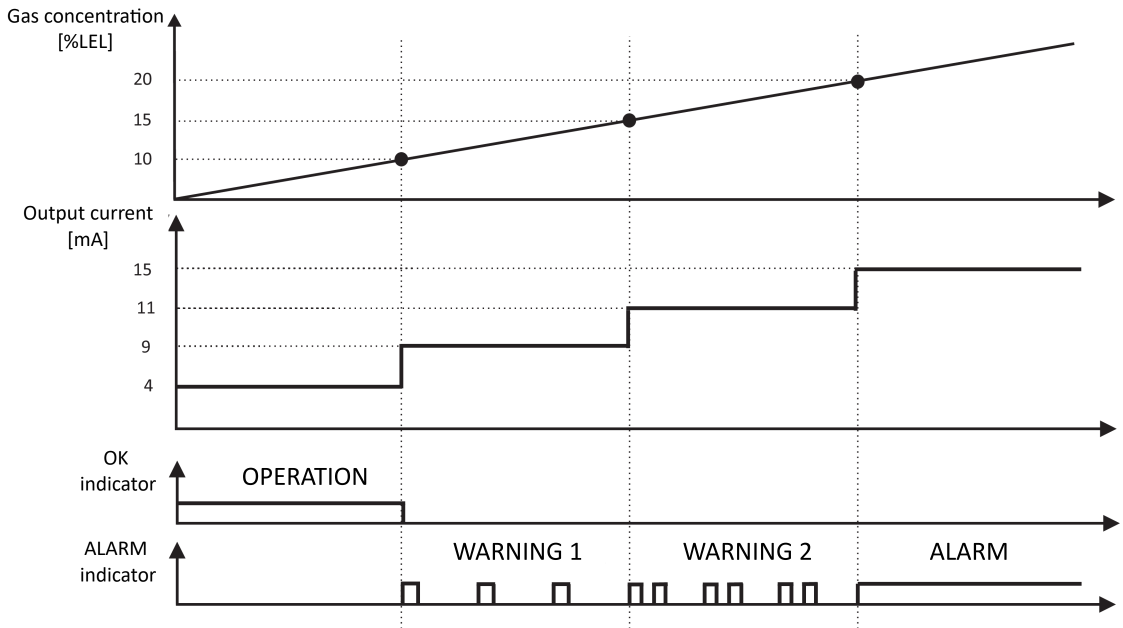


Figure 1: Amperage of output current and behaviour of LED indicators for individual operation modes

> Type of gas to be monitored, warning /alarm thresholds as well as corresponding output currents are specified for each specific detector in its calibration certificate.

Operation of a gas detector consists in continuous measurements of gas concentration within the detector vicinity as well as periodic tests of the gas sensor. Results of the foregoing operations are used to define operation modes described in the following sections.

1.2.1 Operation

It is the mode of operation when the detector works properly and takes regular measurements. Concentration of gases is below the hazardous levels and no irregularities in operation of the device are detected. Operation of the detector needs no particular attention except for the following:

- verification of the detector indications as frequently as possible (daily inspection is recommended),
- regular preventive maintenance and inspections to be carried out by a serviceman (see Section 9.4.3).

1.2.2 Warning 1 (1st threshold) /Warning 2 (2nd threshold)

It is the mode of operation when a slight concentration of a hazardous gas is detected and a user must be aware of the situation.

The following measures should be undertaken:

- identification of a reason for presence of gas, which include:
  - leaks from technological systems of a plant,
  - disturbance of the detector operation by gas-emitting substances, e.g. solvents with high concentration or fuel fumes – such substances must be removed from the monitored areas,
  - bias of the detector characteristic curve. As the time goes by the zero point of the detection curve tends to drift. When scheduled calibration is neglected the warning thresholds may bias to the area of clean air. Such a reason for the detector misbehaviour is expected when competent personnel by means of appropriate instrument found no leaks of gas at the facilities and presence of disturbing substances also was not revealed.

1.2.3 Alarm (3rd threshold)

It is the detector status that occurs when gas concentration exceeds the alarm threshold (3rd threshold).

If so, the following measures should be undertaken:

- evacuate all third persons from the endangered area,
- if possible, enable ventilation of endangered confined areas, open windows and/or doors (when a control system that automatically activates the ventilation system is not in place).

1.2.4 Failure

In parallel to measurements of gas concentration the detector performs a number of self-tests to make sure that both the detector itself and the whole system are in sound operating condition.

Internal failures reported by the detector refer to problems with a gas sensor.

The detector can also report failures within the gas detection system, for instance:

- break of the communication bus,
- incorrect levels of electric current at the detector inputs,
- incorrect position of the configuration switch,
- breaks of connection with the Alpa EcoWent XT detector.

1.2.5 Warm up

Upon the power voltage for the detector is on, the device needs some time until operation parameters of a gas sensor are stabilized. It is the time period when no measurements are taken, but after the warm-up time that usually takes about 1 minute the detectors starts its regular operation.

2 Safety

Do never allow operation of the detector when insulation of interconnecting cables or conductors of the system is damaged or cut.

Do not install a gas detector in places exposed to direct sunlight and water.

In the case of damage, shut down the detector, secure the connection cables and contact with the service.

All activities related to connecting detectors, signallers and other system components must be carried out while control unit's power supply is off

Although switching power supply of the Gas Detection & Safety System off, there is a possibility that a dangerous voltage can exist on the terminals of the Control Unit. It can originate from another system like for an example ventilation system that uses one of the output pins of Control Unit.

When performing repair, building and maintenance works, secure the device in a proper way.

Before painting the walls, make sure the device is secured.

Before painting the floors, make sure the device is secured.

Before using silicons or silicon-containing materials (paints, glues, sealing etc.), make sure the device is secured.

Silicon-based materials irreversibly damage the gas sensor incorporated into the detector. Other incompatible substances are listed in the Appendix [2].

3 Description of the construction

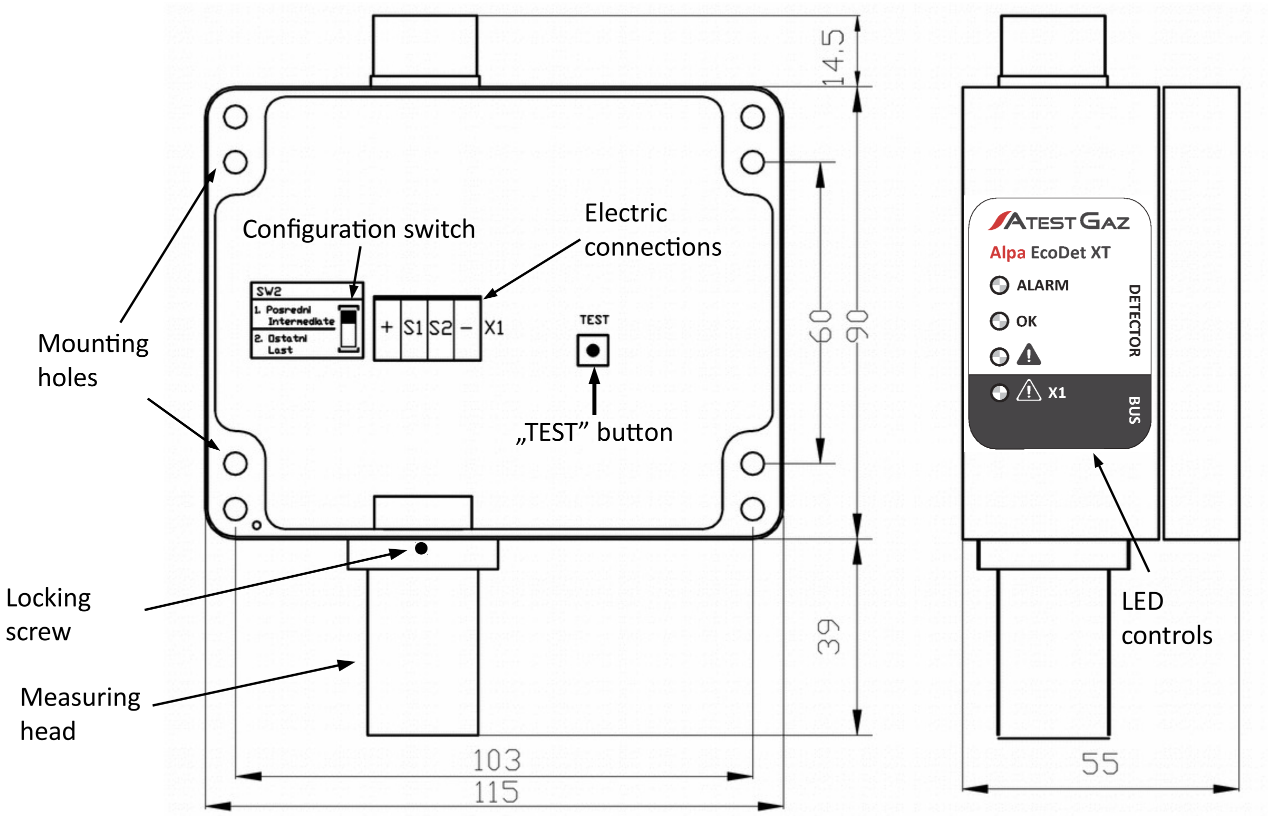


Figure 2: Layout of device components and its dimensions

4 Input-output interfaces

4.1 Electric interfaces

The appearance of the terminal strip is shown in Figure 2.

Port name	Pin	Description
X1		Port of the detector bus / Alpa EcoWent XT Gas Detector / T-connector XT / control unit. Parameters – see Section 10
	+	Positive supply pole
	S1	Signal line S1
	S2	Signal line S2
	-	Negative supply pole

Table 2: Electric interface description

5 User interface

Detectors indicate its status (operation mode) by means of four LEDs that are available on the side wall of the detector enclosure (See Figure 2 and 3).

Information about the Detector status

Information about interconnections of the detectors

Indicating LEDs belong to two areas:

- DETECTOR (information about the detector status.),
- BUS (information about interconnections of the detector).

Figure 3: User interface

Table 3 summarizes how modes of the detector operation are indicated by LEDs, whereas the detailed specification of each status is provided in Section 1.2.

Status of LED indicators		Meaning of indications
Green LED (OK) is permanently ON	DETECTOR	Regular operation of the detector, gas concentration is below the established thresholds
Yellow LED (⚠) is permanently ON		Detector failure
Red LED (ALARM) blinks once per period		The 1st warning threshold is exceeded
Red LED (ALARM) blinks twice per period		The 2nd warning threshold is exceeded
Red LED (ALARM) is permanently on		The alarm threshold is exceeded
Yellow LED (⚠ X1) is permanently on	BUS	Failure (break) of a communication bus, improper input current of the detector – see also Section 8
Periodical flashing of all LEDs		Warm up

Table 3: Indication of operation modes

6 Layouts of gas detection systems

Gas detectors can be mutually interconnected in two ways:

- star layout (conventional architecture), or
- serial bus layout (an open or closed chain of gas detectors connected to a common communication bus).

Such system may comprise only the Alpa EcoDet XT detector or pairs made up of the Alpa EcoDet XT detector combined with the Alpa EcoWent XT unit.

6.1 Star layout

Within a gas detection system arranged according to the conventional architecture any individual detector is directly connected to a central control unit. Such a solution needs routing of great many cables to a single control unit, which makes installation of a system quite difficult and cost of cabling is pretty large.

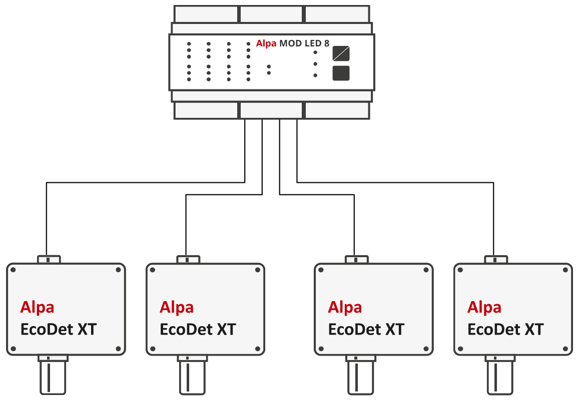


Figure 4: Connection with the Alpa MOD LED8 Control Unit into a star-shaped system

The detailed schematic diagram for such a layout is provided in Appendix [3].

6.2 Bus layout with an open alarm loop

Such a layout assumes that gas detectors are arranged in a chain and connected to a common communication bus by means of T-connectors of the XT type. The layout offers substantial benefits since installation of the system is much easier and cost of cabling can be reduced.

