ATEST GAZ

User Manual

Gas Detector

SmArtGas 4

Product code: PW-044-SG4-X

POD-061-ENG R14

ATEST GAZ

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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 14 is strictly forbidden.

How to use this manual?

- The following symbols of optical indicators status are used throughout the document:

Symbol	Interpretation
	Optical indicator on
	Optical indicator flashing
	Optical indicator off
	Optical indicator status not determined (depends on other factors)

Table 1: Optical indicators status notation

- 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 Preliminary information

The SmArtGas 4 gas detector is a device designed as a components of the Gas Safety System dedicated for operation in areas with potentially explosive atmospheres and under heavy-duty industrial conditions with broad range of ambient parameters variations (high temperatures, corrosive gases, moisture and dust). The key feature of the device, indispensable to guarantee safe and unproblematic operation is its conformity to requirements of the ATEX EU Directive and IECEx standards.

Very specific materials used for construction of the gas detector enable its application to monitoring of low reactive gases (e.g. CO or CH_4).

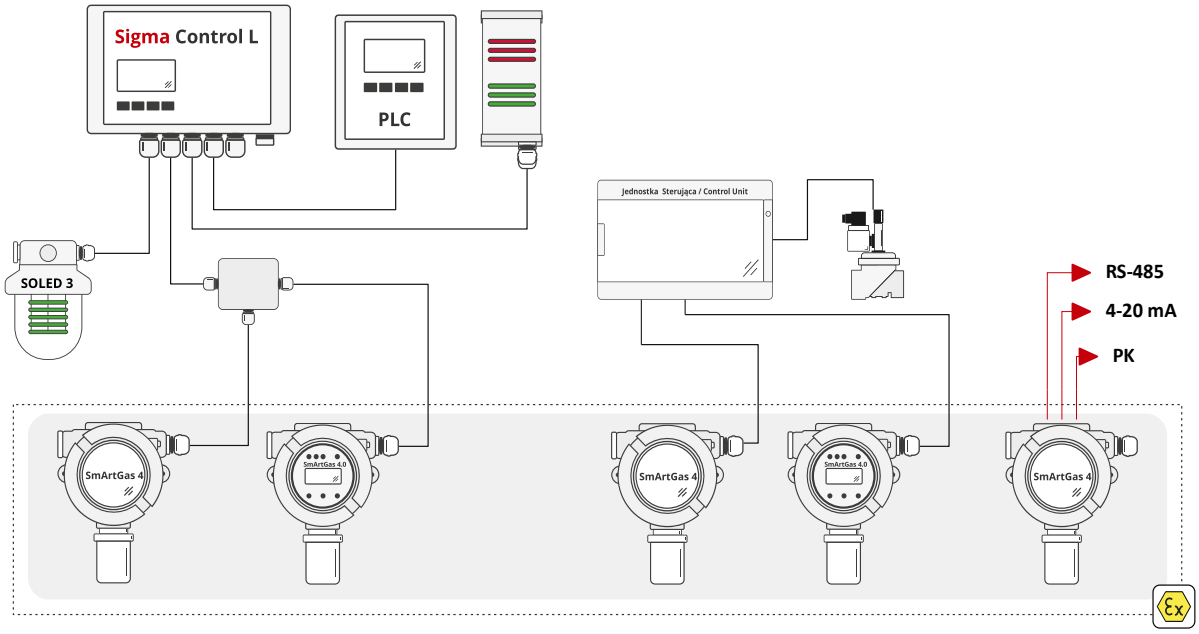


Figure 1: Location and role of the device in Gas Safety System

1.1 Functional properties

Main characteristics

- Variety of detected gases and vapors.
- Wide operating temperature range.
- Wide selection of communication interfaces and HMI panels: Modbus ASCII 4..20 mA, potential-free relay outputs, LCD/FLED displays, wireless interface (Bluetooth).
- Manufacturing option with audial warning.
- Several options for housing materials: aluminium or acid resistant steel.
- Customized accessories dedicated for specific detectors (see Table 14).
- Detectors furnished with a modern measuring head to achieve the topmost metering parameters.
- Upon request, optional upgrade to IP66/IP67 protection class (provided that a suitable membrane is applied).
- Customized configuration of the electric current source (source/sink).

Basic functionalities

- Non-invasive calibration and configuration – the gas detector can be calibrated and parametrized (e.g. the alarm thresholds) in hazardous areas without opening the housing or turning off other parts of the gas safety system (only for RS-485).
- Ability to calibrate gas detectors mounted at inaccessible locations.
- Remote communication with gas detector.
- Electronic compensation of the influence of ambient temperature.
- Self-diagnosis function.
- Storing, in the memory of the gas detector such parameters as: substance CAS number, location name, serial number, the intervals between mandatory calibrations, etc.

1.2 Marking of explosion protection

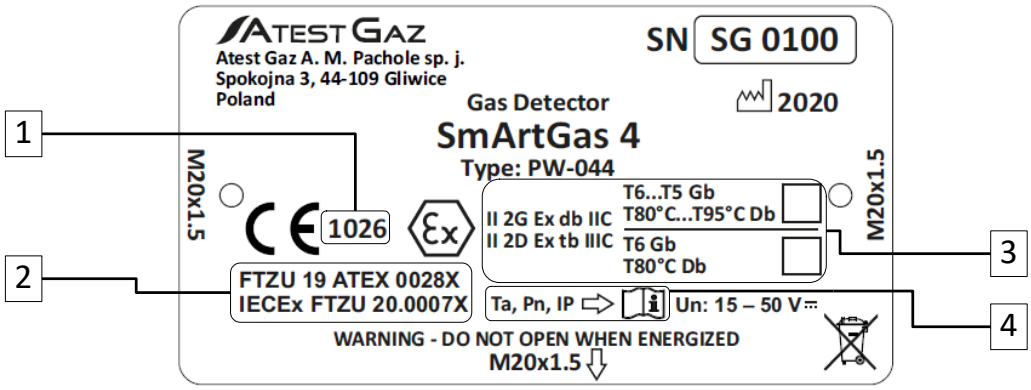


Figure 2: Information on the rating plate of the device

No.	Description
1	Number of the notified body responsible for supervision of the device
2	Numbers of ATEX and IECEx certificates issued for the device
3	Ex code for the device
4	Information about ambient temperature, power and ingress protection IP (see Chapter 7)

Table 2: Meaning of information provided on the rating plate

1.3 Additional information related to the explosion-proof protection of the device

- The only position for the detector operation is the position with its measuring head looking down (see Figure 4).
- Equipment should not be covered by dust.
- While mounting the detector lid pay attention to the thread of the housing body. Skewed rotation of the lid to damage of the thread.
- Improper driving of the screw that secures the housing lid may damage the thread.
- Improper driving of the screw that secures sensor housing could result in damaging of the thread.
- Removal of the protective shield affects its impact protection level. Operation of the device without the shield is not allowed (see Figure 13).
- Defective flameproof joints must be replaced with new ones – no repairs are allowed.
- The cable inserted through the cable gland cannot be shorter than 3 meters[1].

1 PN-EN 60079-14 standard requirement.

1.4 Cable glands and blanking plugs

The cable gland and blanking plug are replaceable elements. To select spare ones please obey the following rules:

- ATEX and IECEx certificates,
- degree of explosion protection (Ex code) – no worse than the detector (see Table 11),
- operating temperature range (see Table 11),
- appropriate mounting thread – see the device nameplate,
- nylon gasket to secure the enclosure tightness (in the case of aluminum enclosures).

Details see Chapter 7.

1.4.1 Replacement of cable glands and blanking plugs

To replace/screw the cable gland or blanking plug:

- remove the gland/blanking plug from device (if it is screwed in),
- apply small amount of technical vaseline on the thread of the gland/blanking plug,
- screw in a new gland/blanking plug (remember to use the appropriate torque specified by the manufacturer).

1.5 Cables

When selecting cables, make sure that:

- thermal resistance of cables must comply requirements set forth in Table 11,
- the connection cable is of the appropriate length – see Section 1.3.

1.6 Blanking enclosure

When there is a need to displace a flameproof enclosure with a sintered sensor inside (e.g. to clean the sensor or to send the head with a sensor for maintenance) the enclosure can be replaced by a flameproof blanking enclosure. It preserves safety of other equipment.

1.7 The principle of operation

The gas detectors measures the concentration of a given component, and then converts it – depending on the concentration level (described below) – to signals understandable for other devices of the gas safety system. Beside measurements, the detector analyses the value of the measured concentration and may provide information that the following thresholds are exceeded:

- warning 1,
- warning 2,
- alarm,
- gas overload (hazard of the sensor damage).

In addition, the gas detector is a self-diagnostic device – in case when any malfunction is detected, relevant information is provided for the user.

1.8 Gas detector status

Mode	Description
Correct operation	The detector operates properly and makes measurements. The concentration value of the gas being measured does not exceed threshold values and no irregularities in the device operation were detected.
Warning 1	Signalled after exceeding the gas concentration above the specific value.
Warning 2	Signalled after exceeding the gas concentration above the specific value.
Alarm	Signalled after exceeding the gas concentration above the alarm threshold.
Gas overload	Gas concentration has exceeded the overload threshold value. If such is the case, the sensor may be damaged or its sensitivity and shelf-life may be reduced.
Lock[2]	Gas concentration is above the overload value (the default value is 100% LEL). The detector is locked (see Appendix [3]) – the last value of the concentration is shut. The detector does not make measurements. It is possible to unlock the condition by means of sending the applicable command from the control unit or from the superior system. ⚠ Removing the lock on a detector which is in the conditions of concentration above the measuring range can damage the sensor.
Warm up	After turning on the detector's power supply, the sensors's working parameters stabilize for some time. ⚠ Measurements are also taken during preheating of the detector but no information about gas hazards is provided. Be aware that exceeding of gas concentration above its maximum measurable range may led to damage of the gas sensor.
Calibration	In this state the detector allows to change your settings. In the calibration mode it is also possible to examine the detector without raising an alarm (in fact, the behaviour of the system will be determined by the interpretation of the data by the central system). The detector can be switched to this state using the appropriate software tools.
Non-critical failure	Detector malfunction threatening its accuracy of measurement (e.g. time out for periodic calibration).
Critical failure	Faulty detector.

Table 3: Gas detector status

1.9 Detected gases

Information on the detected gases can be found in the Guide – "Sigma Gas Safety System" (POD-070-ENG).

1.10 Output signal

- RS-485 – this port allows easy integration with data transmission systems, visualization systems in ACP, industrial controllers – details in Section 4.2.
- 4 – 20 mA output – it allows for easy integration of the gas detectors with other automation systems, e.g. with industrial controllers – details in Section 4.3.
- Relays – it allows the direct use of gas detectors to control executive devices – details in Section 4.4.