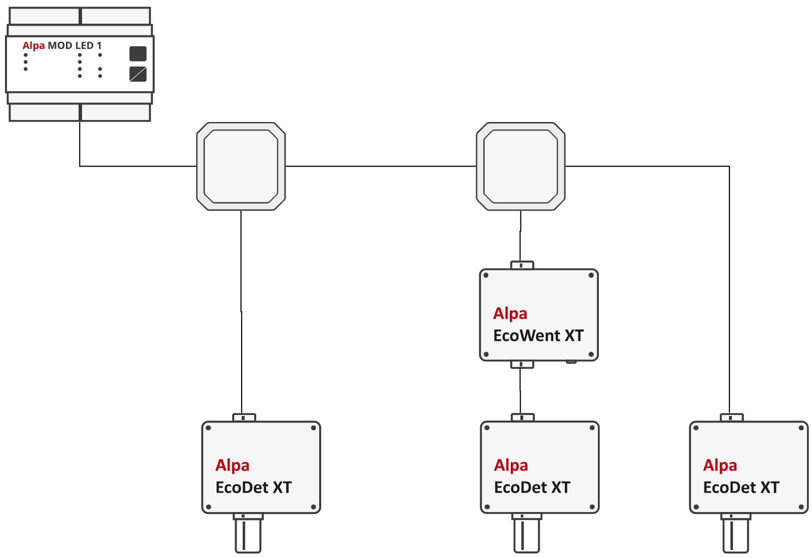


Figure 5: Connection with the Alpa MOD LED1 Control Unit into an open bus system

The detailed schematic diagram for such a layout is provided in Appendix [3].

6.3 Bus layout with a closed alarm loop

That layout differs from the previous one in one aspect, namely the far end of the power supply line and the communication bus is looped back to the control unit that is provided with a dedicated port for test of the communication loop (e.g. the Alpa MOD LED1 Control Unit). Such a solution improves power supply conditions for gas detectors and improve the system reliability since immunity to failures (breaks) of the communication bus is reduced. The layout makes it also possible to test continuity of the loop and verify reliability of the system operation by simulation of an alarm signal at the TEST LOOP port of the control unit, which facilitates scheduled tests of the system operability.

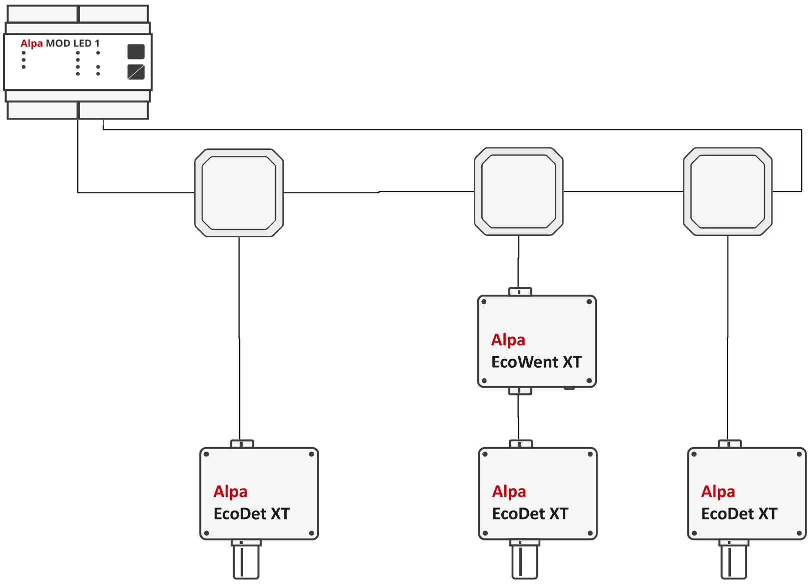


Figure 6: Connection with the Alpa MOD LED1 Control Unit into a closed bus system

The detailed schematic diagram for such a layout is provided in Appendix [3].

6.4 Other possible layouts of gas detection systems

Modifications of the foregoing solutions are possible to set up mixed layouts. For instance, several network fragments with the bus layout can be connected to individual inputs of a control unit. If so, a mixed system is set up with several independent zones but only one control unit is necessary. However one has to keep in mind that such a solution may need installation of additional power supply units to supply specific fragments of the system since sufficient consumption of electric current must be covered.

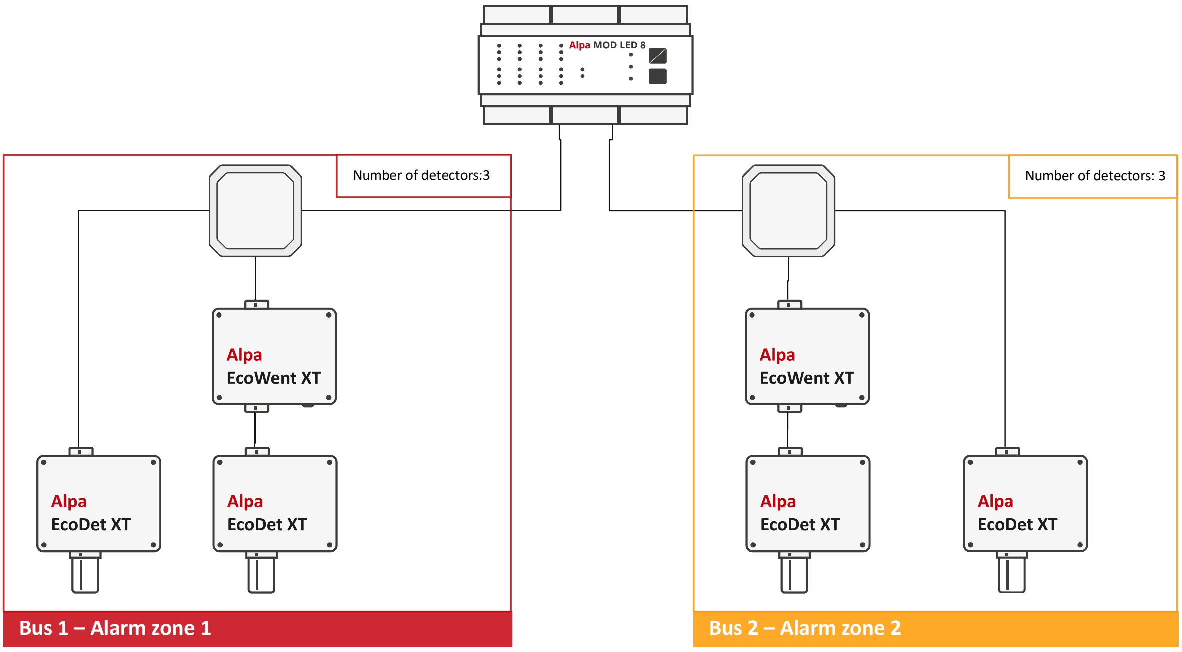


Figure 7: Connecting into two open bus systems servicing two zones

7 Configuration of gas detectors

7.1 Location of the detector operation

To enable reliable operation of gas detectors they have to be configured by appropriate setting of the configuration switch provided inside the detector (see Figures 2 and 8).

Two positions of the switch are possible:

- end-line detector – it is the setting for detectors arranged according to the star layout or for the last detector installed at the far end of the bus line with an open communication loop,
- line-up detectors – it is the setting for all detectors arranged according to the bus layout with an closed communication loop and for nearly all detectors, except for the last one, deployed down an open-loop communication line.

System layout	Detector location	Setting for the configuration switch
Bus layout with an open loop	Last (most distant) location	Position 2 (OST)
	Line-up detector	Position 1 (POS)
Bus layout with a closed loop	Any location	Position 1 (POS)
Star layout	Any location	Position 2 (OST)
Direct connection to Alpa EcoWent XT	Any location	Position 1 (POS) – see also Section 7.2

Table 4: Settings of the configuration switch

Incorrect setting of the configuration switch usually leads to misbehaviour of the gas detection system (false information about system defects or failure of a line-up detector to pass on signals from more distant detectors).

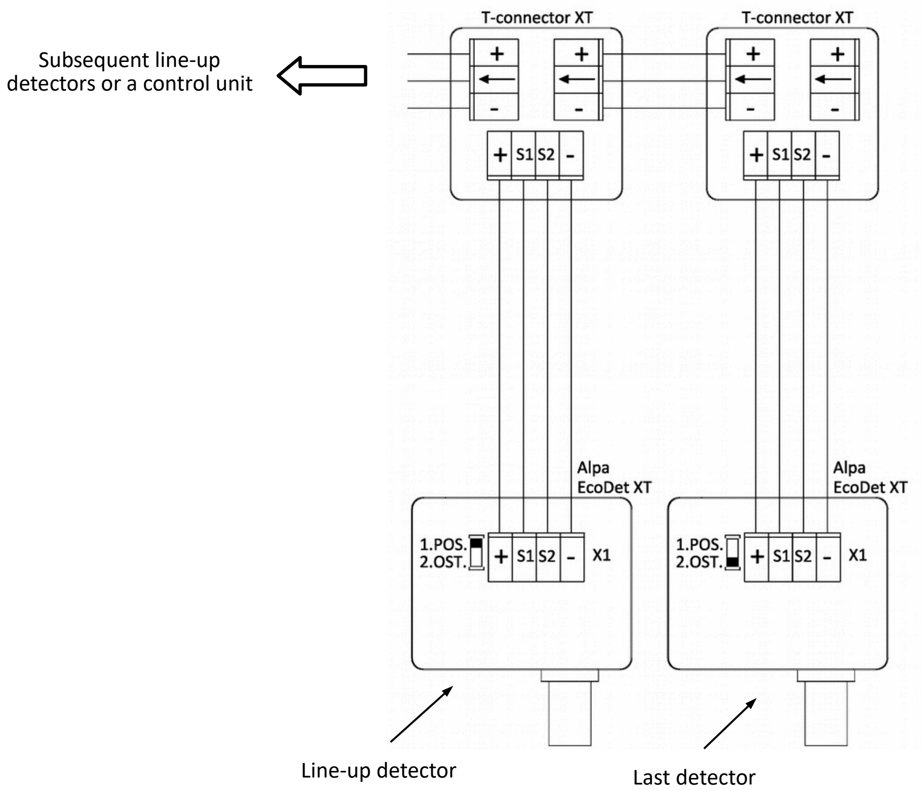


Figure 8: Settings of the configuration switch

7.2 Collaboration with Alpa EcoWent XT detectors

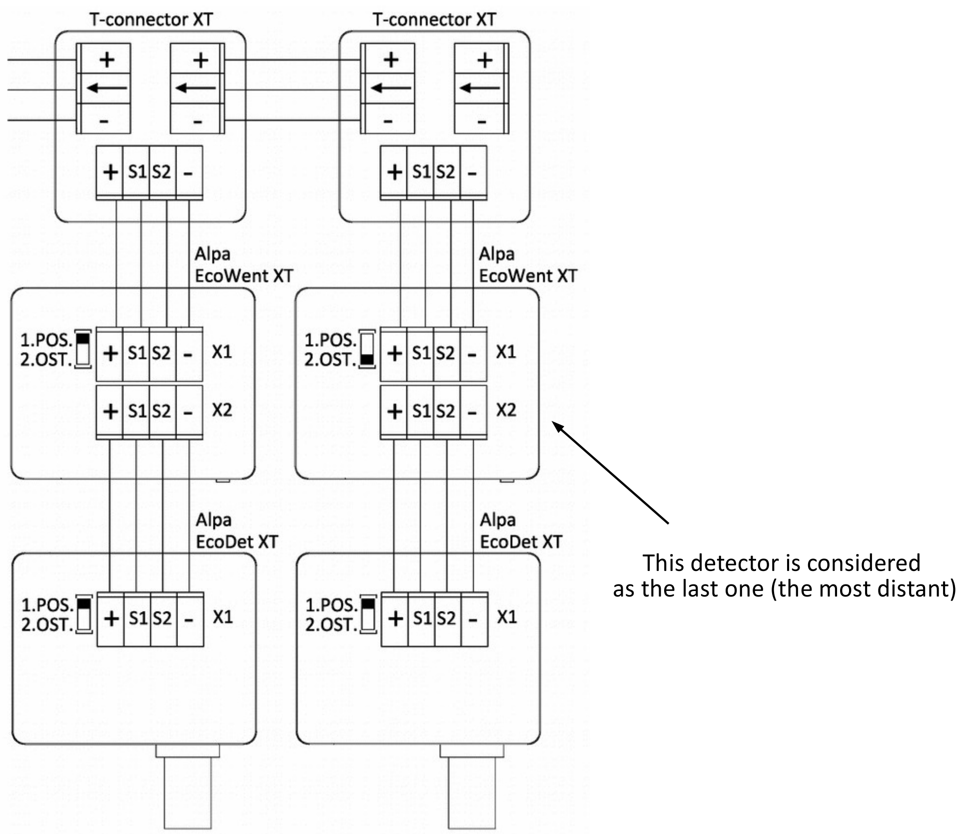
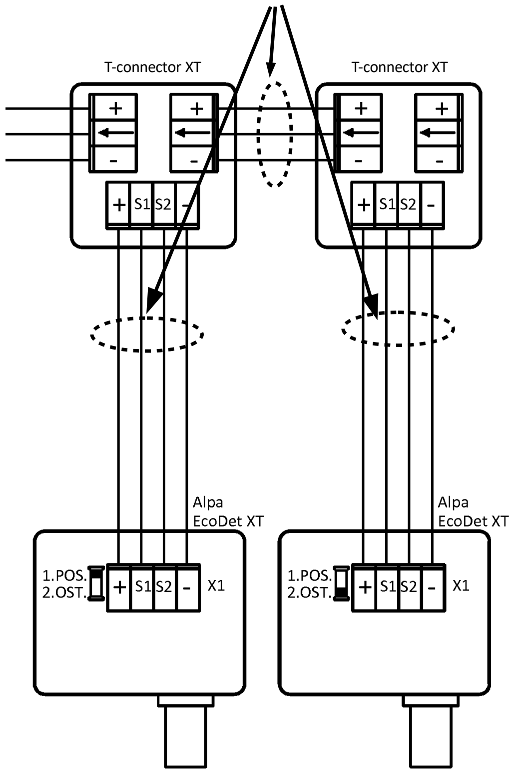


Figure 9: Collaboration with Alpa EcoWent XT detectors

> ⚠ For collaboration with Alpa EcoWent XT detectors, the setting or the configuration switch needs particular attention, i.e. the switch must be always set to the position 1 (POS), even in case when the Alpa EcoDet XT detectors is coupled with the last (the most distant) Alpa EcoWent XT detector (see also Section 7.1.

8 Troubleshooting of electric interconnections – seeking for connection errors

When any detector reports problems with interconnections within the system (see Section 5), guidelines summarized in Table 5 may be helpful to find a remedy for the failure.

LED indicator	Further conditions	Possible reason for the problem
⚠ X1	The detector is installed as line-up one	Faulty T-connector of the XT type or mismatched interconnection at locations encircled in the drawing below: Possibly mismatched interconnections 
		Improper setting of the configuration switch (see Section 7.1)
	The detector is installed as the last (most distant) one	Improper setting of the configuration switch (see Section 7.1)

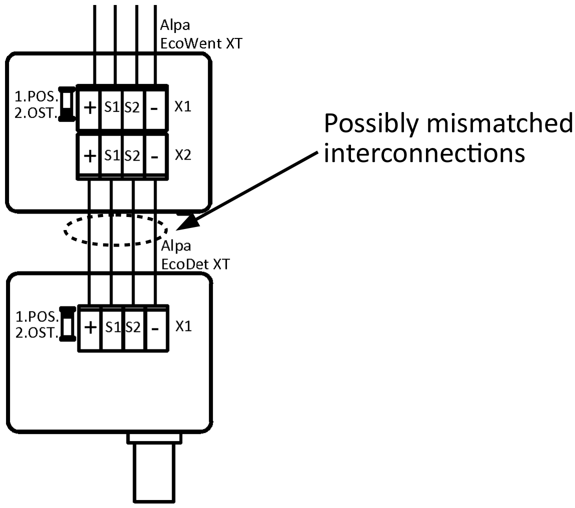
LED indicator	Further conditions	Possible reason for the problem
⚠ X1	The detector is coupled with the Alpa EcoWent XT detector	Mismatched interconnection at locations encircled in the drawing below: 
		Improper setting of the configuration switch (see Section 7.1)

Table 5: Possible reasons for indication of interconnection failures

9 Life cycle

9.1 Transportation

The device can be shipped in the same way as new equipment of that type. If the original package or another protecting means (e.g. corks) is unavailable the conveyed equipment must be secured against shocks, vibrations or moisture by means of adequate methods and material at the own responsibility of the sender.

The device can be conveyed under environmental conditions as described in Table 6.

9.2 Installation

9.2.1 Deployment of gas detectors

Deployment of detectors must be established by a designer of a gas safety system with consideration of the following issues:

- LPG detectors should be installed in such a way that the distance between the measuring head and the lowest point of the floor must be less than 20 cm and the detector should be, if possible, inaccessible to third persons. The propane-butane mixture is heavier than air so that leaking gas may be present nearby the room floor (its accumulation and long-term deposition can be particularly dangerous),
- installation of LPG detectors is recommended at locations where deposition (accumulation) of gas is the most probable due to specific features of the facility design (e.g. a portion of the facility area fenced with structural components from the remaining parts),
- detectors must not be exposed to direct effect of water and other chemical substances (e.g. household chemical agents when the facility is being cleaned) as well as direct impact of sun radiation, rain or wind,

- detectors must be protected against mechanical impacts (e.g. by application of the WM3 mounting bracket, see details in Section 12),
- location of detectors must enable scheduled inspection and adjustments of equipment as well as replacement or disconnection of a detector.

9.2.2 Electric network

Power supplying network for gas detectors must be designed and installed exclusively by persons with adequate competences or acting in coordination and under supervision of the equipment manufacturer. The electric power supplying system must be installed in line with the engineering documentation.

- The electric network for power supply of detectors must be installed in line with general rules for design and deployment of I&C[2] systems. Cables and conductors must be secured against damage. Routing of cables in cable trays is recommended.

> ⚠ All jobs associated with connection of detectors and other components of a gas safety system must be carried out with power voltage isolated from the control unit. Be aware that another collaborating system (e.g. a ventilation system controlled by common contact outputs of relays) can still deliver hazardous voltage, despite the power voltage for the gas detection system is off.

- All interconnections within the system must be made with three-core cables, for instance the following cable types are recommended: YTKS, OMY and LiYY (for the communication bus). Detectors Alpa EcoDet XT must be connected by means of a four-core cable. Selection of appropriate cables is within the responsibility scope of the system designer with consideration of local conditions at the installation site of the Gas Safety System. Maximum lengths of cable sections for connections between detectors and a control unit for specific cross-sections of cable cores are listed in Appendix [4].
- For proper selection of cable type take account of voltage drops down interconnecting lines.

> ⚠ Power supply lines for detectors must be designed in such a way that the actual voltage across the detector terminal must never drop below the minimum permissible level, even under the most unfavourable power supply conditions with the minimum expected limit of power supply voltage at the line input (see Section 10).

- Springy contacts of terminal blocks are released after depressing the contact button with a screwdriver.
- Detectors can be mounted with the use of mounting holes that are accessible after opening of the detector enclosure so that the gas inlet faces down. Dimensions of enclosures, spacing of mounting holes and layout of components inside the detector are shown in Figure 2. D A drilling template attached to the detector enclosure is recommended for drilling boreholes in walls and other support structures.

If multi-core strands (commonly referred to as "cables") are used for connection, the ends of these strands must be secured with terminal ferrules and lugs.

When two or more conductors are to be connected to a single terminal of the device all these conductors must be clamped beforehand into a common ferrule with a lug (see details in Table 6).

2 Instrumentation and Control

It is not allowed to combine two or mode conductors with individual ferrules and lugs in a single terminal. Clamp all conductors into a single ferrules beforehand.

It is not allowed to leave spare lengths of cables inside the device. Bare wires or wires surplus may lead to a hazard of electric shock or equipment damage.

All cable cores must be terminated inside the device. Leaving of unterminated cores is not allowed.

Incorrect routing of cables may lead to compromising the device immunity to electromagnetic interferences.

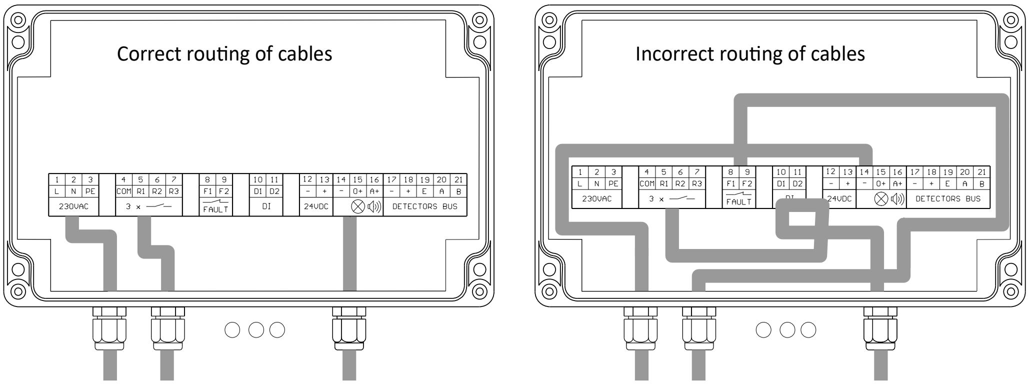


Figure 10: Example of cable routing inside an electronic device

9.2.2.1 Star layout of detectors

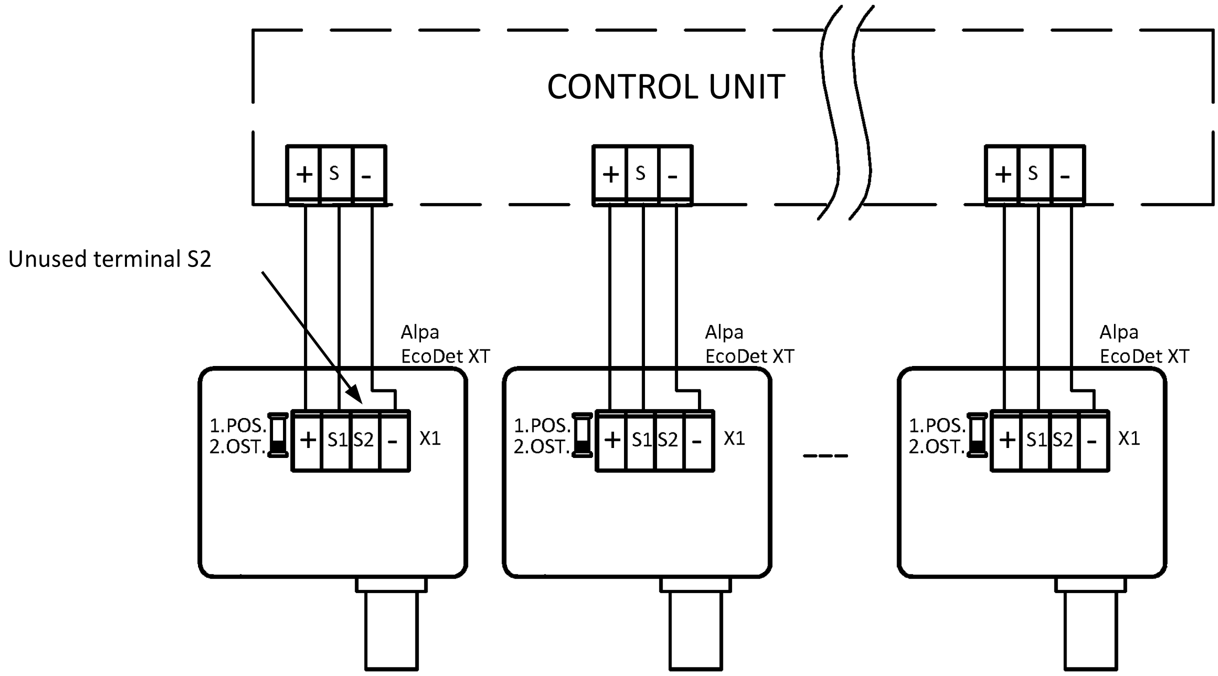


Figure 11: Connection of gas detectors Alpa EcoDet XT according to the star layout

> Only the S1 terminal is used.

> The configuration switch of gas detectors must be always set to the OST position (the last /most distant detector). See details in Section 7.

- Install interconnecting cables on the facilities leaving sufficient spare length for connection of detectors.
- Install a control unit and supply power voltage to it. Upon power up the control unit should report the status FAILURE (AWARIA) since no detectors are connected to it. Switch power voltage for the control unit off.
- Fix the detector on the facility area to support structures.
- Connect the input port of the first detector to an interconnecting cable leading to a control unit. Set the configuration switch of the detector to the 'OST' position (the last detector in a chain) – see Figure 11.
- Connect the interconnecting cable between the detector and a control unit to appropriate port (channel) of a control unit. Upon power up the control unit should report the status of OPERATION (PRACA) and indicator LEDs on the user interface panel of the detector should flash one after another during the time period of one minute (warm up and stabilization of the detector). Upon expiration of that time period the 'OK' indicator on the detector interface panel should go on.
- If the control unit still reports the status FAILURE (AWARIA), the connection is incorrect and possible connection errors must be identified and remedied.

- After the control unit reports the status of OPERATION (PRACA) the test of a detector can be launched. For that purpose enforce the ALARM status by depressing the TEST button of the detector. The control unit should also report the ALARM status.
- Switch the power voltage off.
- Repeat the foregoing installation procedure for all other detectors.
- Upon having all detectors connected, switch the power voltage on. All employed channels of the control unit should report the status of OPERATION (PRACA). Measure power voltage across terminal of the most distant detector with the longest power supply line and make sure that the voltage is not less than 10 V.

See more details in Appendix [3].