1.11 Gas detector with an FL.C head

Gas detectors designed for installation at poorly accessible or inaccessible locations (e.g. highly, closely under ceilings) can be equipped with dedicated heads that enable supplying a reference gas directly to the detector (H=FL.C).

2 The condition is present only for the detectors with a catalytic sensor. Active lock mechanism.

It is the solution that facilitates calibration of gas detector, where one end is a flexible hose (with the size of 6/4 mm) is connected to the detector and the other end is lowered to a location that is accessible for an operator – see Figure 3.

The calibration procedure for gas detectors furnished with the FL.C head must be carried out with consideration of the following constraints (detector with FL.C head parameters – see Table 11):

- minimum flow of reference gas,
- wind velocity nearby the detector – it is important to pay attention to the air movement at a location where the detector with the FL.C head is used – excessive wind velocity makes calibration impossible – in practice it prevents from use of this solution outdoors or at intensely ventilated locations.

The FL.C can be used only for some specific gases – see details in DOK-6073-ENG "Configuration of measurement parameters".

Details for installation of a detector with the FL.C head – see Section 6.2.2.1.

Details for calibration of a detector with the FL.C head – see Section 6.6.2.2.

The manufacturer recommends to use a Reference Gas Supply Unit together with a suitable hose – see details in Table 11.

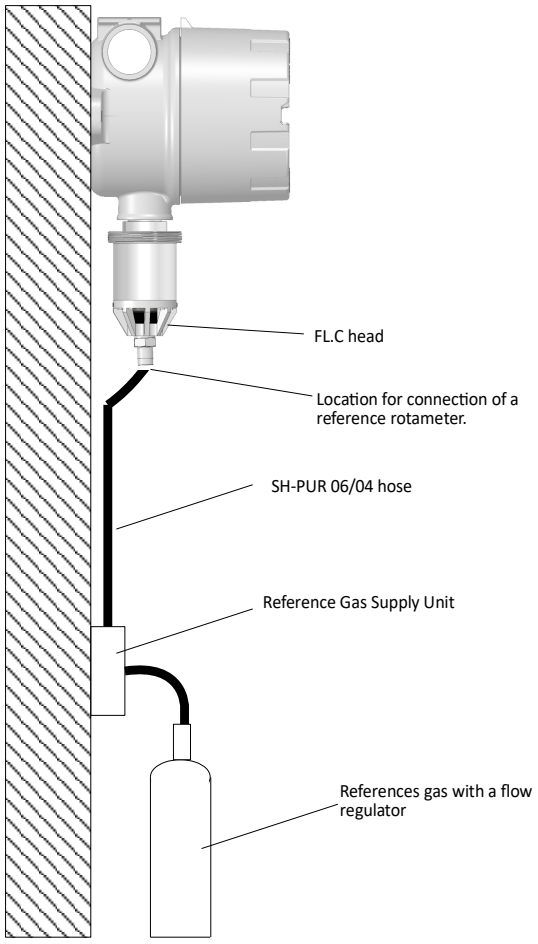


Figure 3: Calibration of a gas detector with the FL.C head

2 Safety

Testing of the detector with a gas of unknown composition or excessive concentration is forbidden since it may lead to irreversible damage of the gas sensor.

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

Despite the power supply voltage for the Gas Safety System is off, dangerous voltage may persist across terminals of the control unit. Such a voltage may come from another system controlled by the same unit, for instance ventilation, that use one output pin of the control unit.

The gas detector must be reliably secured during any repair, installation or maintenance works.

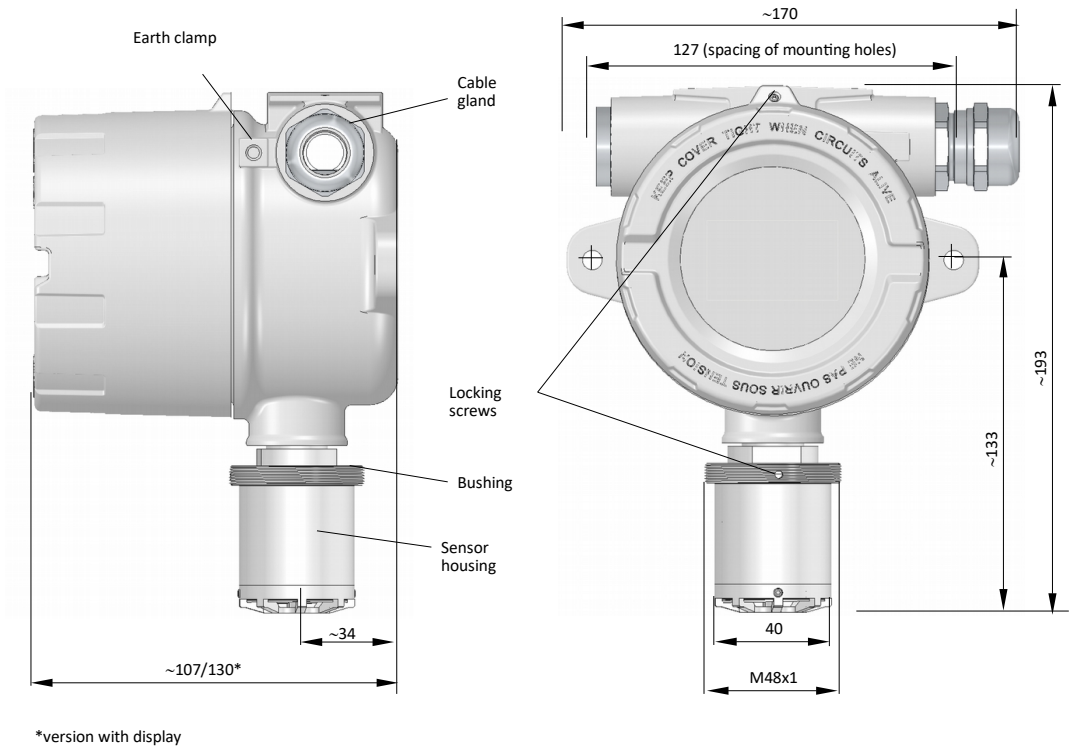
Before painting the facility walls make sure that the device is properly secured against unintentional painting or paint splashing.

Before use of silicon or silicon-based materials (paints, adhesives, sealant, etc.), make sure that the device is properly secured against unintentional coating.

2.1 Conditions of the working environment

Information about condition of the working environment can be found in the Guide – "Sigma Gas Safety System" (POD-070-ENG).

3 Description of the construction



*version with display

Figure 4: The construction of the device and its dimensions

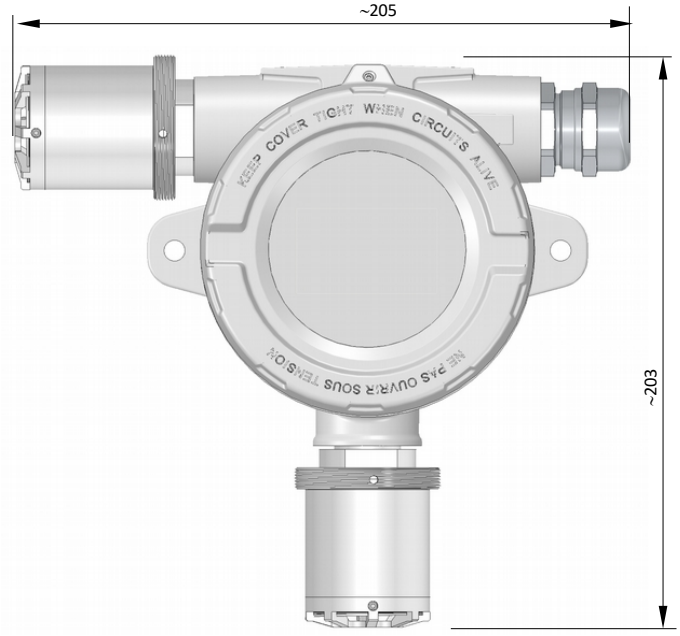


Figure 5: The construction of the gas detector – version with acoustic – and its dimensions

4 Input-output interfaces

4.1 Electric interface

Assignment of contacts on the terminal block depends on the device configuration (see details is Section 10). All possible options of the terminal block layouts are shown on illustrations below.

4.1.1 RS-485 digital communication port

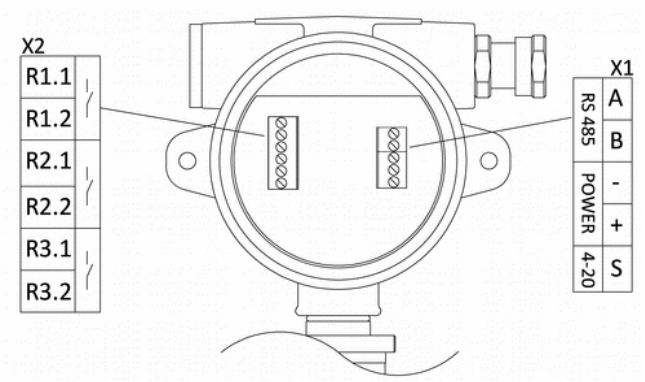


Figure 6: Electric connections for the option with the RS-485 port

Port designation	Name	Pin	Description
X1	RS-485	A, B	Signal lines for the RS-485 port
	POWER	-, +	Power supply
	4-20	S	4 – 20 mA current output
X2	R1.1 – R3.2	—⁀—	Relays terminals

Table 4: Connections diagram for the option with the RS-485 port

4.1.2 Teta Bus digital communication port

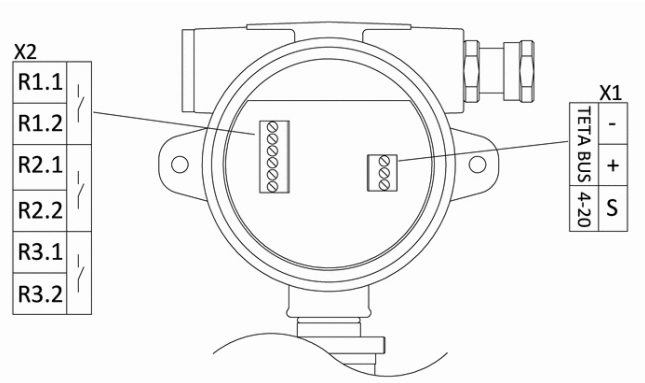


Figure 7: Electric connections for the option with the Teta Bus port

Port designation	Name	Pin	Description
X1	TETA BUS	-, +	Combined transmission and power supply lines
	4-20	S	4 – 20 mA current output
X2	R1.1 – R3.2	—⁀—	Relays terminal s

Table 5: Connections diagram for the option with Teta Bus port

4.2 RS-485

Communication via the RS-485 employs either the Modbus ASCII or the Sigma Bus protocol (when the detector communicates with other devices of the Sigma system).