9.2.2.2 Bus layout with an open alarm loop

- Route the bus cable across the facilities.
- Install a control unit and supply power voltage to it. Upon power up the control unit should report the status FAILURE (AWARIA) since no detectors are connected to it. Switch power voltage for the control unit off.
- Fix all detectors together with T-connectors on the facility area to support structures. Make connections between T-connectors and T-connectors.
- Connect the output port of the first T-connector (the closest one to the control unit) to the system bus. Set the configuration switch of the gas detector to the 'OST' position (at the moment the detector is the last/most distant one within the system).
- Upon power up the control unit should report the status of OPERATION (PRACA) and indicator LEDs on the front panel of the detector should flash one after another during the time period of one minute (warm up and stabilization of the detector). Upon expiration of that time period the 'OK' indicator on the detector front panel should go on.
- If the control unit still reports the status FAILURE (AWARIA), the connection is incorrect and possible connection errors must be identified and remedied.
- If the control unit reports the status of OPERATION (PRACA) set the configuration switch of the detector to the 'POS' position (the detector shall be used as a line-up one). The X1 indicator on the front panel of the detector should go on and the control unit should report the status of FAILURE (AWARIA) – a detector at the far end of the communication bus is missing.
- Switch the power voltage off.
- Repeat the foregoing installation procedure for all other T-connectors and detectors.
- Set configuration switches for all line-up detectors to the 'POS' position (No. 1). The configuration switch of the last (the most distant) switch must be set to the 'OST' position (No. 2) – see Figure 8). The control unit should report the status of OPERATION (PRACA) for the entire bus structure.
- Launch a test for the already assembled bus structure. For that purpose enforce the ALARM status on the last (the most distant) gas detector by depressing its TEST button. After expiration of the time gap that lasts from 5 to 30 seconds depending on the number of detectors, the control unit should also report the ALARM status.
- Hold the TEST button depressed on the last detector and measure the power voltage across its power supply terminals. When the power voltage is lower than 10 V increase the voltage supplied to the input of the bus or rearrange the system to the bus layout with a closed communication loop.

See more details in Appendix [3].

9.2.2.3 Bus layout with a closed alarm loop

That layout differs from the previous one only in the following aspects:

- configuration switches for all gas detectors included into the communication loop are set to the 'POS' (No. 1) position (the control unit is deemed to be the last detector within the loop) – see Figure 8,
- the output port of the last T-connector is linked to the output port of the control unit.

See more details in Appendix [3].

9.3 Commissioning and start-up

9.3.1 Acceptance inspection

After the entire system for power supply and data transmission is assembled and installed the commissioning test of the system can be commenced. The test consists is subsequent incorporation of detectors (or their dummies, see below), one after another, into the system and checking of the control unit behaviour.

9.3.2 Commissioning tests

To make sure that the entire system is in sound operating condition the following checks have to be done:

- verification whether the control unit reports the status of OPERATION (PRACA) when none of detectors is tripped with gas,
- tripping of the first detector with a hazardous gas and verification of the control unit behaviour (it should report a WARNING (OSTRZEŻENIE) or ALARM depending on concentration of a test gas),
- tripping of the last (the most distant) detector with a hazardous gas and verification of the control unit behaviour as well as behaviour of all intermediate line-up detectors – they should indicate either a warning ⚠ or ALARM – depending on concentration of a test gas,
- random triggering of various intermediate line-up detectors,
- random disconnection of single detectors and verification of the control unit response – it should report the status of FAILURE (AWARIA) for the entire system.

See also more details in Section 9.4.

9.3.3 Start up

After installation of the entire system, verification of all electric connections and passing results of commissioning tests the system start-up and final inspection can be commenced pursuant to the following procedure:

- double check correctness of electric connections and positions of configuration switches,
- switch the power voltage for the system on. All detectors should carry out the warm-up operation, which is indicated by flashing of LED indicators on detector front panels. During the warm-up operation the channels (ports) of a control unit that are employed by the system should report the status of OPERATION (PRACA). After about 1 minute all detectors and control units should be ready for operation, which is reported by indication of the OPERATION (PRACA) status on all detectors and on the control unit (provided that air is free of a contaminant that may trigger a warning/alarm on any detector),

- launch test of the detector operability, i.e. depress and hold the TEST button provided inside the detector (see Figure 2) and wait until the central unit reports the ALARM status. Depressing of the TEST button on a specific detector should trigger indication of the ALARM status on the detector under test and on a control unit,
- keep the TEST button depressed (all detectors report the ALARM status) take a measurement of power voltage across power supply terminals of the most distant detector. The actually measured voltage must not be lower than the minimum limit for supplying the detectors (see Table 6). Insufficient level of power voltage across input terminals of detectors indicates that cross-section of power supplying cables are selected improperly or output voltage of the power supply unit for the system is too low,
- test of detector response to a reference gas is recommended,
- operability test must be carried out for each single detector,
- should the system fails operate in a proper way, recheck all connections or contact the equipment manufacturer,
- passing result of all foregoing test is the indispensable condition to approve the system for regular operation.

9.4 Scheduled maintenance

Operators of gasometric systems must be aware of the fact that gas detectors, or more precisely gas sensors, are vulnerable to ageing processes as the time goes by and to impact of ambient environment. It is why scheduled maintenance and checks of the system must be carried out on regular basis.

Such inspections and maintenance must be carried out by trained personnel, in line with the applicable state-of-the-art, general safety rules and special conditions for installation of the equipment.

Schedules maintenance includes the following operations:

- verification and calibration of detectors,
- replacement of consumables and fast wearing parts,
- scheduled inspections.

9.4.1 Verification and calibration of detectors

A gas sensor incorporated into the device is vulnerable to ageing and impact of ambient environment. As a consequence, its sensitivity naturally decreases in pace with its operation time.

To compensate that deterioration effect all gas detectors must undergo regular verification /calibration, where the frequency of such measures is specified in the Calibration Certificate (see Table 6) issued for the Gas Detector Alpa EcoDet XT. These operations must be entrusted to a service company authorized by the equipment manufacturer. The calibration process can be carried out in several way:

- removing of a detector from a gas safety system to send it to the manufacturer for calibration,
- disassembling of gas detector to remove sole measuring heads and to send them to the manufacturer – the MiniPel measuring head can be removed from the Alpa EcoDet XT gas detector upon opening of the device enclosure (see Figure 2). Keep in mind that power voltage for the detector must be mandatory switched off beforehand,
- execution of calibration on site by an authorized service team against a request sent by the system operator.

In any case, all expenses related to calibration, p&p and travels shall be borne by the system operator.

9.4.2 Replacement of consumables and fast wearing parts

Service life of consumables and fast wearing parts is specified in Table 7.

9.4.2.1 Replacement of the MiniPel measuring head

In pace with operation time of the detector its sensor subjects to natural deterioration of its metrological parameters. That phenomenon can be compensated by periodical and regular adjustment of the sensor indications until the moment when the deterioration reaches the boundary threshold and the sensor must be replaced. It is generally assumed that a sensor must be substituted with a new one when its sensitivity drops below 50% of the initial level.

However, the sensor itself is not a detachable component and the entire measuring head must be replaced – see Table 7.

To substitute a measuring head the following procedure must be followed:

- switch off power voltage for the detector,
- undo the locking screw (see Figure 2),
- remove the head from its socket and insert a new one,
- retighten the locking screw,
- switch the power voltage on.

9.4.3 Scheduled inspections

Scheduled inspections are recommended after each three months of the device operation. The inspection scope should include visual inspection of the system and its components as well as operability tests of all detectors:

- supply gas to the first of detectors and check the response of a control unit (it should report the WARNING (OSTRZEŻENIE) or ALARM status, depending on concentration of test gas supplied to the detector),
- repeat the test for all remaining detectors.

> ⚠ To supply test gas in correct manner a calibration kit and appropriate reference gas should be used. The reference gas is propane C_3H_8 with the concentration of 30% to 40% of LEL (See Section 12.

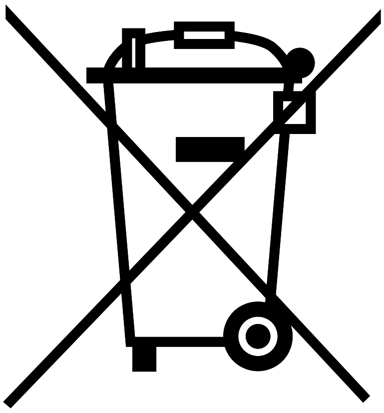
> ⚠ Unprofessional tests of a gas detector, i.e. by supplying gas of unknown composition and concentration to the detector, for instance from a gas lighter, are forbidden. Such behaviour inevitably leads to poisoning of the sensor and decalibration of the detector.

9.4.4 Maintenance

Device must never be cleaned with agents that contain solvents, white spirit naphtha or alcohols.

The device needs no other maintenance beside cleaning external surface of the enclosure. These surfaces should be wiped with a soft cloth moistened with water and slight amount of a mild detergent.

9.5 Utilization



This symbol on a product or on its packaging indicates that the product must not be disposed of with other household waste. Instead, it is the user's responsibility to ensure disposal of waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The proper recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. Information about relevant designated collection points can be obtained from the Local Authority, waste disposal companies and in the place of purchase. The equipment can also be returned to the manufacturer.

10 Technical specification

Power voltage • V_{CC} • I_{CC}	 10 – 42 V ⎓ 130 mA	
Environment	In-operation	Storage
• Ambient temperatures • Humidity • Pressure	-20 – 50°C 10 – 90% long term 0 – 99% short term 1013 ± 10% hPa	-20 – 50°C 20 – 80% long term
Detected substance	LPG (C_3H_8, C_4H_{10})	
Measuring range	0 – 50% LEL	
Standard configuration • warning 1 • warning 2 • alarm	 10% LEL 15% LEL 20% LEL	
IP	IP 43	
Analogue input parameters R_{IN}	 200 Ω	
Analogue output parameters • R_{LOAD_MAX}	 200 Ω	
The output signal according to the operating status of the detector: • failure • operation • warning 1 • warning 2 • alarm	 2.4 mA 4 mA 9 mA 11 mA 15 mA	
Integrated signalling equipment (optical)	LED controls	
Protection class	III	
Dimensions	See Figure 2	
Cable glands (cable diameter range)	Cable glands pressed into installation pipes – pipe diameter 16 mm Multi-range cable glands – cable diameter 3.5 – 12 mm	

Acceptable cables	0.25 – 1.5 mm^2 – solid wire 0.25 – 1 mm^2 – stranded wire
Enclosure material	ABS
Weight	0.3 kg
Mandatory periodic inspection	Every 12 months (Calibration Certificate validity)
Lifetime of consumables	See Table 7, Section 11
Mounting	4 holes for screws with the diameters of 4 mm, hole layout – see Figure 2

Table 6: Technical specification

11 List of consumables

No.	Consumables	Lifetime	Manufacturer	Product code
{1}	MiniPel Measuring Head	5 years	Atest Gaz	PWS-016-LPG

Table 7: List of consumables

12 List of accessories

Product code	Description
PW-049-CB3	Service cable CB3
PW-064-WM1	Mounting bracket WM1 (for wall mounting)
PW-064-WM3	Mounting bracket WM3 (for wall mounting, with cover)
PW-092-B	Calibration kit
-	Standardized reference gas – propane C_3H_8 / 30% LEL

Table 8: List of accessories

13 Product marking

Product code	Device
PW-098-LPG	Alpa EcoDet XT Gas Detector

Table 9: Method of product's marking

14 Appendices

[1] DEZG114-ENG – EC Declaration of Conformity – Alpa EcoDet XT

[2] PU-Z-054-ENG – Parameters of gas detectors with catalytic sensor

[3] PU-Z-099-ENG – Connection diagrams of gas detectors XT series

[4] PU-Z-098-ENG – Maximum quantity of Alpa EcoWent XT and Alpa EcoDet XT detectors by cable type

[5] PU-Z-039-ENG – Classification of chemicals used at Atest Gaz

EU Declaration of Conformity

Atest Gaz A. M. Pachole sp. j. declares with full responsibility, that the product:

(Product description)	(Trade name)	(Type identifier or Product code)
Gas Detector	**Alpa EcoDet XT**	**PW-098**

complies with the following Directives and Standards:

- in relation to Directive 2014/30/EU – on the harmonisation of the laws of the Member States relating to electromagnetic compatibility:
  - EN 50270:2015
- in relation to directive 2011/65/EU – on the restriction of the use of certain hazardous substances in electrical and electronic equipment:
  - EN IEC 63000:2018

This declaration of conformity is issued under the sole responsibility of the manufacturer.

This EU Declaration of Conformity becomes not valid in case of product change or rebuild without manufacturer's permission.

Gliwice, 20.04.2022

(Name and Signature)
Managing Director
Aleksander Pachole

Parameters of gas detectors with catalytic sensors

1 Detected substances

Detectors equipped with catalytic sensors are used for measuring and detecting the presence of gases and flammable gases in the range of up to 100% LEL.

2 Principle of operation

The catalytic sensor (figure 1) consists of two components: an active and a passive one, heated to a high temperature. They are both constructed of a very thin coiled platinum wire, however, the active element (figure 2) is additionally coated with a catalyst (e. g. palladium, platinum). A combustion reaction occurs on the active element. Heat is generated as a result, which causes an increase in the temperature of this element and a resultant change in its resistance. Whereas combustion is not possible on the passive element, therefore, its properties do not change under the influence of a combustible substance. This allows the passive element to compensate for the impact of ambient temperature. The same resistance change of both elements occurs when the ambient temperature changes. The passive and active elements are integrated in the Wheatstone bridge circuit, which ensures conversion of the change of resistance to voltage.

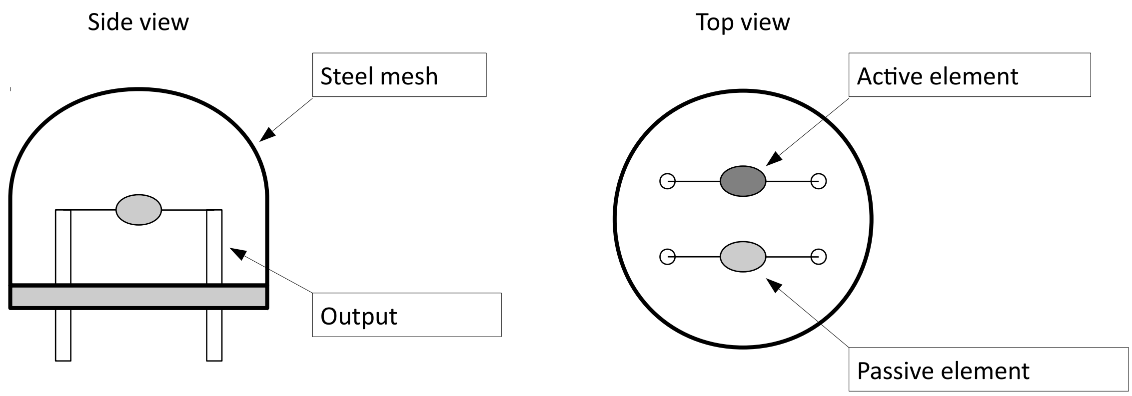


Figure 1: Sample view of catalytic sensor

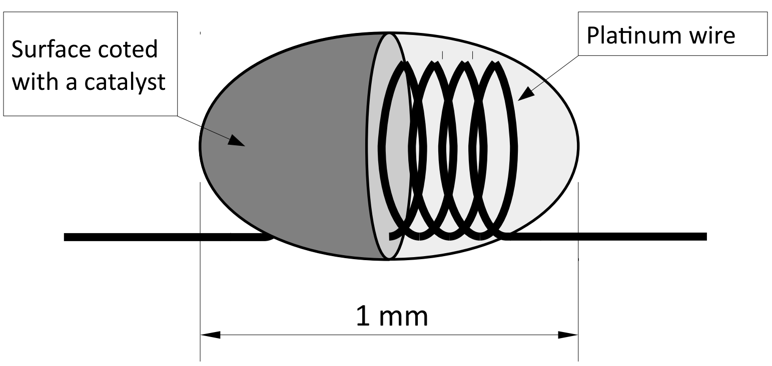


Figure 2: Active element construction

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3 Impact of environmental conditions

> Never exceed the rated operating parameters of the detector. These parameters can be found in the detector calibration certificate.

> The detector must be used in accordance with the provisions in the User's Manual.

3.1 Composition of the controlled atmosphere

It is assumed that the standard composition of the atmosphere is a mixture of gases with the proportions indicated in table 1.

Ingredient	C [% vol]	C [ppm]
Nitrogen	78.084	780 840
Oxygen	20.946	209 460
Argon	0.934	9 340
Carbon dioxide	0.0360	360
Neon	0.00181	18.18
Helium	0.00052	5.24
Methane	0.00017	1.70
Krypton	0.00011	1.14
Hydrogen	0.00005	0.50
Xenon	0.000008	0.087

Table 1: Typical composition of atmospheric air

When gas concentrations in the atmosphere differ significantly from those indicated in the table 1, it is necessary to conduct the analysis of the impact of such a situation on the detector operation.

> Catalytic sensor working properly at an oxygen concentration of about 21%.

3.1.1 Impact of the presence of a working gas or other reaction gas

Catalytic sensor isn't selective – it reacts (with different sensitivity) to most flammable substances appearing in its surroundings. Because of that it is necessary to consider their presence when the sensor is operating.

When using detectors with catalytic sensors, it is necessary to be aware that:

- long-term presence of significant concentrations results in faster sensor wear. Basically, catalytic sensors are used to detect the incident presence of combustible gases. They should not work in atmospheres in which flammable gases at concentrations greater than about 20% LEL occur in a continuous or prolonged manner, as it may lead to a rapid reduction of their sensitivity and the appearance of a zero drift,

- concentrations over 100% LEL, even temporarily persistent ones, can lead to a physical wear of the sensor. For these reasons, detectors operating in places where such conditions may occur are / should be equipped with mechanisms to prevent the negative effects of high concentrations,
- a very high concentration of combustible gas (well above 100% LEL) leads to a decrease in oxygen concentration – thereby lowering the sensor's indication. Volumetric concentrations close to 100% can result in a zero sensor response, as shown in the figure (example: a small room and a large amount of flammable gas released into the atmosphere). See section 3.1.2.

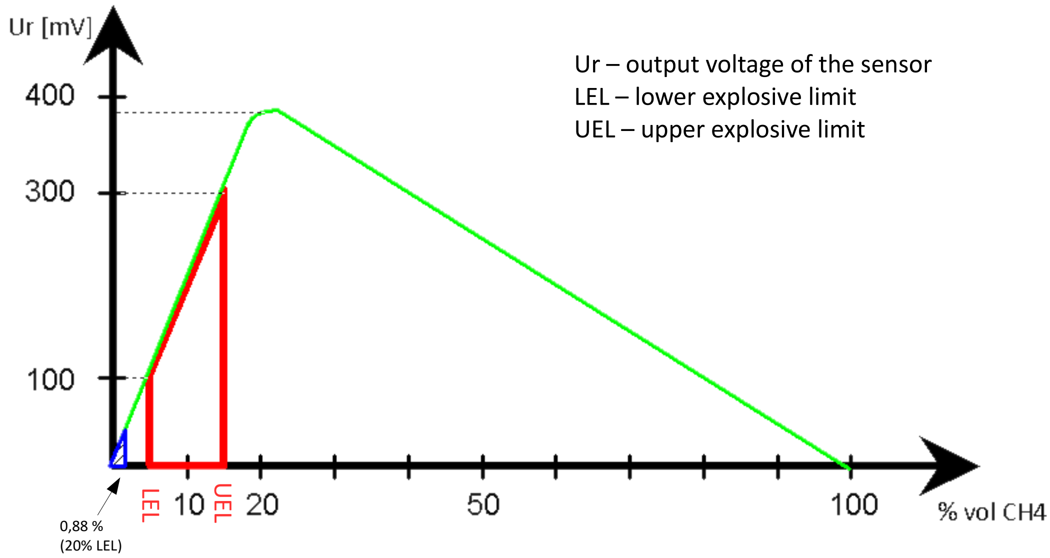

Figure 3: Sample characteristic of catalytic sensor

3.1.2 Effect of oxygen concentration value

Oxygen is required for a proper operation of the catalytic sensor. If the monitored atmosphere contains gas or gases that dilute or replace air (thereby reducing the oxygen concentration), for example, nitrogen or carbon dioxide, then the catalytic detector can give a low or even zero response.

A similar effect can occur when large amounts of reaction gas are released to the atmosphere(creating a concentration over the measurement range) – due to a too low amount of oxygen, the concentration indication of the detector will be lower than it actually is, and it may even be zero.

3.2 Influence of temperature

The temperature can have an influence on the sensor's characteristics. Within the scope of the detector's environmental parameters, its influence is compensated electronically.

3.3 Influence of pressure

Within the environmental parameters of the sensor, the influence of pressure on the measurement is negligible.

3.4 Influence of moisture

Within the environmental parameters of the sensor the influence of moisture on the measurement is negligible.

3.5 Influence of vibrations, impacts

Vibrations and impacts affect the detector's operation, as they may cause:

- damage to delicate parts of the sensor (e. g. detector element, compensation element),
- shift of the sensor's zero.

It should be ensured that the detector is not exposed to shock and vibration in excess of the amplitude of vibrations amounting to 0.15 mm of the frequencies of over 10 Hz. Under no circumstances should the peak acceleration exceed the value of 19.6 m/s^2.

3.6 Influence of physicochemical phenomena

- In the case of chemical compounds with high flash point (approx. 50°C and above) it is necessary to remember that in typical environmental conditions (ambient temperature below 40°C), it is unlikely that they will be able to produce atmospheres close to 100% LEL. Particularly in the case of ambient temperatures below 0°C it may occur that achieving measurable concentrations by the catalytic sensor (of 10% LEL) is impossible. Another measurement method is required in this case.
- High concentration**s** of inserting gases (e. g. argon, helium) can change the thermal equilibrium of the sensor, resulting in the apparent reading of the presence of a combustible substance.

4 Factors shortening the lifetime of the sensor

4.1 Poison and inhibitors

For every reaction with the presence of a catalyst that cause permanent (poisons) or temporary deceleration (inhibitors) of this reaction, which results in reduced sensor sensitivity – in particular the lack of reaction to a combustible substance.

For catalytic sensors, on the active element side, we distinguish the following poisons:

- silicons (organosilicone compounds) – e. g. PDMS (polydimethylsiloxane), HDMS (hexamethyldisiloxane), sealants, adhesives, raising agents, specific oils and lubricants, some medical supplies,
- organometallic compounds – e. g. Grignard compounds, lead tetrachloride (leaded petrol, certain aviation fuels),
- organophosphorus compounds – e. g. in herbicides, insecticides, phosphoric esters in fire-proof hydraulic fluid,

and inhibitors:

- sulfur compounds – e. g. hydrogen sulfide, mercaptans, carbon disulphide, sulfur dioxide,
- halogen compounds – e. g. methyl chloride, some freons (among others R134a), vinyl chloride,
- olefins – e. g. styrene, propylene, acrylonitrile.

Acetylene is a poison for the passive element of the catalytic sensor.

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Connection diagrams of gas detectors XT series

Examples of connection between Alpa EcoWent XT and Alpa EcoDet XT gas detectors with control units are shown in the drawings.

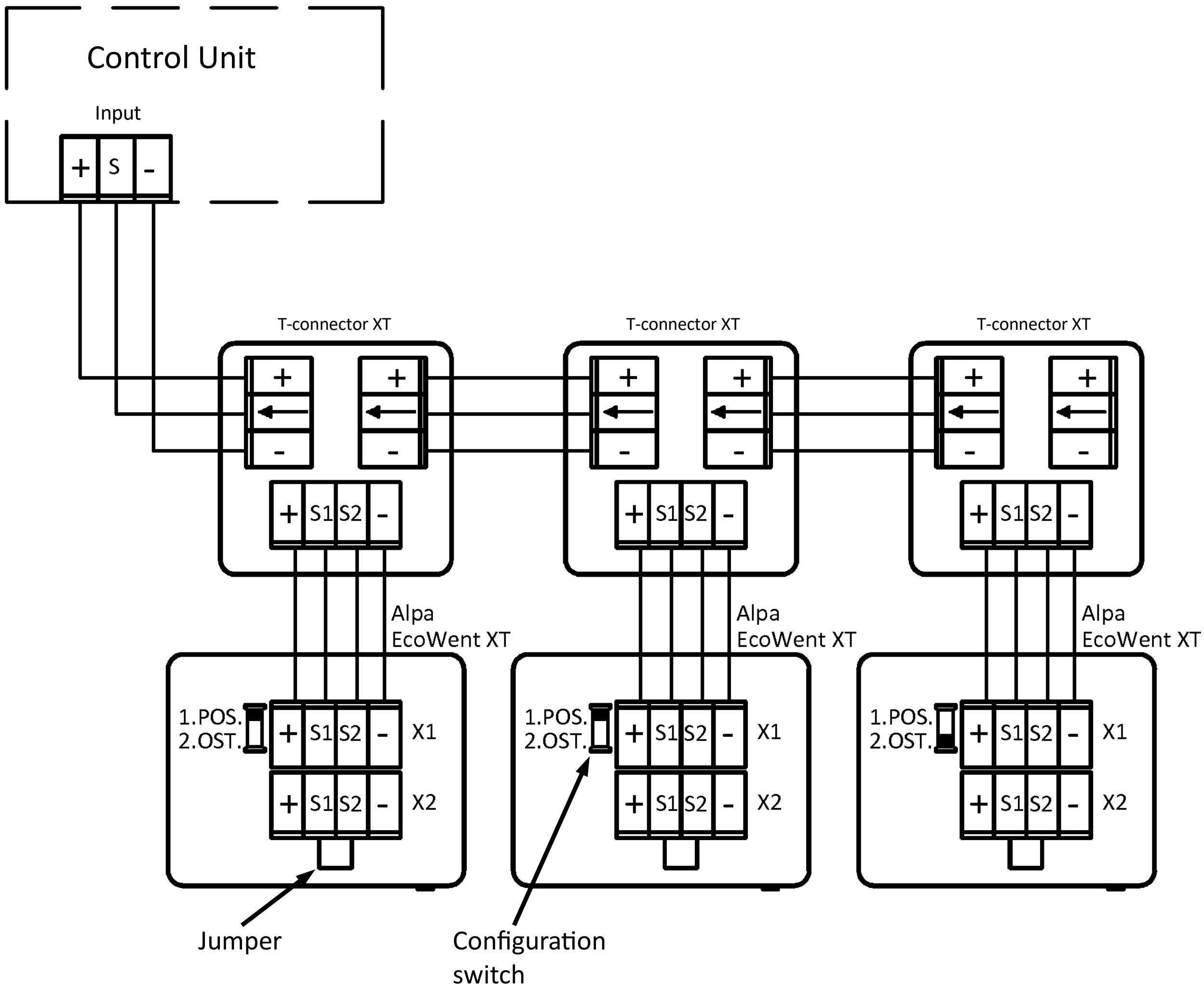

Figure 1: Connection Alpa EcoWent XT Gas Detector with control unit into an open bus system

Please make sure that configuration jumpers are in correct positions. The jumper in the terminal block X2 of the Alpa EcoWent XT must be installed when the detector is not directly coupled with the Alpa EcoDet XT detector). Recheck position of the configuration switch (a transient of a line-end detector).