Detectors provided with the RS-485 port transmit output signals in the digital form (see Appendix [4]). Each detector provides information about its status by transmission of the following parameters:

- result for measurements of gas concentration expressed as percentage ratio of the full range,
- information whether warning /alarms thresholds are exceeded or not,

- status details, e.g. possible failures or defect, etc.

4.3 Current output

4.3.1 Operating modes – direction of current flow

The current output can be used in two modes: sink or source. The diagram below explains how to connect the detector for each of the operating mode.

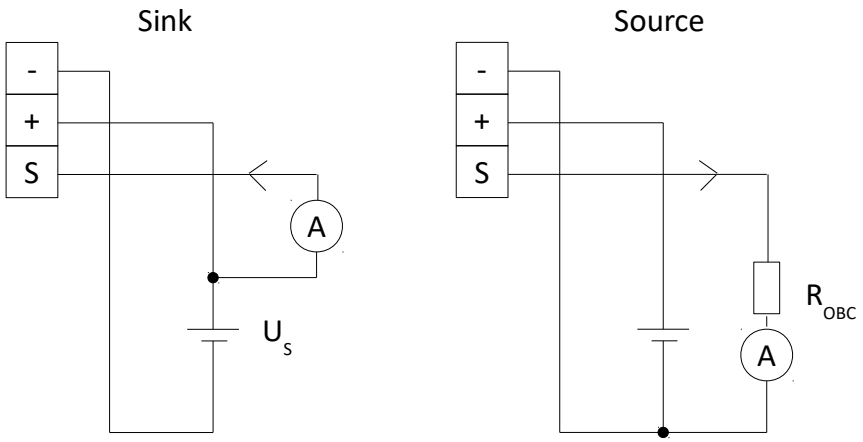


Figure 8: Connection of a gas detector according to the direction of current flow

Maximum limits for U_s and R_{obc} are provided in Table 11.

More configuration details – see Section 6.4.1.

4.3.2 Operation modes – status details

The level of output current is in proportion to the gas concentration measured by the detector (constant output signal). Possible signal levels are listed in the table below.

Current output	Status
2 mA	Critical failure
From 4 mA to 20 mA	The signal level is in proportion to the gas concentration: 4 mA – 0% of the full range 20 mA – 100% of the full range
22 mA	Detector overloaded

Table 6: Constant output signals

The level of output current may also correspond to warning of alarm thresholds (stepped intervals). Levels of output current for specific degrees of gas hazard are listed in the table below.

Current output	Status
2 mA	Critical failure
4 mA	No alarm
9 mA	Warning 1
11 mA	Warning 2
13 mA	Alarm
22 mA	Detector overloaded

Table 7: Intervals of the output current according to the detector status

The specific operation mode with respect to information provided at the 4..20 mA current output can be set upon configuration detectors by means of dedicated software – for details see Section 6.4.

4.4 Relay outputs

Each gas detector has three relay outputs that can be used for the following purposes:

- tripping control contacts for status indicators
  - Warning 1,
  - Warning 2,
  - Alarm,
  - Failure,
- mode of indication: inverted or not.

Assignment and operation mode of each relay output can be independently set by means of dedicated software – see Section 6.4.

Specification of relay parameters is provided in Table 11.

4.5 Bluetooth wireless interface (WI=BT)

Wireless interface enables the operator to control gas detectors from remote locations by means of dedicated software (see details in Section 6.4).

The the Bluetooth interface behaviour depends on the operation mode selected for the Bluetooth port upon configuration and position of the magnetic key. See details in Table 8 below.

Operation of the Bluetooth interface	Magnetic key in place	The detector is seen on the list of devices with Bluetooth interface	The detector can communicate via the Bluetooth interface
Detector not available for remote control	-	No	No
Detector is always seen but can communicate only with the permanent magnet in place	No	Yes	No
	Yes		Yes
Detector is seen and can communicate only with the permanent magnet in place	No	No	No
	Yes	Yes	Yes
Detector is always seen and can communicate	-	Yes	Yes

Table 8: Operation modes of gas detectors with the Bluetooth interface

The picture below depicts how to mount the magnetic key on the detector housing.

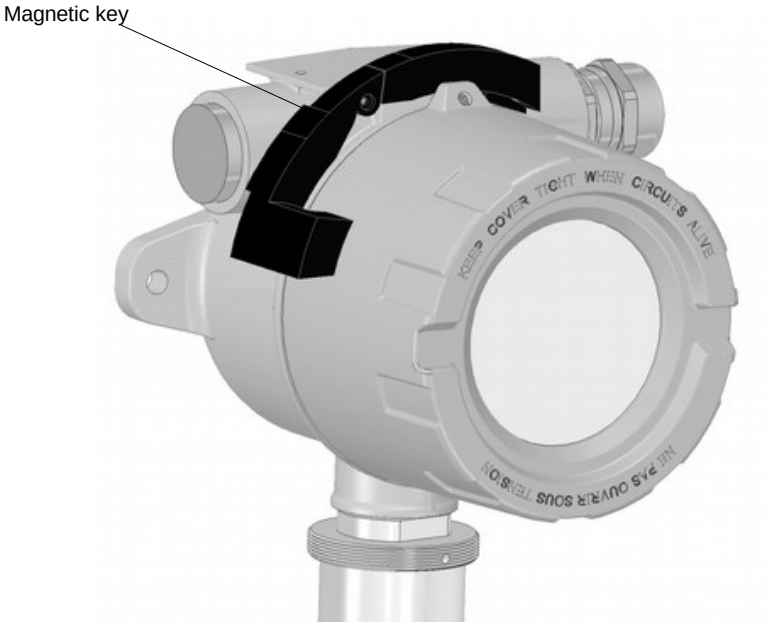


Figure 9: Gas detector with a magnetic key in place

Also a strong neodymium permanent magnet can be used instead of a magnetic key. Figure 10 below depicts how to mount the permanent magnet on the detector housing.

Be careful to mount the permanent magnet correctly with right orientation of poles.

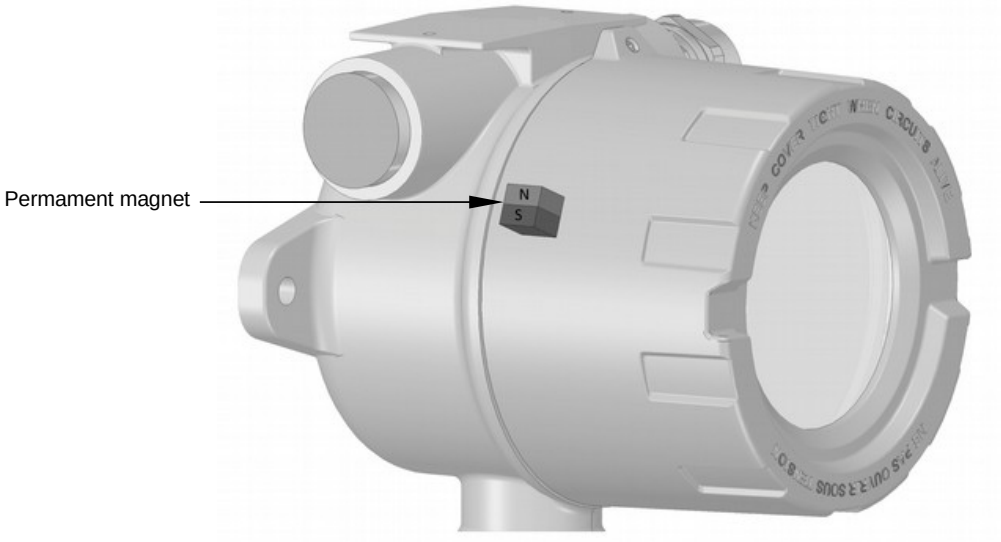


Figure 10: Gas detector with a permanent magnet in place

Upon communication between the gas detector and the control software is established, the magnetic key/permanent magnet can be removed.

5 User interface

A detailed description of the user interface is provided in the Attachment [5].

6 Life cycle

6.1 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 11.

6.2 Installation

6.2.1 Deployment of gas detectors

Deployment of gas detectors must be determined by the system designer. Information can be found in the Guide – "Sigma Gas Safety System" (POD-070-ENG).

6.2.2 Mechanical mounting of detectors

Detectors must be mounted on a flat, vertical wall in the orientation shown in Figure 5 (with the detection element down), using the two mounting holes, with the use of two expansion plugs or M5 screws.

The detectors can be optionally furnished with a mounting bracket (see Table 14) to mount the detector within a certain distance from the wall (e.g. in case of rough or uneven walls). Eventually, a shield can be made to protect the detector head against water splashes and prevent from penetration of water into the detector interior when water drips down walls.

Detectors that are mounted outdoor can be protected against atmospheric precipitations (rain or snow) by means of a special weatherproof enclosure (see Table 14).

6.2.2.1 Installation of a detector with FL.C head

After installation of the detector is completed, it is recommended to check the gas flow at the far end of the hose where a nipple of the FL.C head is to be connected.

Procedure:

- supply the reference gas to the hose inlet (the appropriate flow is ensured by using a referenced gas canister with a flow regulator, the connection method is shown in Figure 3),
- connect a rotameter at the far end of the hose (at the location where the nozzle of the FL.C head is to be connected), the rotameter must indicate the same flow as in case when it is connected directly to the flow regulator – the location for connection of the reference rotameter is shown in Figure 3.

6.2.3 Electric network

The applied flameproof cable glands allows to introduce cables with diameters of a specific range. The suggested cable types are included in the Guide – "Sigma Gas Safety System" (POD-070-ENG).

When performing electrical connections, it is necessary to observe the following order:

- make sure that the connected cables are disconnected from any electrical circuits and potentials,
- make sure that during installation there is no risk of explosion or fire,
- unlock the detector cover by loosening the cover locking screw which is located on the periphery, thereof,
- unscrew the cover of the detector,
- remove the cover of the detector,
- untighten the cable gland,

- peel insulation from conductor ends (see Appendix [6]) and thread the cable through the gland. Use a suitable sealing sleeve for glands with adjustable diameter of tightening. For more details please refer to the manual POD-066-ENG „Cable glands used in offered devices".

Make sure that the cable outer diameter corresponds to the type of cable gland.

- arrange the cable correctly so that it is not affected by mechanical stress, that water does not flow down it to the detector - see Figure 11, and that it is of the appropriate length (Section 1.3),
- tighten the cable gland,
- tighten the detector cover, making sure that the seal is in place,
- tighten the protecting screw,
- make sure that the second threaded inlet is plugged by appropriate blanking appliance.

Ground the detector by connecting the cable to the ground terminal (see Figure 11). Use a cable with a cross-section of at least 0.5 mm^2.

Ground connection should be protected from corrosion (e. g. a small amount of technical petroleum jelly).