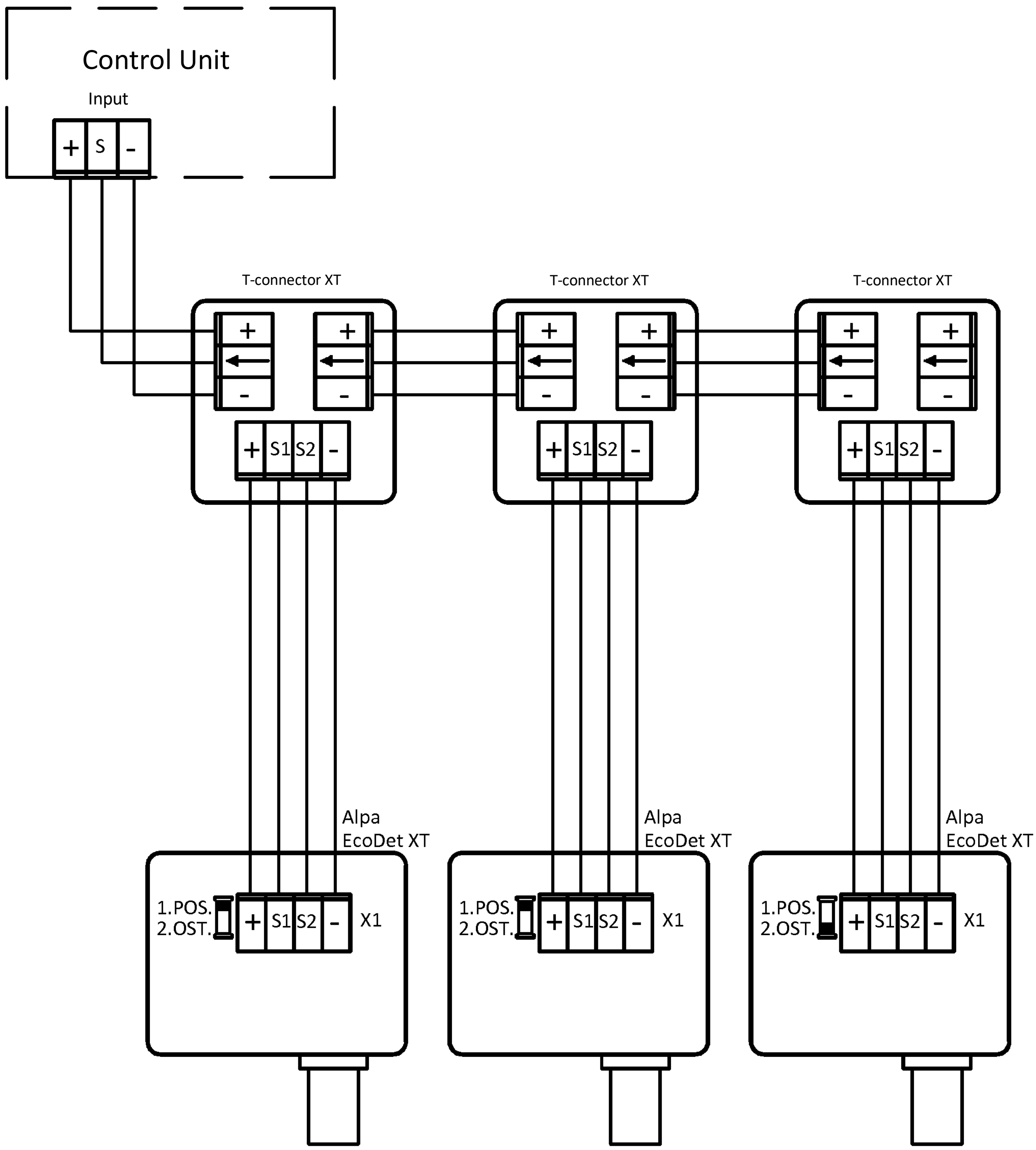

Figure 2: Connection Alpa EcoDet XT Gas Detector with control unit into an open bus system

While connecting detectors to the control loop pay attention to the position of an internal configuration switch (the last detector in the loop or a transient detector).

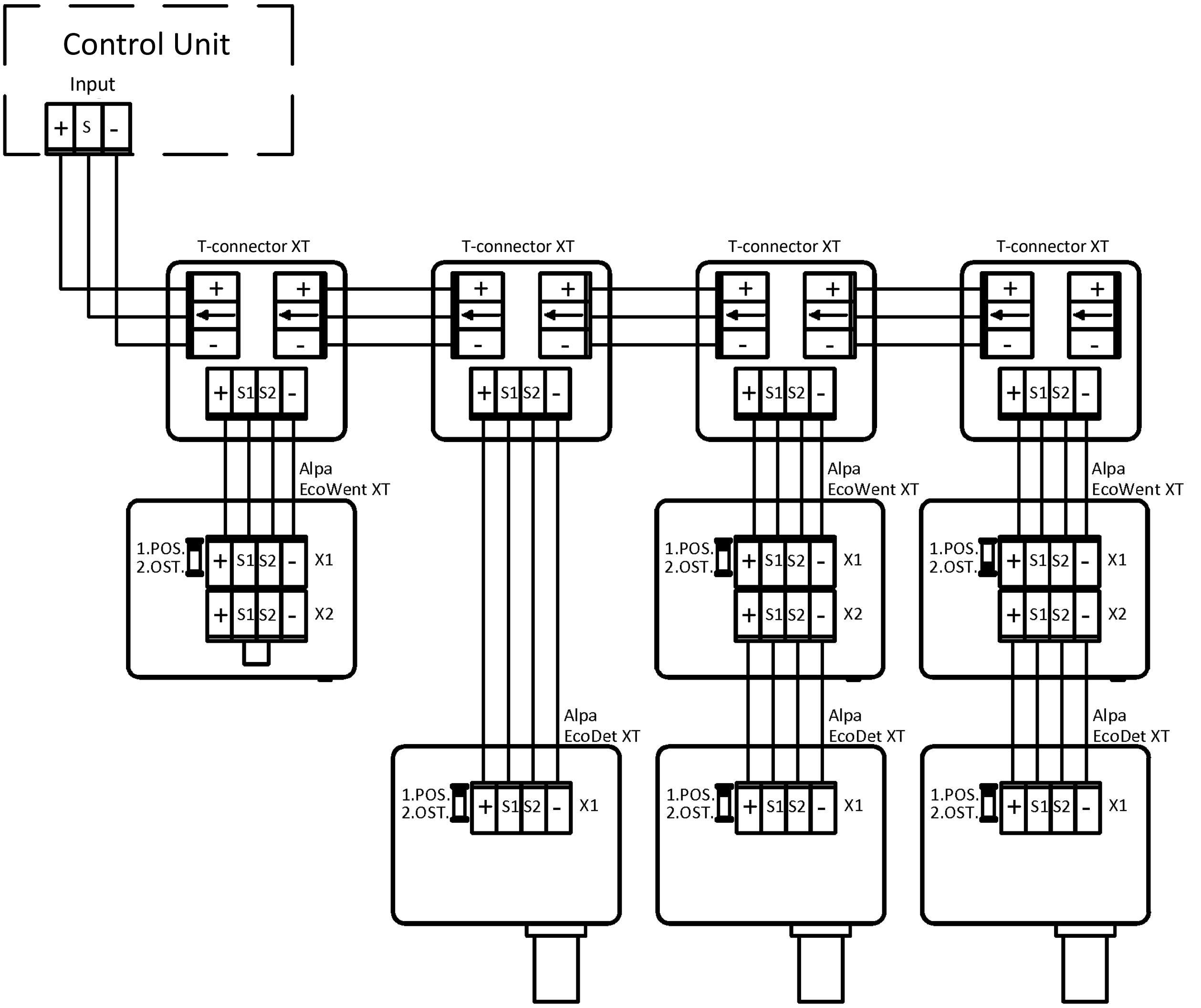

Figure 3: Connection Alpa EcoWent XT and Alpa EcoDet XT Gas Detectors with control unit into an open bus system

Please make sure that configuration jumpers are in correct positions. The jumper in the terminal block X2 of the Alpa EcoWent XT must be installed when the detector is not directly coupled with the Alpa EcoDet XT detector). Recheck position of the configuration switch (a transient of a line-end detector).

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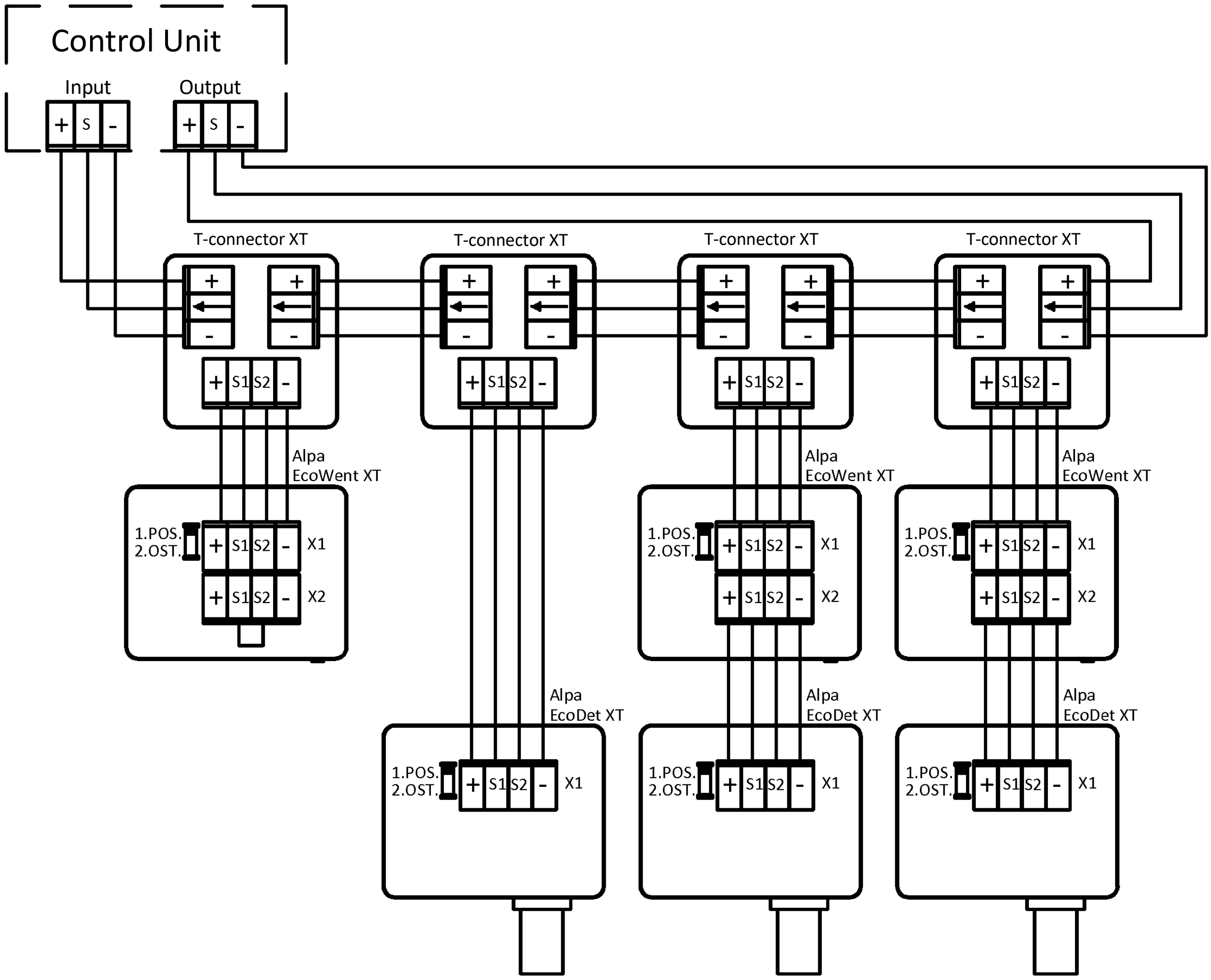

Figure 4: Connection Alpa EcoWent XT and Alpa EcoDet XT Gas Detectors with control unit into an closed bus system

Please make sure that configuration jumpers are in correct positions. The jumper in the terminal block X2 of the Alpa EcoWent XT must be installed when the detector is not directly coupled with the Alpa EcoDet XT detector). Recheck position of the configuration switch (a transient of a line-end detector).

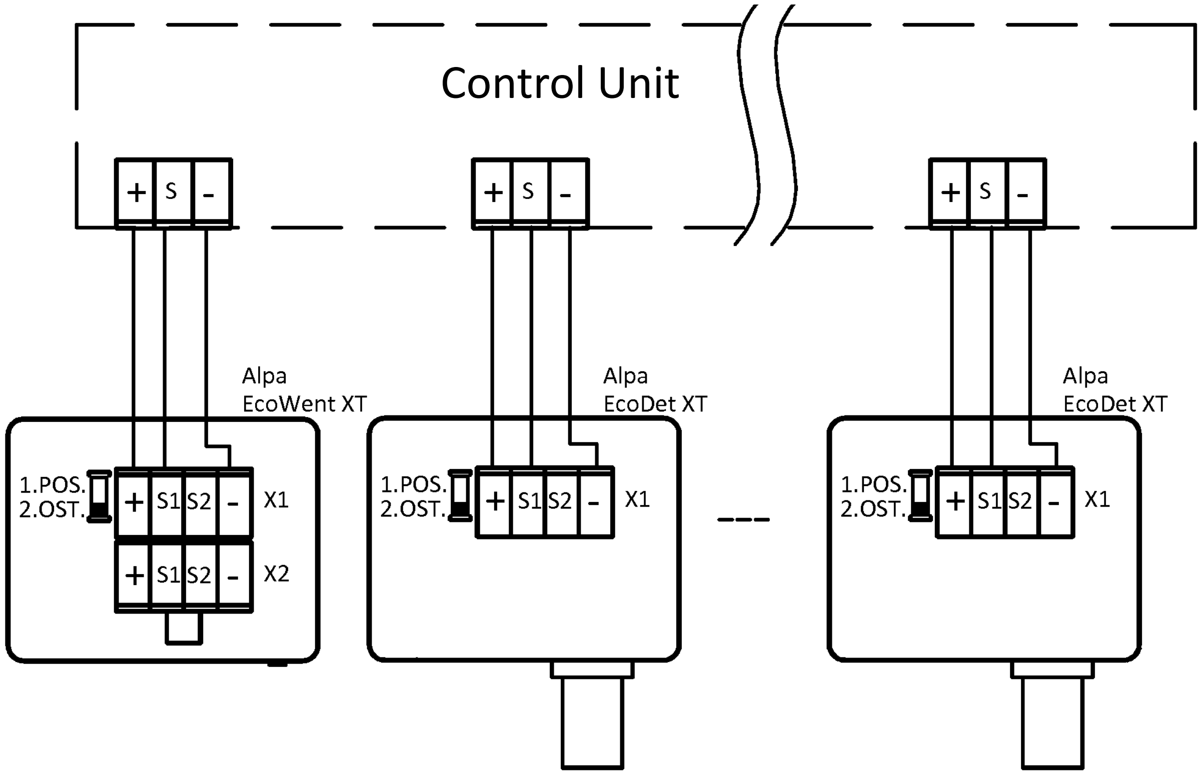

Figure 5: Connection Alpa EcoWent XT and Alpa EcoDet XT Gas Detectors with control unit into a star-shaped system

⚠ Please make sure that configuration jumpers are in correct positions. The jumper in the terminal block X2 of the Alpa EcoWent XT must be installed when the detector is not directly coupled with the Alpa EcoDet XT detector). Recheck position of the configuration switch (a transient of a line-end detector).

Maximum quantity Alpa EcoWent XT and Alpa EcoDet XT detectors by cable type

1 Open loop configuration

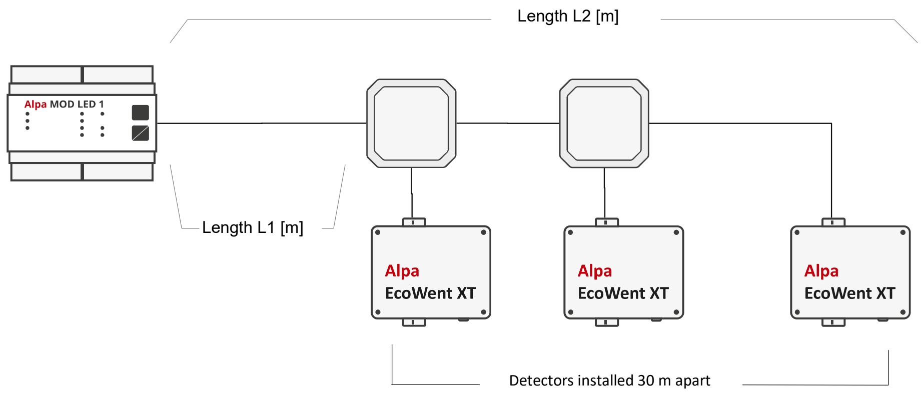

Figure 1: Open loop configuration for Alpa EcoWent XT detectors

Cross-section of a single cable conductor [mm^2]	Alpa EcoWent XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of detectors	L1 [m]	L2 [m]	Quantity of detectors
0,75	58	628	20	53	533	17
	91	631	19	87	537	16
	127	637	18	123	543	15
	165	645	17	163	553	14
	206	656	16	206	566	13
1	63	723	23	75	615	19
	96	726	22	109	619	18
	131	731	21	146	626	17
	168	738	20	186	636	16
	207	747	19	229	649	15
1,5	62	872	28	81	741	23
	94	874	27	115	745	22
	128	878	26	150	750	21
	163	883	25	188	758	20
	200	890	24	229	769	19
2,5	69	1389	45	53	1193	39
	100	1390	44	84	1194	38
	133	1393	43	116	1196	37
	166	1396	42	150	1200	36
	200	1400	41	184	1204	35

Table 1: Maximum quantity of Alpa EcoWent XT detectors – open loop configuration

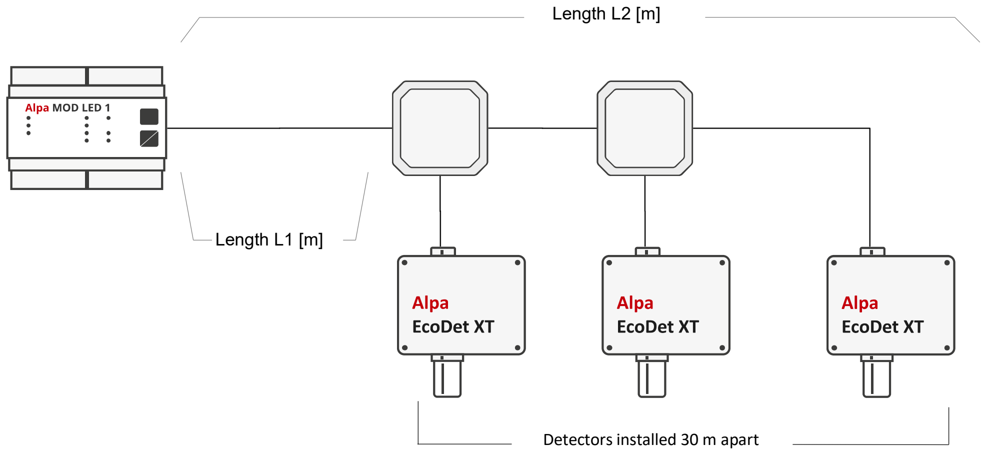

Figure 2: Open loop configuration for Alpa EcoDet XT detectors

Cross-section of a single cable conductor [mm^2]	Alpa EcoWent XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of detectors	L1 [m]	L2 [m]	Quantity of detectors
0,75	72	402	12	67	337	10
	109	409	11	103	343	9
	147	417	10	145	355	8
	190	430	9	194	374	7
	241	451	8	257	407	6
1	73	461	14	55	385	12
	107	463	13	89	389	11
	144	474	12	126	396	10
	184	484	11	169	409	9
	229	499	10	218	428	8
1,5	45	555	18	42	462	15
	77	557	17	74	464	14
	111	561	16	109	469	13
	146	566	15	146	476	12
	184	574	14	187	487	11
	224	584	13	234	504	10
2,5	35	725	24	28	598	20
	66	726	23	59	599	19
	98	758	22	91	601	18
	132	762	21	125	605	17
	166	766	20	160	610	16

Table 2: Maximum quantity of Alpa EcoDet XT – open loop configuration

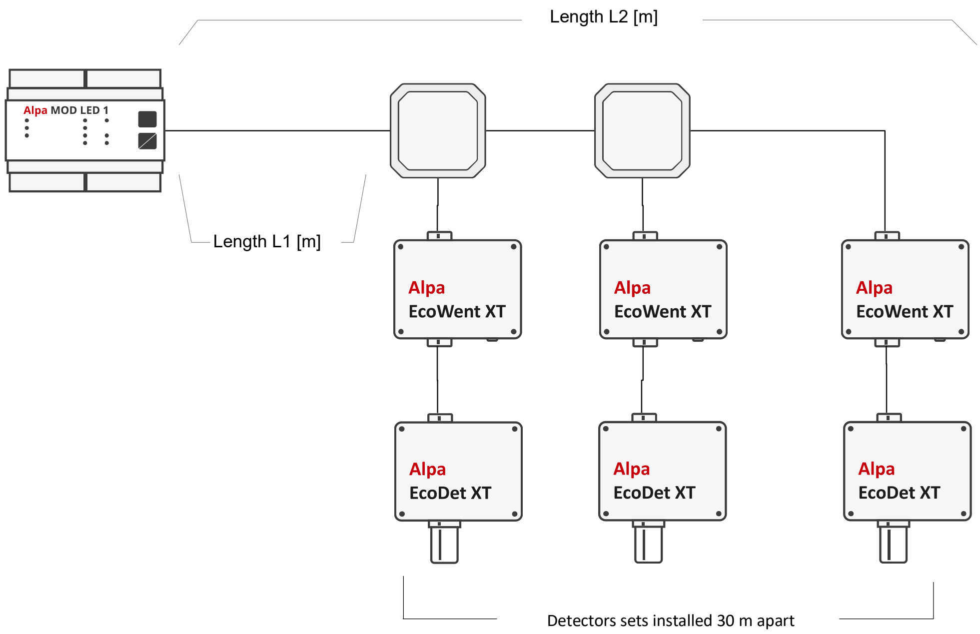

Figure 3: Open loop configuration for sets of Alpa EcoWent XT and Alpa EcoDet XT detectors

Cross-section of a single cable conductor [mm^2]	A set of one Alpa EcoWent XT Gas Detector and one Alpa EcoDet XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of sets	L1 [m]	L2 [m]	Quantity of sets
0,75	70	319	9	80	267	7
	107	325	8	122	278	6
	152	339	7	173	298	5
	203	359	6	243	337	4
1	58	369	11	56	305	9
	93	373	10	93	311	8
	133	382	9	135	322	7
	177	395	8	185	341	6
	229	416	7	249	374	5
1,5	78	451	13	62	373	11
	114	456	12	98	378	10
	153	464	11	138	387	9
	197	477	10	183	432	8
	245	494	9	237	424	7
2,5	66	636	20	52	532	17
	99	639	19	84	534	16
	133	643	18	118	538	15
	169	649	17	154	544	14

Table 3: Maximum quantity of sets of Alpa EcoWent XT and Alpa EcoDet XT – open loop configuration