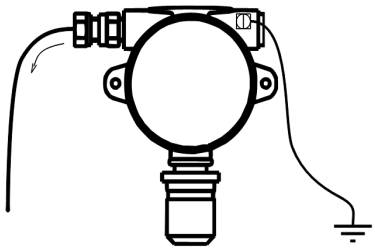


Figure 11: Grounding connection and correct cable laying

The cable shield shall be isolated and slightly protrude from the cable entry inside the detector. The shield cannot be connected to any device point.

A detailed description of the preparation of the cable and connecting the cable to the detector is provided in Appendix [6].

On the side of the control unit, screens must be connected to ground.

According to good practice, wiring of the detectors should be carried out as far as possible from the power cables / high-current cables, preferably in separate trays.

According to good practice, wiring of the detectors should be carried out as far as possible from the power cables / high-current cables, preferably in separate trays.

If the connection was made with the use of multi-wire cables (commonly known as a "cord"), the ends of these connectors should be ended with clamp sleeves.

If there is a need to connect two conductors in one terminal of the device, the only allowable option is to connect them in a common clamping sleeve (see Table 11).

It is unacceptable to combine in one connector two wires which are not pinched in one cable lug.

Do not place the cable reserve in the device. Bare wires or wires surplus may create a danger of electric shock or equipment damage.

Do not leave disconnected cables inside the device.

Incorrect cable routing can lead to reducing the device's immunity from electromagnetic interference.

Unused screw terminals must be tightened home.

6.3 Commissioning

Before power up make sure that all parts are tightly screwed (cable glands, blinding plugs and the detector lid). All fixing bolts (for the detector lid and bushing) must be in place and firmly tightened to prevent any self-loosening during operation of the detector.

New detectors and factory calibrated and checked.

The detector behaviour after power on is described in Table 3.

If a test of the gas detection system is required, supply test gas to the gas detector and make sure that the detector behaviour is in line with the specification.

It is recommended that – if possible – the commissioning of a gasometric installation should take place in conditions where there is no risk of explosion – e.g. during a standstill of the technological installations

For large systems it is recommended to carry out commissioning of the entire system in several steps with successive connection and commissioning of subsequent detectors. It makes easy to reveal and remedy any possible errors.

6.4 Configuration of gas detectors

Detectors have two jumpers designed for configuration of the device – see Figure 12.

Other parameters of gas detectors are configured using dedicated software:

- Sigma Toolbox package for PCs with the Windows system,
- Detector Toolbox for Android devices.

This software can be downloaded from the manufacturer's website https://www.atestgaz.pl/en/category/software/all/all.

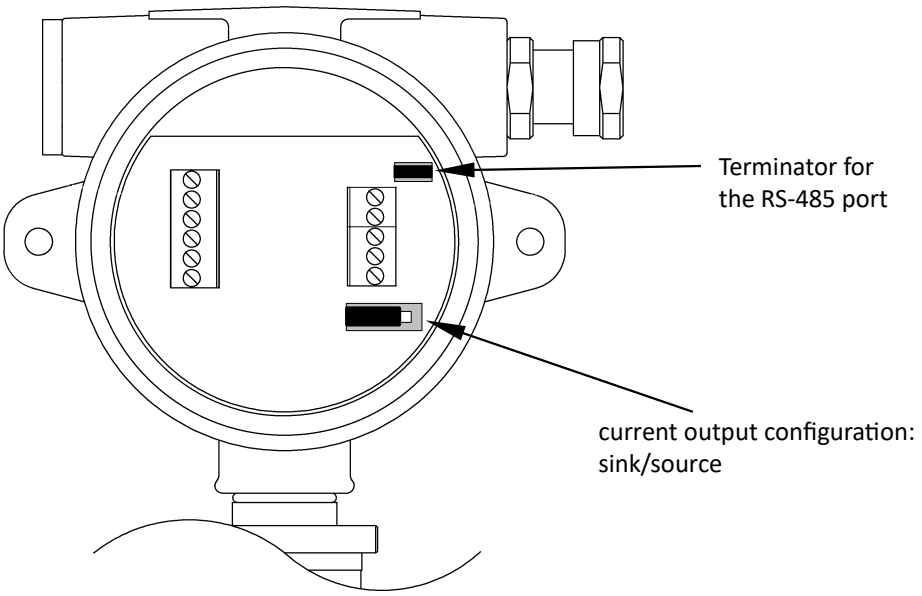


Figure 12: Front view of the detector – configuration jumpers

6.4.1 Configuration of the current source

The detector is furnished with a source of electric current. Depending on needs the source can be configured as a SOURCE or a SINK – see Point 4.3.1.

Configuration by installing a jumper – see table below.

Setting of jumpers	Operation mode
	SOURCE of electric current (default setting)
	SINK for electric current

Table 9: Configuration of the embedded source of electric current

6.4.2 End-line terminals

The communication port is furnished with end-line terminals. Configuration of these terminals needs opening of the device housing to insert a jumper into the terminal connector (TERM.).

Setting of jumpers	Operation mode
	**Terminal** for the serial port is off (default setting)
	**Terminal** for the serial port is on

Table 10: Configuration of the serial port terminal

6.5 Troubleshooting

Details for detects and failures reported by the detector are provided in Appendix [5].

6.6 Periodical operations

The detector, similarly to all gas sensors, are components that subject to ageing and wear due to environmental influences. Thus, a variety of maintenance operation must be carried out within a regular schedule.

Periodical operations include:

- zero point adjustment,
- calibrations,
- replacement of fast wearing parts,
- periodical inspections.

6.6.1 Resetting

Gas sensors are characterized by a certain drift of zero over time. It's mean that during operation, the detector may indicate minor gas concentration despite the fact that in reality there is no gas in the building.

In such a situation, the reset function should be used (available in devices cooperating with the detector, e.g. in the control unit).

In some detectors configurations, the mechanism for automatic deletion of this drift is active. In this case, you do not need to use the above-mentioned zeroing function, and its use in this case can only speed up the automatic zeroing.

The reset function is available only for a narrow range of detector's indications (there is not hazard of resetting high concentrations).

It is recommended to apply clean air to the detector before performing the zeroing function.

6.6.2 Calibration

6.6.2.1 General rules

The gas sensor applied for the device is a components that is subject to ageing and other environmental impacts with decrease of its sensitivity as a natural effect.

Therefore regular calibration must be carried out to compensate the foregoing phenomenon. The calibration must be performed only by authorized maintenance staff of the manufacturer with the frequency is specified in the Calibration Certificate – see Table 11.

Please remember that the calibration should be carried out each time under the following circumstances:

- when the deadline for a subsequent calibration is exceeded (the deadline is specified in the Calibration Certificate or is indicated by the detector itself),
- when the detector fails the functionality test or,
- when the maximum limits for environmental impacts are exceeded.

Gas detectors manufactured by Atest Gaz are classified to the A category of instruments (see Appendix [7]) with respect to environments conditions for calibration.

When local conditions for calibration of gas detectors on site are not suitable the device must be taken out from the plant and sent to the Atest Gaz office for calibration.

The detector calibration occurs digitally. It involves connecting a service device:

- a PC computer with appropriate software:

- to the control unit – a common data bus transfers data between detectors located in the area with explosion hazard and the control unit to be always located outside the hazardous zone, however the master control device must be connected to the bus outside the area with explosion hazard,
- directly to the detector – when you open the cover (note that explosion-proof properties of the device can be violated – see Section 1.3) – allowed only for detectors located outside the explosion hazard area,

- or an Android device:
  - directly to the detector – for devices with a Bluetooth radio interface (WI=BT) – see Section 4.5. Calibration is also allowed in hazardous areas provided that a master control device approved for use in areas with potentially explosive atmospheres is used.

Execution of the calibration procedure needs a calibration kit and a specific reference gas – see Table 14.

6.6.2.2 Calibration of a detector with FL.C head

Figure 3 shows how to supply the reference gas to the detector - for more details see Section 6.2.2.1.

If the detector is mounted at the location exposed to high velocities of wind the measures must be undertaken beforehand to limit wind gusts to a permissible level that enables calibration (see Section 1.11).

If it is impossible, the calibration should be performed with a calibration kit. Remember to remove the protective cover of the head beforehand – see Figure 13.

6.6.2.3 Calibration procedure

To calibrate gas detectors follow the procedure below:

- to avoid undesired alarms when the detector responds to excessive concentration of reference gas, switch the detector to be calibrated to the calibration mode – the calibration mode is recognized by the control unit,
- supply the calibration gas
  - baseline (zero-air) gas (e.g. synthetic air or nitrogen),
  - calibration (reference) gas (composition of reference gas depends on the gas to be detected and the detector range),

  to individual detectors one after another. Indications of the detectors are automatically recorded by the supervising computer,
- check and analyse the data acquired, apply a correction factor to each detector,
- switch the calibration mode off.

During calibration the following is determined:

- the degree of characteristics drift,
- the degree of sinter contamination (measuring the response time T90),
- the degree of sensor wear,

The calibration also includes checks of the following explosion proof properties:

- tightness of cables in cable glands, retighten glands when necessary,
- symptoms of a flameproof housing damage.

6.6.3 Replacement of fast wearing parts

Please refer to Table 13 for the recommended lifetime and replacement schedule of fast wearing parts.

It is highly recommended to entrust all jobs related to the measuring head to the service staff of the manufacturer or to properly trained personnel.

All jobs must be performed with the power voltage for the detector switched off.

6.6.3.1 Replacement of the shield with sintered material {1}, {2}

When contamination of the piece of sintered material is found out its shield must be replaced in the following way:

- loosen the locking screw with a 1.5 mm Allen wrench (see Figure 5),
- replace the shield with the attention paid to make sure that the shield is correctly installed, i.e. screws must be tightened until a clear resistance is sensed),
- retighten the securing screw (if the screw fails to fully sink into the hole it means that components of the head do not match).

Note the possibility of violation of the explosion-proof protection of the device – see Section 1.3

6.6.3.2 Membrane replacement {3}

To replace the membrane follow the procedure below:

- loosen the securing bolts for the protective cover (see Figure 5) with a 1.5 mm Allen wrench,
- remove the cover,
- replace the membrane,

The membrane should be put with the hydrophobic side outwards (see Figures 13 and 14).

- reinstall the protective cover and retighten the securing bolts.

The securing screws should be screwed in alternately at both sides to achieve equal clamping forces.

Before assembly, make sure that the O-ring is in the groove of the cover with sinter (see Figure 13).

Note the possibility of violation of the explosion-proof protection of the device – see Section 1.3.