2 Closed loop configuration

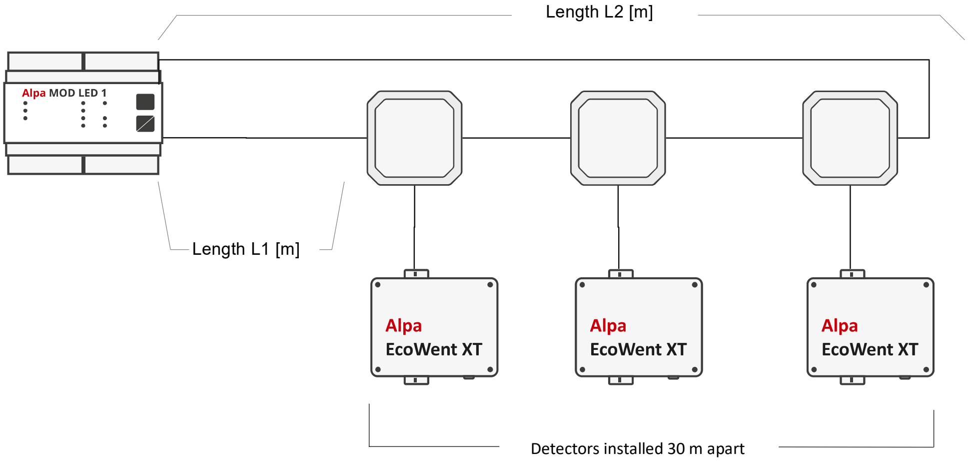

Figure 4: Closed loop configuration for Alpa EcoWent XT detectors

Cross-section of a single cable conductor [mm²]	Alpa EcoWent XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of detectors	L1 [m]	L2 [m]	Quantity of detectors
0,75	57	807	26	50	680	22
	89	809	25	83	683	21
	123	813	24	118	688	20
	160	820	23	153	693	19
	198	828	22	194	704	18
	237	837	21	237	717	17
1	63	933	30	67	787	25
	96	936	29	101	791	24
	130	940	28	136	796	23
	164	944	27	172	802	22
	202	952	26	212	812	21
1,5	50	1130	36	55	955	31
	82	1132	35	87	957	30
	115	1135	34	120	960	29
	149	1139	33	155	965	28
	184	1144	32	192	972	27
	220	1150	31	230	980	26
2,5	47	1877	62	56	1616	53
	78	1878	61	87	1617	52
	110	1880	60	119	1619	51
	142	1882	59	152	1622	50
	174	1884	58	185	1625	49

Table 4: Maximum quantity Alpa EcoWent XT – closed loop configuration

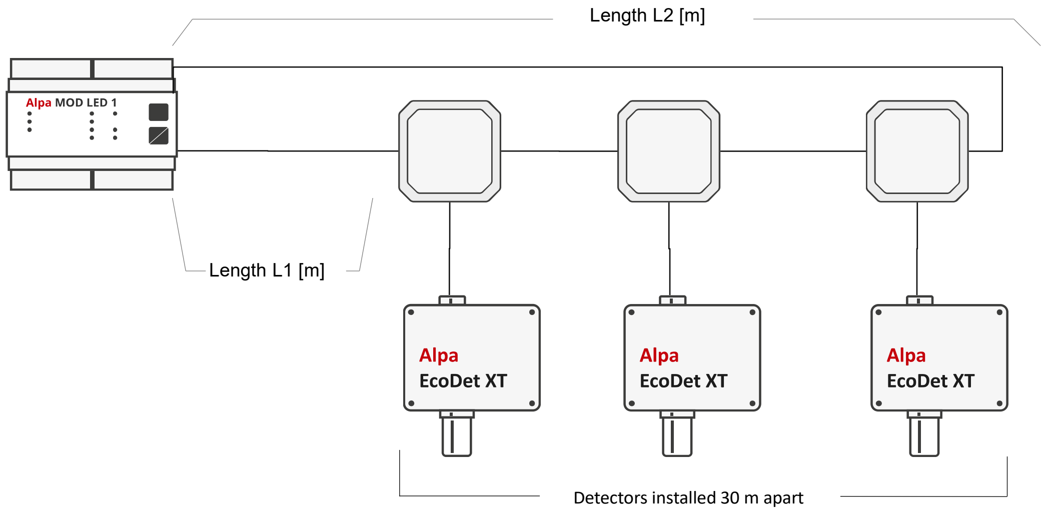

Figure 5: Close loop configuration for Alpa EcoDet XT detectors

Cross-section of a single cable conductor [mm²]	Alpa EcoDet XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of detectors	L1 [m]	L2 [m]	Quantity of detectors
0,75	45	495	16	50	410	13
	76	496	15	86	415	12
	112	502	14	120	420	11
	149	509	13	160	430	10
	190	520	12	207	447	9
	235	535	11	-	-	-
1	64	574	18	55	475	15
	97	577	17	89	479	14
	132	582	16	124	484	13
	169	589	15	163	493	12
	209	599	14	207	507	11
1,5	67	697	22	68	578	18
	99	699	21	101	581	17
	133	703	20	137	587	16
	169	709	19	174	594	15
	207	717	18	215	605	14
2,5	51	951	31	65	785	25
	82	952	30	98	788	24
	115	955	29	131	791	23
	148	958	28	166	796	22
	182	962	27	203	803	21

Table 5: Maximum quantity of Alpa EcoDet XT – closed loop configuration

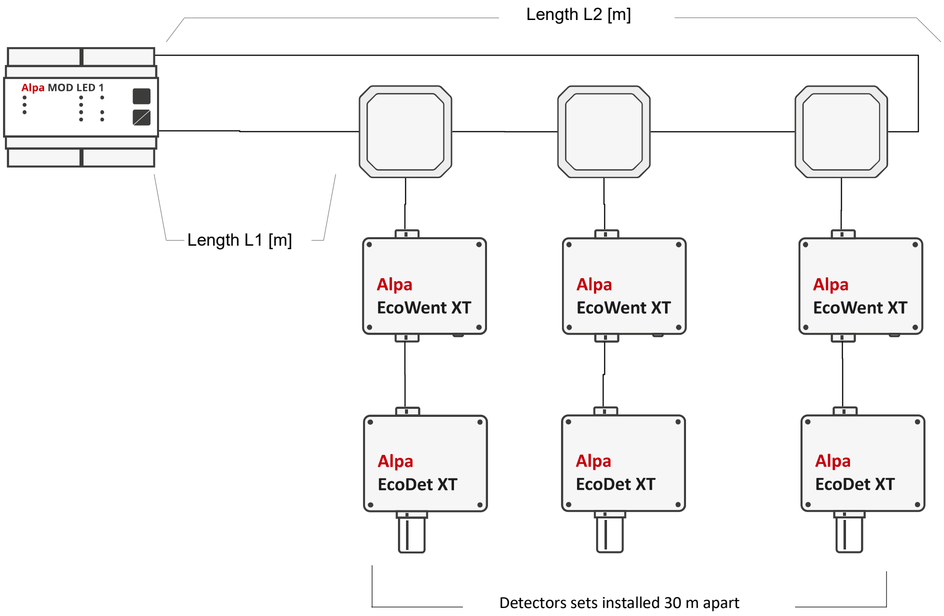

Figure 6: Closed loop configuration for sets of Alpa EcoWent XT and Alpa EcoDet XT detectors

Cross-section of a single cable conductor [mm^2]	A set of one Alpa EcoWent XT Gas Detector and one Alpa EcoDet XT Gas Detector					
	System without backup battery supply (U_{IN} = 24 V)			System with backup battery supply ($U_{IN(min)}$ = 20 V)		
	L1 [m]	L2 [m]	Quantity of sets	L1 [m]	L2 [m]	Quantity of sets
0,75	53	426	13	44	355	11
	88	430	12	78	358	10
	126	437	11	162	411	9
	169	449	10	217	435	8
	218	467	9	-	-	-
1	59	494	15	71	413	12
	94	498	14	108	419	11
	131	504	13	149	429	10
	172	514	12	197	446	9
	217	528	11	252	490	8
1,5	40	599	19	66	501	15
	75	603	18	101	505	14
	108	605	17	139	512	13
	144	610	16	181	523	12
	184	619	15	228	539	11
	227	631	14	-	-	-
2,5	24	834	28	38	698	23
	55	835	27	70	700	22
	87	837	26	103	703	21
	120	840	25	137	707	20
	154	844	24	173	713	19

Table 6: Maximum quantity of sets of Alpa EcoWent XT and Alpa EcoDet XT – closed loop configuration

3 Star configuration

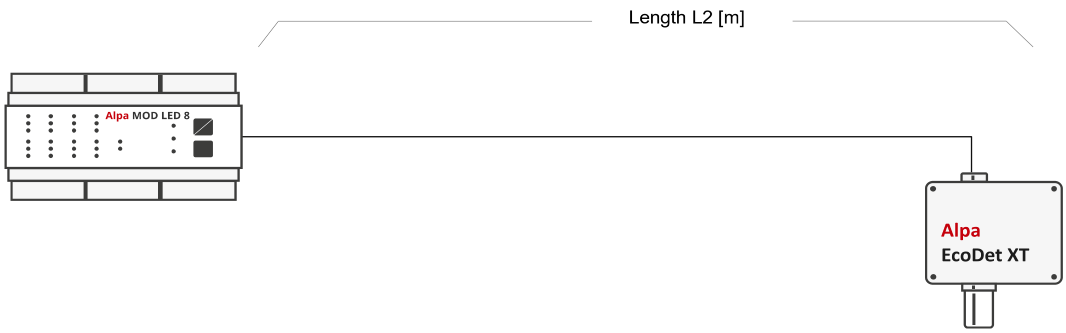

Figure 7: Star configuration

Cross-section of a single cable conductor [mm^2]	System with backup battery supply ($U_{IN(min)}$ = 20 V)	
	One Alpa EcoWent XT Gas Detector at the end of the line	One Alpa EcoDet XT Gas Detector at the end of the line
	L2 [m]	L2 [m]
0,75	1400	1400
1	1400	1400
1,5	1400	1400
2,5	1400	1400

Table 7: Maximum length of cables – star configuration

Classification of chemicals used at Atest-Gaz

Because of the need to present a **consistent and high level of maintenance services**, to ensure **the safety of the calibration process** and to **create a basis for a rational calculation of the costs** of this process, Atest-Gaz developed the "Classification of Chemical Substances" described below.

The classification determines the complexity of the calibration process of a particular detector type, consider two criteria:

- stability of the calibration mixture (criterion **A**):
  - ease of generate and its stability,
  - ergonomic complexity of operations,
  - required experience and knowledge of the employee performing the calibration,
  - required equipment,
  - environmental requirements for the process (e.g. weather conditions).
- safety / potential hazard generated by the mixture (criterion **B**).

These both criteria have an impact on the final cost of the calibration services and level of competence required from the employee conducting the calibration.

This classification is applied both by Atest-Gaz and the entities cooperating with it – distributors, authorized service providers and users of the systems.

In the case of calibration with the "crossover" substances, the classification is made in accordance with the substance category that is applied (e.g. for the detector with a PID sensor this substance is isobutylene, i.e. B0 A0).
The detector are classified on the stage of offer.

On the next page we present tables showing the above relationships.

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Category	Description	Terms of facility calibration
A0	Cylinder gases, stable environment	No precipitations, and no strong winds, and temperature over **– 10°C**[1]. In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A1	Cylinder gases, unstable environment or absorption by the moisture	No precipitations, and no strong winds, and temperature over **+ 10°C**[1], and relative humidity under 70%. In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A2	Gases not available in cylinders can be generated at the relevant facilities	like **A1** In other cases, calibration at a location that meets the above conditions (necessary to remove the detectors).
A3	Laboratory calibration	Facility calibration impossible, laboratory calibration only, probably at the manufacturer's. This group also includes conditions resulting from other reasons, e.g. the need for temperature compensation, non-linearity of the sensor, the need for calculation, the use of special tools, etc.

Table 1. Classification of chemicals used at Atest-Gaz. Criterion A: mixture stability

Category	Description	Classification criteria
B0	Safe substances	concentration of flammable components **< 60% LEL**, and concentration of toxic components ≤ **NDSCh**[2], and oxygen concentration **< 25% vol**, and tank **< 3 dm^3** (water capacity) and **p ≤ 70 atm**, or specified liquid chemical compounds, e.g.: glycerol, 1,2-propanediol.
B1	Low-risk substances	concentration of flammable components **< 60% LEL**, and concentration of toxic components ≤ **NDSCh**[2], and oxygen concentration **< 25% vol**, and tank **> 3 dm^3** (water capacity) or **p > 70 atm**, or toxic gases with the concentration of **STEL ÷ 15 x NDSCh**, or specified liquid chemical compounds, e.g.: petrol, acetone, 1-methoxy-2-propanol.
B2	High-risk substances	inert gases having an oxygen concentration **> 25% vol**, or flammable gases with a concentration **> 60% LEL**, or specified liquid chemical compounds, e.g.: styrene, methanol, xylene, toluene, methyl methacrylate.
B3	Extremely dangerous or extremely flammable substances	toxic gases with the concentration of **> 15 x NDSCh**[2], or specified liquid chemical compounds, e.g.: benzene, formaldehyde, formic acid, epichlorohydrin.

Table 2. Classification of chemicals used at Atest-Gaz. Criterion B: OHS

1 Is allowed to perform calibrations at lower temperatures, if they meet the conditions of operation of the detector, e.g. ammonia refrigeration units.
2 In the absence of determined NDSCh it is necessary to adopt 2 x NDS as a criterion.

Notes

Notes

Reliable and Innovative Gas Detection & Safety Systems

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