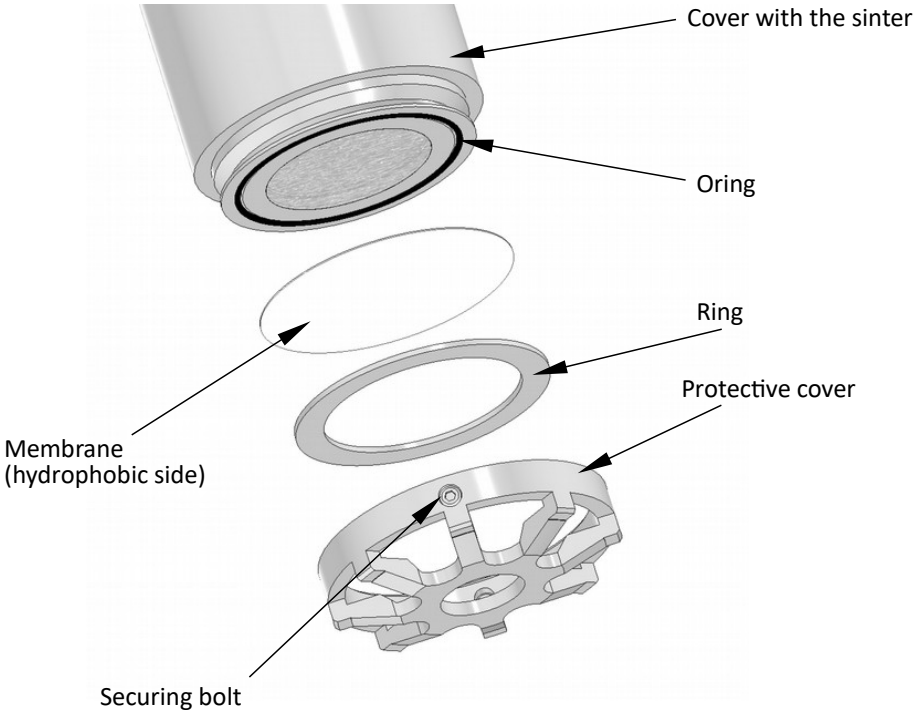
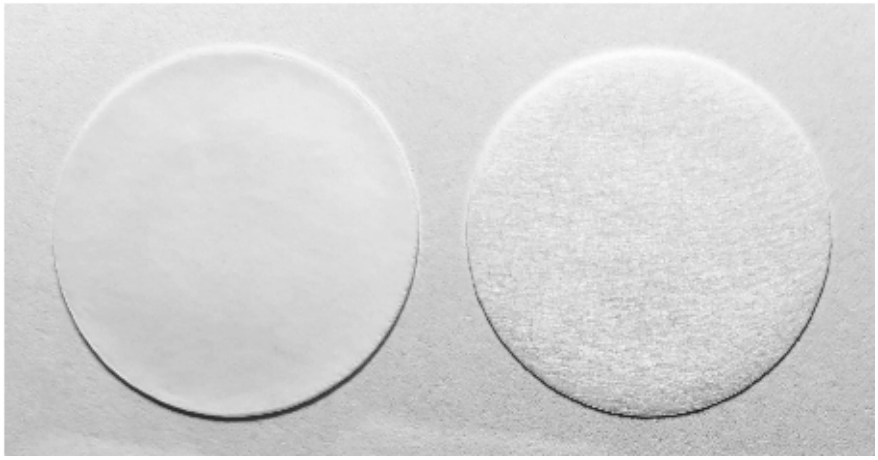


Figure 13: Design of the gas sensing head



Outer side, hydrophobic.
Matte surface, smoother than printer paper.

Inner side, not hydrophobic.
Clearly visible, shiny fibers.
The surface is more porous than the surface of the paper.

The photo shows the membrane visible against the background of white paper

Figure 14: Identification of the hydrophobic side of the membrane

6.6.3.3 Sensor replacement {4}

During operation there is a natural loss of metrological parameters of the sensors. Compensation of this phenomenon occurs through periodic, systematic adjustment of the display (see Section 6.6.2.3) – until the moment when it is necessary to exchange the sensor. It is assumed that the exchange should be carried out after the loss of sensitivity below 50% of the initial sensitivity.

Sensor replacement must be always combined with subsequent calibration of the detector.

To assembly and disassembly the sensor, it is necessary to:

- loosen the locking screw with 1.5 mm Allen key (see Figure 5),
- grab the gland, do not allow it to rotate (due to the possibility of damage to the connector inside the enclosure),
- remove the filling stuff,
- take out the old sensor (or a sensor module) from the head and replace it with a new one, make sure that the new sensor is positioned correctly,
- insert the filling stuff,
- follow instruction in Section 6.6.3.1 to complete the replacement,
- carry out calibration of the detector.

Note the possibility of violation of the explosion-proof protection of the device – see Section 1.3.

Not all errors resulting from improper assembly are detected by the diagnostics system of the detector. Each disassembly and assembly of the measurement head must be verified by supplying gas and checking the detector's reaction to gas.

When the bushing of the detector head is damaged or removed the detector must be sent back to the manufacturer for repair.

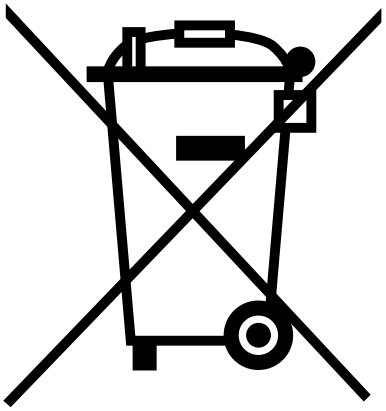
6.6.4 Maintenance

The regular maintenance of the detector is limited to wiping its housing with a damp soft cloth. cleaning agents that contain solvents, white spirit or alcohol are not allowed.

Gas detectors SmArtGas 4 are designed for operation in areas with potentially explosive atmospheres. Thus, its explosion-proof properties must be verified and maintained on regular basis in the following way:

- checking and cleaning inserts made of sintered material (dry cleaning with a brush or a cloth),
- checking of the cable gland with verification of its sound installation and lack of damage.

6.7 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.

7 Technical specification

<table>
<tr><td>Power supply
• Voltage Vcc
• Power</td><td colspan="2">15 – 50 V ⎓
0,1 – 4 W (depends on the configuration, see Table 12)</td></tr>
<tr><td>Environment</td><td>In operation</td><td>Storage</td></tr>
<tr><td>• Ambient temperatures Ta

• Humidity

• Pressure</td><td>Specified depending on:
• the temperature class of the device (see line ATEX and IECEx below),
• device configuration, including the sensor used (see Section 10)
10 – 90% long term
0 – 99% short term
Without condensation
1013 ± 10% hPa</td><td>0 – 40°C

30 – 90% long term</td></tr>
<tr><td>ATEX / IECEx
• Certificate No.</td><td colspan="2">FTZU 19 ATEX 0028X / IECEx FTZU 20.0007X

The temperature range, temperature class and power consumption depends on the gas detector configuration (see Section 10):

D = 0
II 2G Ex db IIC T6...T5 Gb
II 2D Ex tb IIIC T80°C...T95°C Db

D = FLED / FLED.A / LCD
II 2G Ex db IIC T6 Gb
II 2D Ex tb IIIC T80°C Db</td></tr>
<tr><td></td><td colspan="2"><table>
<tr><td>H \ D</td><td>0</td><td>FLED, FLED.A, LCD</td></tr>
<tr><td>HL, HH</td><td>T6 (T80°C): -40 < Ta < 65°C
T5 (T95°C): -40 < Ta < 80°C</td><td>T6 (T80°C): -40 < Ta < 65°C</td></tr>
<tr><td>FL, FL.M, FL.C, FH, FH.M</td><td>T6 (T80°C): -40 < Ta < 50°C
T5 (T95°C): -40 < Ta < 60°C</td><td>T6 (T80°C): -40 < Ta < 50°C</td></tr>
</table></td></tr>
<tr><td>Additional requirements related to the ATEX / IECEx certificate
• Thermal resistance required for cable glands

• Thermal resistance required for cables</td><td colspan="2">For class T6: -40 < $T_{service}$ < 80°C
For class T5: -40 < $T_{service}$ < 100°C
Details see Point 1.4

For class T6: -40 < $T_{service}$ < 85°C
For class T5: -40 < $T_{service}$ < 95°C
Details see Point 1.5</td></tr>
<tr><td>Requirements to tripping time</td><td colspan="2">For catalytic sensor:
• Hydrogen $T_{90} \leq 9$ s $T_{Alarm}(T_{20}) \leq 3$ s
• Methane $T_{90} \leq 13$ s $T_{Alarm}(T_{20}) \leq 4$ s
• Propane $T_{90} \leq 17$ s $T_{Alarm}(T_{20}) \leq 4$ s
• Ethanol $T_{90} \leq 18$ s $T_{Alarm}(T_{20}) \leq 5$ s</td></tr>
</table>

IP	• IP66/IP67 (measuring head with membrane FL.M, FH.M) • IP63 (other)
Analog output 4 – 20 mA • Output type • R_{load_MAX} (source mode) • U_{S_MAX} (sink mode)	 Sink / source 300 Ω 30 V (max. voltage between pins „S” and „-”)
Digital output parameters • Relays	 3 x Floating contacts, NO/NC 24 V / 0.3 A Not protected against overloading
Digital communication parameters • RS-485 • Teta	 • RS-485, Modbus ASCII, Sigma Bus, od 19200 Bd 7E1 • Teta Bus
Parameters of wireless communication	Bluetooth 4.2
Integrated signalling equipment (optical)	• D=LCD: alphanumeric display 2x8 of the LCD type with LED indicators • D=FLED: multicolour status display LED
Integrated signalling equipment (acoustic)	D=FLED.A: 70 dB 1 m distance
Protection class	III
Dimension	See Figure 5
Cable glands • Cable diameter range • External thread	 See Section 10 M20 x 1.5
Acceptable cables	0.5 – 2.5 mm^2 (cable lugs 2 x 1 mm^2 or 2 x 0.75 mm^2 should be used for double wires)
Parameters of the hose coupling to the FL.C head	6 / 4 mm
Operating parameters for the FL.C head • Flow rate of the reference gas • Maximum wind velocity • Connector size	 0,5 l/min 0,5 m/s 6 / 4 mm
Enclosure material	See Table 15 “E – enclosure”
Measuring head material	SS316L
Weight	3.5 kg
Mandatory periodic inspection	Every 12 months (Calibration Certificate validity) – time can be shortened due to difficult working conditions
Lifetime of consumables	See Table 13
Mounting	• To the supporting structure, 2 screw holes 4 mm, hole spacing 127 mm • We recommend using mounting brackets – see Table 14

Table 11: Technical specification

The technical parameters of the standard version of the detector you can find in Table 11. Some of the above-mentioned parameters may be different in the case of customized design. Details can be found in the Appendix [2].

In the table below shows the gas detector current consumption depending on the device configuration.

Product code					Current consumption [mA]	
					15 V	24 V
PW-044	SG4	EC	0	FL, FL.M, FL.C, HL	20	20
			LCD		45	35
			FLED, FLED.A		125	75
		PEL	0		100	70
			LCD		115	80
			FLED, FLED.A		205	125
		IR	0	FL, FL.M, FL.C, HL	80	55
				FH, FH.M, HH	155	95
			LCD	FL, FL.M, FL.C, HL	95	65
				FH, FH.M, HH	170	105
			FLED, FLED.A	FL, FL.M, FL.C, HL	185	110
				FH, FH.M, HH	260	150
PW-044	SG4	PID	0	FH, FH.M, HH	120	75
			LCD		145	90
			FLED, FLED.A		225	130

Table 12: Power consumption

8 List of consumables

No.	Consumables	Estimated average lifetime[3]	Manufacturer	Product code
{1}	Breathing flameproof enclosure with an insert made of sintered material, size 5 mm	Depends on ambient conditions	Atest Gaz	PWS-046-A
{2}	Breathing flameproof enclosure with an insert made of sintered material, size 2.5 mm	Depends on ambient conditions	Atest Gaz	PWS-055-A
{3}	Hydrophobic membrane	Depends on ambient conditions	Atest Gaz	EM-197A
{4}	Sensor with gasket	Depends on the sensor type	-	-

Table 13: List of consumables

3 Unless otherwise stated, when operating at a temperature of 25°C.

9 List of accessories

Product code	Description
PW-063-A	Ventilation Adapter AW1
PW-064-WM4	Mounting Bracket WM4
PW-064-WM6	Mounting Bracket WM6
PW-064-WM11	Mounting Bracket WM11
PW-069-DP2	Roofing for the WM6 bracket
PW-082-X	Calibration kit
PW-049-CB6	Service cable CB6
EM-183-A	Blanking Enclosure
PW-125-KEY1	Magnetic Key KEY1 (for PW-044-SG4-X, PW-093-RA4-X-ALB/ALZ/C/SS-X gas detectors)
PW-126-A	Reference Gas Supply Unit
TUBES_INTERNATIONAL_SH-PURE-06_04	Hose SH-PURE-06/04, transparent, material: PUR polyurethane (PUR)
-	Standardized reference gas

Table 14: List of accessories

10 Product code

SmArtGas 4 Gas Detector

PW-044-SG4- M - D - H - E - T - DI - AI - WI - MC - G

M **Converter module**	**X**	Selected by the manufacturer depending on the chosen MC – field value does not matter when ordering the product (when ordering, please specify X, available EC, PEL, IR, PID options show the used sensor type – see DOK-6073-ENG)
D **Display**	⚠	Gas detector operating temperature with display can also be narrowed due to Ta temperature limits due to ATEX / IECEx certificate – see Table Technical specification.
	0	Without
	LCD	LCD display and LED controls **(Ta: -20 – 50°C)** Note: a decrease in contrast may occur at -20°C – difficult reading
	FLED	Bright, multi-colour display **(Ta: -40 – 60°C)**
	FLED.A	Bright, multi-colour display equipped with an acoustic signaller **(Ta: -40 – 60°C)**
H **Measuring head**	⚠	Gas detector operating temperature with measuring head can also be narrowed due to Ta temperature limits due to ATEX / IECEx certificate – see Table Technical specification.
	Type of the measuring head installed in the detector is associated with the MC – the head specification is determined by gas to be detected and its parameters	
	FL	With sinter (fast – reduced T90), made of stainless steel
	FL.C	With sinter (fast – reduced T90), made of stainless steel, with remote test gas supply and calibration
	FL.M	With sinter (fast – reduced T90) and membrane, made of stainless steel
	FH	With sinter (fast – reduced T90), made of stainless steel, warmed
	FH.M	With sinter (fast – reduced T90) and membrane, made of stainless steel, warmed
	HL	With sinter, made of stainless steel
	HH	With sinter, made of stainless steel, warmed
E **Enclosure**	**ALB**	Aluminium, spray epoxy – white
	ALZ	Aluminium, spray epoxy – yellow (the version is available only for authorized distributors)
	SS	Stainless steel
T **Temperature**	**0**	Standard **(Ta: -30 – 50°C)**
	T	Extended temperature range for gas detector **(Ta: -40 – 85°C)**
DI **Digital interface**	**485**	RS-485
	Teta	Teta Bus – *under development*
AI **Analog interface**	**0-0**	Without
	420-PK	4 – 20 mA (sink/source) + 3 x relay
WI **Wireless interface**	**0**	Without
	BT	Wireless interface allowing remote sensor calibration
MC **Measurement parameters configuration**	**-**	See details and **Ta** in DOK-6073-ENG „Measurement parameters configuration”
G **Cable gland**	**0**	Without
	X	See details in POD-066-ENG „ Cable glands used in offered devices”

Table 15: Method of product's marking

⚠ The configuration for the standard version of the detector you can find in Table 15. Some configurations may be different in the case of customized design. Details can be found in the Appendix [2].

11 Appendices

[1] DEZG136-ENG – EC Declaration of Conformity – SmArtGas 4

[2] PU-Z-114-ENG – SmArtGas 4, ProGas 4 – special design

[3] PU-Z-093-ENG – Instructions for removing the lock of a detector with a catalytic sensor

[4] PU-Z-113-ENG – Register map of gas detectors of PW-017, PW-044 and PW-093 type

[5] PU-Z-073-ENG – The user interface and failure codes of Gas Detectors of PW-017, PW-044 and PW-093 type

[6] PU-Z-015-ENG – Manual for the wiring of PW-044 sensors for cable glands without the possibility of connecting a cable shield

[7] 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	**SmArtGas 4**	**PW-044**

complies with the following Directives and Standards:

- in relation to Directive 2014/34/EU – on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres:

Marking	Certificate no.	Standards	Notified body
Ex II 2G Ex db IIC T6...T5 Gb II 2D Ex tb IIIC T80°C...T95°C Db or Ex II 2G Ex db IIC T6 Gb II 2D Ex tb IIIC T80°C Db	FTZU 19 ATEX 0028X	EN 60079-0:2018 EN 60079-1:2014 EN 60079-31:2014	1026 Physical-Technical Testing Institute, Pikartska 7, 716 07 Ostrava-Radvanice, Czech Republic
CE 1026	FTZU 03 ATEX Q 004	EN ISO/IEC 80079-34:2020	1026 Physical-Technical Testing Institute, Pikartska 7, 716 07 Ostrava-Radvanice, Czech Republic

- 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, 10.02.2023

(Name and Signature)
Managing Director
Aleksander Pachole

SmArtGas 4, ProGas 4 – special design

1 Gas detectors with a broad range of power voltages

1.1 Description

These design options of gas detectors are dedicated for operation in systems with the power voltage of 12 V DC.

1.2 Technical specification

The table below summarizes those parameters of gas detectors that are different from the ones for devices of standard design and listed in the section Technical Parameters of User Manuals for specific detectors.

Power supply • Voltage • Power	 10,5 – 50 V ⎓ 0,1 – 4 W (depends on the configuration, see Table “Power consumption” in User Manual for the individual gas detector)

1.3 Product code

- Detector dedicated to areas with potentially explosive atmospheres (Ex)

  SmArtGas 4 PW-044-SG4.LV-X Gas Detector

- Detectors dedicated to areas without potentially explosive atmospheres (non-Ex)

  ProGas 4 PW-017-PG4.LV-X Gas Detector

X – optional components of the product code – see details in user manuals for specific gas detectors, sections “Product code”.

All possible design options available for gas detectors are summarized in the table below.

Product code				
PW-044	SG4.LV	EC	0	FL, FL.C, FL.M, HL
			LCD	
			FLED, FLED.A	
		PEL	0	
			LCD	
		IR	0	FL, FL.C, FL.M, FH, FH.M, HL, HH
			LCD	FL, FL.C, FL.M, HL
		PID	0	FH, FH.M, HH
			LCD	
PW-017	PG4.LV	EC	0	FL, FL.M, FL.C, HL, HR
		PEL		
		IR		FL, FL.C, FL.M, FH, FH.M, HL, HH, HW
		PID		FH, FH.M, HH

2 Gas detector dedicated to specific applications (details to be consulted with the manufacturer)

2.1 Technical specification

Detailed parameters of specific gas detector are outlined in sections “Technical specification” in user manual for specific detector.

2.2 Product code

SmArtGas 4 Gas Detector PW-044-SG4- M - D - H - E - T - DI - AI - WI - MC - G

M	**Converter module**	**PELm**	Catalytic, 40% LEL
D	**Display**	**0**	Without
H	**Measuring head**	**HL**	With sinter, made of stainless steel
E	**Enclosure**	**ALB**	Aluminium, spray epoxy – white
T	**Temperature**	**0**	Standard
DI	**Digital interface**	**485**	RS-485
AI	**Analog interface**	**0-0** **420-PK**	Without 4 – 20 mA (sink/source) + 3 x relay
WI	**Wireless interface**	**0**	Without
MC	**Measurement parameters configuration**	**C.CH4.40L.B** **C.C3H8.40L.B** **C.H2.40L.A**	Catalytic sensor, methane, 40% LEL **(Ta: -20 – 50°C)** Catalytic sensor, propane, 40% LEL **(Ta: -20 – 50°C)** Catalytic sensor, hydrogen, 40% LEL **(Ta: -20 – 50°C)**
G	**Cable gland**	**EX.NB01** **EX.NB02**	Nickel plated brass, regulated clamping range 4 – 12 mm Nickel plated brass, regulated clamping range 10 – 16 mm. See details in POD-066-ENG „Cable glands used in gas detectors produced by Atest Gaz”

ProGas 4 Gas Detector PW-017-PG4- M - D - H - E - T - DI - AI - WI - MC - G

M	**Converter module**	**PELm**	Catalytic, 40% LEL
D	**Display**	**0**	Without
H	**Measuring head**	**HL**	With sinter, made of stainless steel
E	**Enclosure**	**AL**	Aluminium with paint
T	**Temperature**	**0**	Standard
DI	**Digital interface**	**485**	RS-485
AI	**Analog interface**	**0-0** **420-PK**	Without 4 – 20 mA (sink/source) + 3 x relay
WI	**Wireless interface**	**0**	Without
MC	**Measurement parameters configuration**	**C.CH4.40L.B** **C.C3H8.40L.B** **C.H2.40L.A**	Catalytic sensor, methane, 40% LEL **(Ta: -20 – 50°C)** Catalytic sensor, propane, 40% LEL **(Ta: -20 – 50°C)** Catalytic sensor, hydrogen, 40% LEL **(Ta: -20 – 50°C)**
G	**Cable gland**	**STD.NB03**	Nickel plated brass, clamping range 7 – 13 mm. See details in POD-066-ENG „Cable glands used in gas detectors produced by Atest Gaz”

Instructions for removing the lock of a detector with a catalytic sensor

Detectors using a catalytic sensor (more details concerning the sensor – see User Manual POD-062-ENG “Sensors used in gas detectors produced by Atest Gaz”) are equipped with a system protecting against its damage caused by a gas concentration exceeding the measuring range of the sensor and before entering non-monotonic part of the catalytic sensor characteristics. In the case of occurrence of such a situation, the detector is switched into the lock state. In this state, the detector saves the last value of gas concentration and switches it off to protect the sensor and prevent false indications.

The lock state is signalled on the detector's display and on all devices showing the detector status (e. g. control units). When the lock detector status occurs, the level of gas concentration in the place of the detector operation must be measured with the use of another measuring device. In a situation when the concentration level drops to the value within the measuring range of the sensor, the operator may proceed to removing the lock – see illustration 1. If the lock is turned off, when the gas concentration in the place of the detector operation is beyond the measuring range of the sensor, a permanent sensor damage or a false reading of the concentration can occur, as a result of the non-monotonic characteristics of the sensor.

When the detector is in the inhibit state and the gas overload condition occurs, the detector will also enter the lock mode and it will be visible after the inhibit mode is deactivated.

The method of executing the **"Remove the lock"** command can be found in the documentation of the control unit that controls the detector. Turning off the power of the detector automatically disables the lock.

Removing the lock on a detector which is in the conditions of concentration above the measuring range can damage the sensor.

Removing the lock on a detector which is in the conditions of concentration over the measuring range can cause its false indication (due to the non-monotonic characteristics of the sensor).

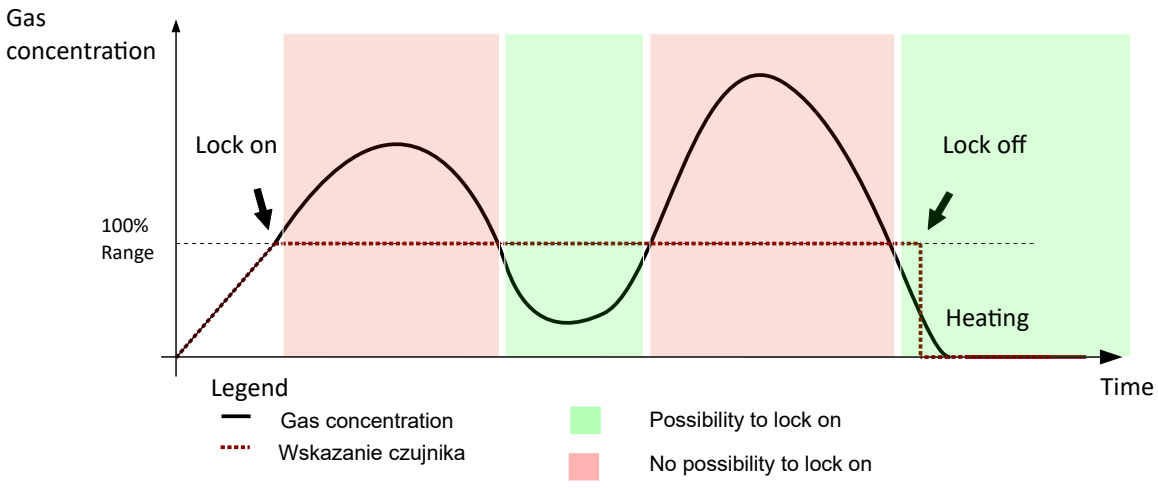


Figure 1: Operation of lock on /off detector

Register map of gas detectors of PW-017, PW-044 and PW-093 type

All the data are available in the 'holding registers' (function code 3).

Register	Name	Description	Type
40001	State_A	Detector status – the definition of bits below	flags
40002	-	Inessential data, can take any value	-
40003	N	Gas concentration A value of 0 corresponds to the 0 concentration, the value of 1000 corresponds to a concentration of the range of the detector	16 bit integer
40004	-	Inessential data, can take any value	-
40005	Sample_Cnt	Sample counter. The value is increased by 1 after each measurement. It takes values from 0 to 65 353	Total number 16 bit

State_A - detector status. The meaning of the bits is described in the table below.

Bit	Name	Description
0	Collective_W1	Gas concentration is above first warning threshold
1	Collective_W2	Crossing the second warning threshold
2	Collective_AL	Crossing the alarm threshold
3	Collective_CrFail	Collective information about a critical failure
4	Collective_NonCrFail	Collective information about a non-critical failure
5	Gas_Hi_Range	Operation on a coarse measuring channel (for type 2 and 3).
6	Gas_HiHi_Range	Gas overload
7	Sensor_Lock	Lock of the sensor (the last measurement was locked)
8	Calibration	Calibration mode
9	Test	Test mode
10	Warm_Up	Sensor warm-up
11..15	-	Inessential data, can take any value

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The user interface and failure codes of Gas Detectors of PW-017, PW-044 and PW-093 type

1 Indicator marking symbols

Symbol	Description
	Optical indicator on
	Optical indicator flashing
	Optical indicator off
	Optical indicator status not determined (depends on other factors)

2 Gas detector with FLED display (D=FLED) / FLED.A (D=FLED.A)

In case of use of a detector with FLED four – colour detector status display, information regarding the state of the detector are indicated via colours.

Colour	Description	Acoustic signalling (only for version D=FLED.A)
 – green	The detector works properly	-
 – red alternating with green	The first warning threshold is exceeded	-
 – green LED alternating with two yellow blinking 30 seconds apart	Non-critical failure	-
 – red	Alarm	Modulated sound signal
 – yellow	Detector's critical failure	-
 – white	Test, calibration	-

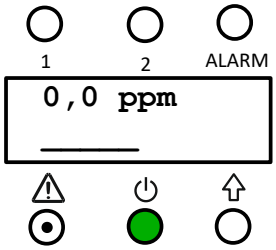
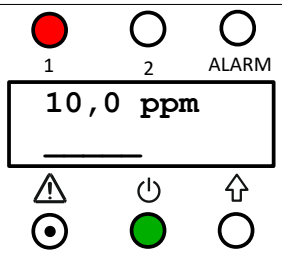
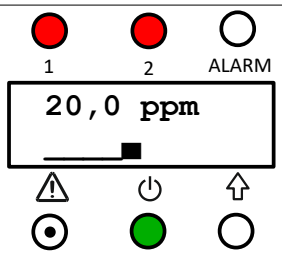
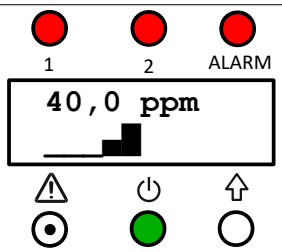
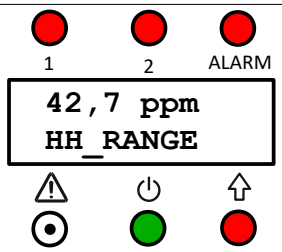
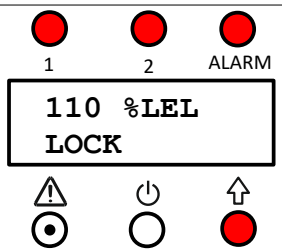
3 Gas detector with LCD display (D=LCD)

3.1 Description of detector state indicators

Indicator	Colour	Description
1	 – red	The first warning threshold is exceeded
2	 – red	The second warning threshold is exceeded
ALARM	 – red	The alarm threshold is exceeded
	 – yellow	Detector's failure
	 – green	The detector works properly (detector's operation status)
	 – red	Gas overload

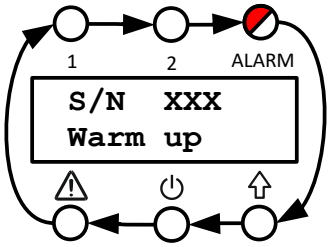
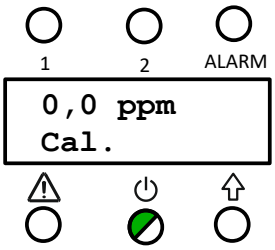
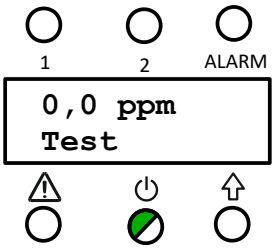
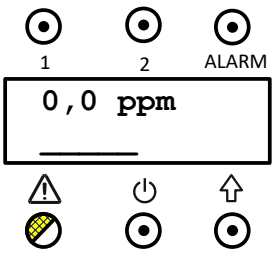
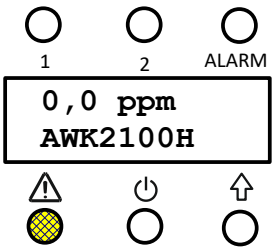
The display has light-sensitive area, which ensures appropriate backlit of the display during operation in an unlit room.

3.2 Detector's state signalling – gas alarms

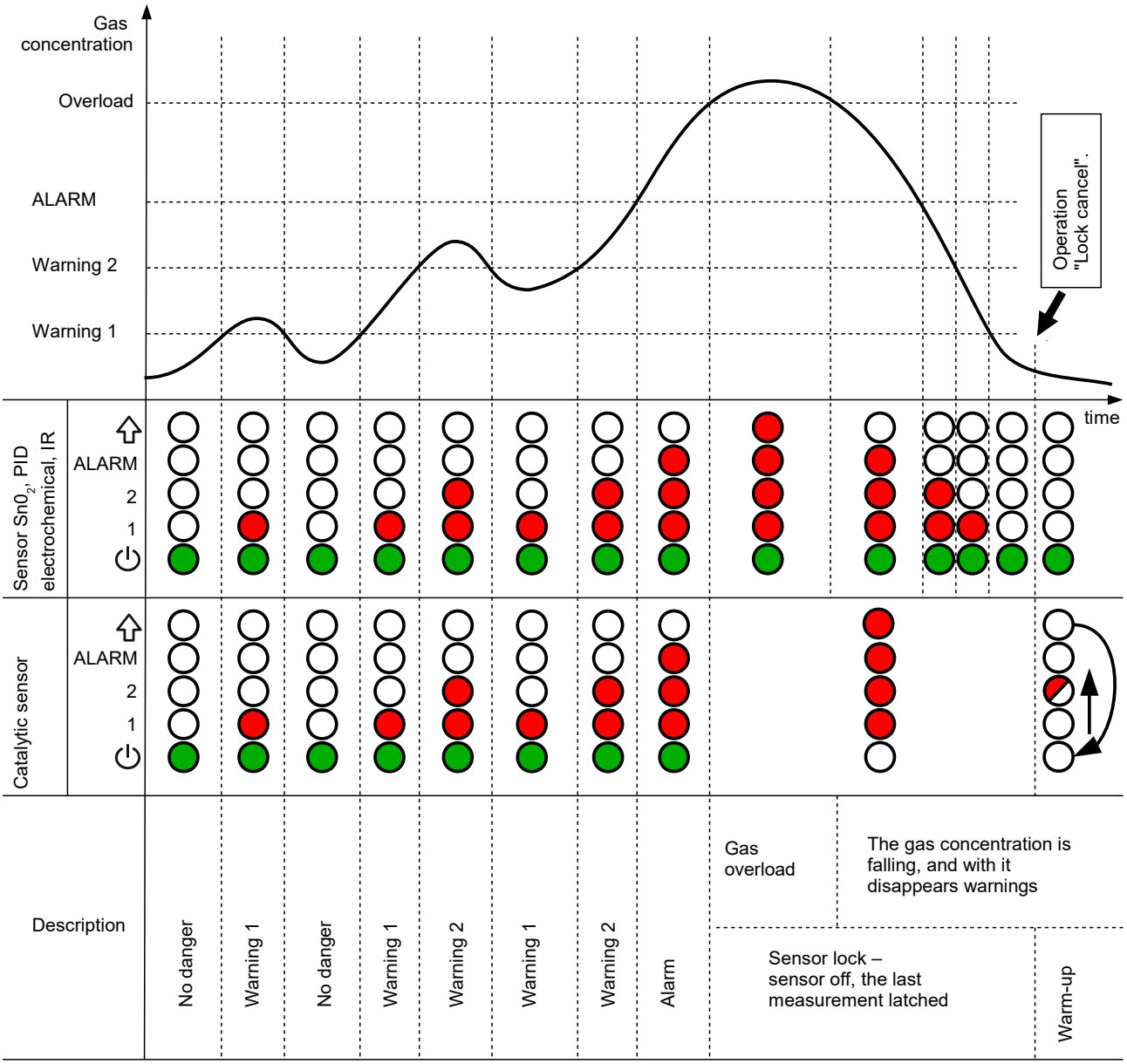
Situation	Description	Indicators/display[1]
No danger	The detector works properly, measures the concentration, which is indicated by continuously lit ⏻ indicator.	
Warning 1	The gas concentration exceeds the first warning threshold. Indicator 1 in the panel is continuously lit. The detector performs measurement, which is indicated by continuously lit ⏻ indicator	
Warning 2	The gas concentration exceeds the second warning threshold. Indicator 1 and 2 in the panel are continuously lit. The detector performs measurement, which is indicated by continuously lit ⏻ indicator	
Alarm	The gas concentration exceeds the alarm threshold. Indicators 1, 2 and ALARM in the panel are continuously lit. The detector performs measurement, which is indicated by continuously lit ⏻ indicator	
Overload	The gas concentration exceeds the overload value. Indicators 1, 2 and ALARM and ⇧ in the panel are continuously lit. The detector still performs measurement, which is indicated by continuously lit ⏻ indicator The display shows HH_RANGE information.	
Lock[2]	The gas concentration exceeds the overload value. Indicators 1, 2 and ALARM and ⇧ in the panel are continuously lit. The detector is in a locked state – the last value of concentration has been latched. The detector does not measure – ⏻ indicator is turned off. The display shows LOCK information.	

1 Display description contains sample content.
2 The state occurs only in case of detectors with a catalytic sensor. The lock mechanism is active.

3.3 Detector's state signalling – special states

Situation	Description	Indicators/display
Heating	Preparation of the detector to work. Its indications are ignored. The indicators are lit one after another in the clockwise direction. The display shows message Warm up.	
Calibration	The detector is in calibration state – its indications are ignored. ⏻ indicator flashes evenly. The remaining indicators are turned off. The display shows message Cal.	
Test	The detector is in test state – its indications are simulated and all signals are treated as real. Gas alarms and failures are possible. ⏻ indicator – two flashes per 2s (_⎍_⎍_____). The display shows TEST message.	
Non-critical failure	Detector malfunction that may negatively impact its measurement accuracy (e.g. exceeding of time until periodic calibration or small zero drift). The detector still performs measurement. ⚠ indicator flashes evenly.	
Critical failure	The detector is damaged and does not perform measurement. ⚠ indicator is lit continuously, the remaining ones are turned off. The display shows AWK2100H message.	

3.4 Signalling depending on the concentration of gas measured by the detector



3.5 Failure codes

Message	Description
AWK<failure code>	Critical failure – the detector is damaged – does not perform measurements. The failure code is a hexadecimal number, the meaning of particular bits is as follows:
	bit 0 non-volatile memory error bit 1 incorrect values in the data block bit 2 damage of electronics bit 3 damage of electronics bit 4 negative zero drift bit 5 damage of the measurement path bit 6 damage of electronics bit 7 incorrect hardware configuration bit 8 collective critical failure – active when any AWK bit is active bit 9 damage of the measurement path bit 10 damage of the measurement path bit 11 sensor signal is too high bit 12 sensor signal is too low bit 13 damage of the temperature detector bit 14 damage of the program block bit 15 damage of the data block
AWN<failure code>	Non-critical failure – malfunction of the defector that may negatively impact its measurement accuracy (e.g. exceeding of time until periodic calibration) or failure of a hardware module not affecting the measurement function of the detector. The failure code is a hexadecimal number, the meaning of particular bits is as follows:
	bit 8 collective non-critical failure – active when any AWN bit is active bit 9 incorrect detector supply voltage bit 10 minor negative zero drift bit 11 temperature overload bit 12 Bluetooth module is failure bit 13 calibration time is exceeded bit 14 digital amplifier operation monitor warning

Shielded cables applied for connecting detectors – preparation and installation

The cable shall be prepared in accordance with the following guidelines (see also 1):

- the cable external sheath shall be removed at the applicable length (see 1),
- the cable shield shall be cut right by the end of the external sheath,
- the cable shield shall be protected with isolation,
- at the ends of the cables, isolated clamp sleeve shall be placed,
- he conductive part of the clamp sleeve shall have applicable length (see 1).

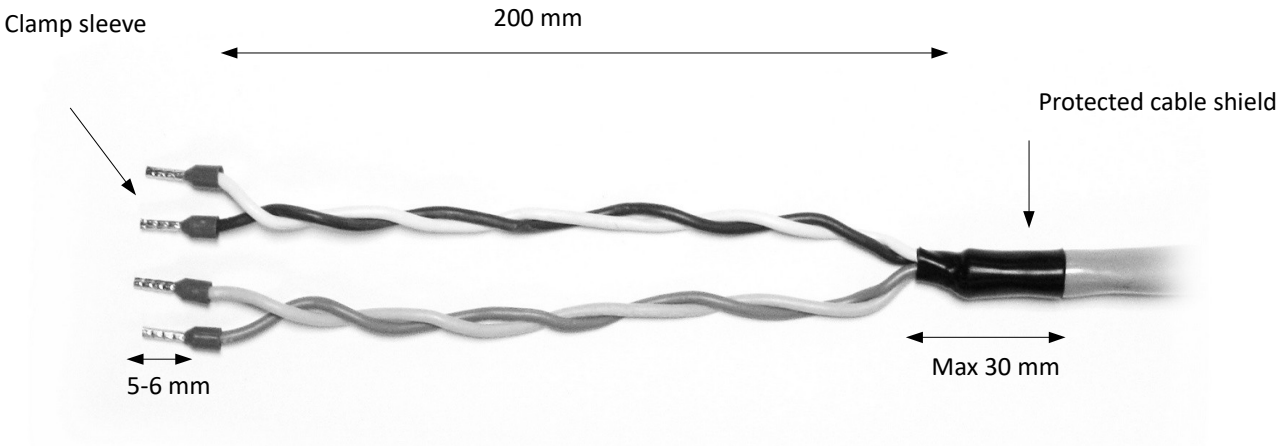


Figure 1: Cable preparation

For the systems with RS-485 interface, it is necessary to make sure that A and B transmission signals as well as + and – power supply were led with the use of the cables which belong to one pair.

The cable shall be placed in the detector as shown on figure 2. It is necessary to make sure that the shield protection is not located in the rubber element of the cable entry and that the smallest part of the cable external sheath was located inside the detector.

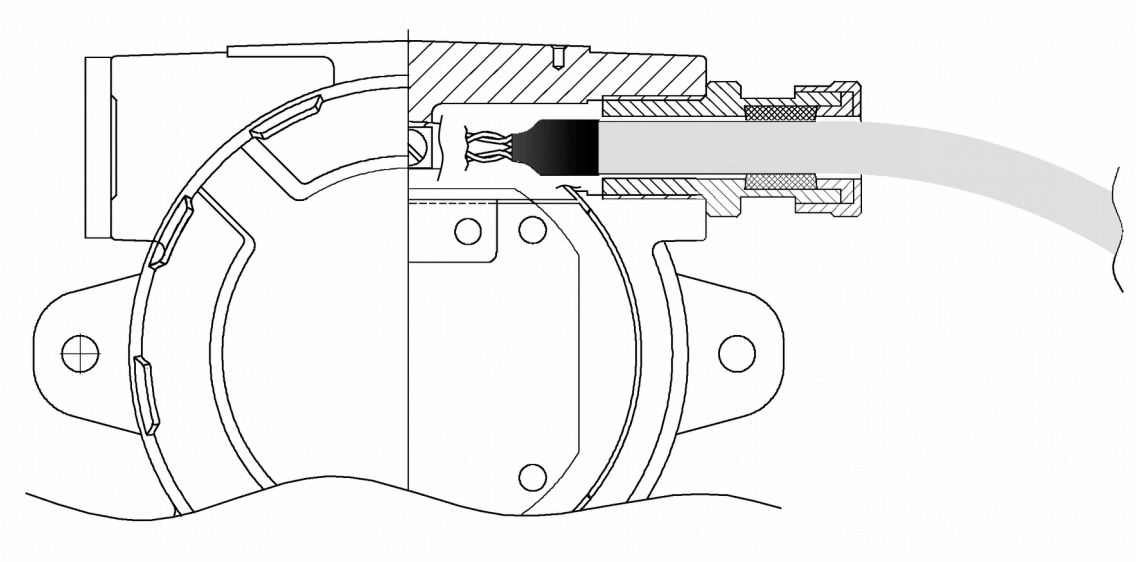


Figure 2: Placing cables in the detector

When laying the cable inside the detector enclosure, it must be remembered that:

- cables should be ordered,
- connecting cables should be kept as far away from the detector electronics as possible and routed as directly as possible to the crimp connection,
- it is necessary to minimize the amount of unnecessary conductor on the detector electronics. It is unacceptable to leave a reserve inside the detector.

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.

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 dm³** (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 dm³** (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

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