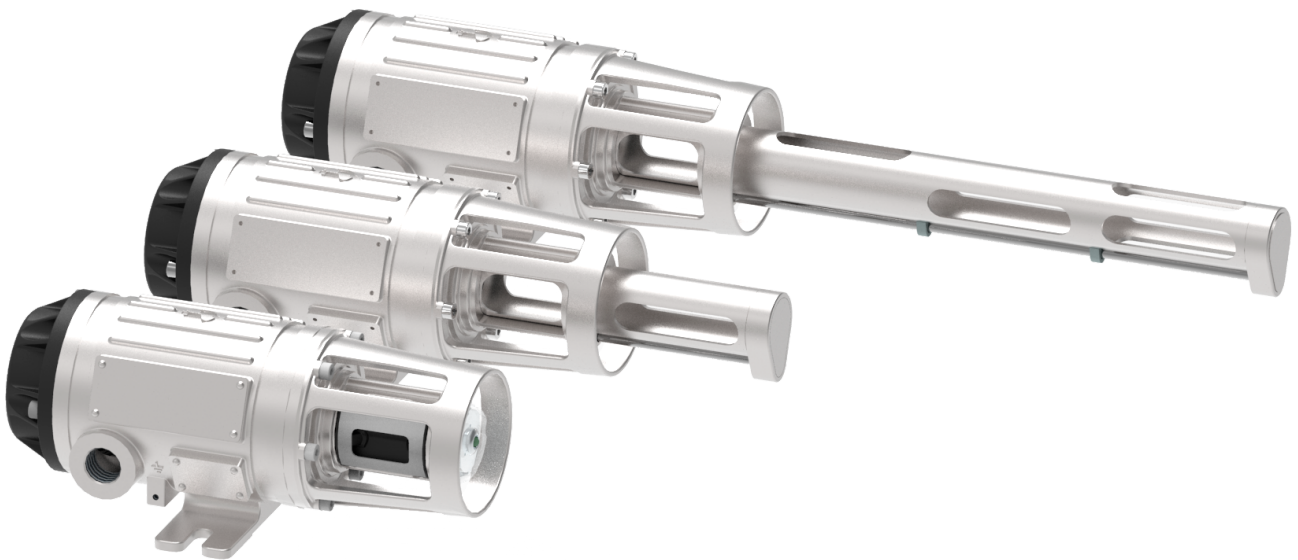


PG11 / PGE11

Optical Gas Detection

Operating Manual



OPTRONICS

Detection for real safety - for real life

Website: Optronics-Technology.com

Warnings



It is important that the manual is carefully read in its entirety. The manual shall be read and understood by those having the responsibility for the Operation and Maintenance of the product. If the product is not used and maintained in accordance with the manufacturer's instructions, the product may not perform as intended.



Warranties with respect to the product are voided if the product is not used and maintained as described in this manual. Warranties are also voided if product is used outside temperature and vibration certified ranges. Please read the general warnings in the separate chapters.



Please see the *Abbreviations* chapter for a description of abbreviations and foreign words.

Table of contents

1 Product Description and detection principle	5
1.1 Technical Specifications	6
1.2 Dimensions PG11	7
1.3 Dimensions PGE11	8
1.4 Detection principle of PG11 and PGE11	9
2 Safety and Warnings PG11	10
3 Installation	11
3.1 Installation checklist	11
3.2 Preparations and Positioning considerations	11
3.3 Mounting the detector	12
3.3.1 Pole mounting	13
3.3.2 Duct or pipe mounting	14
3.4 Electrical connections and Earthing	16
3.4.1 Booting up the Gas Detector	18
3.4.2 Performing loop test	18
3.5 Environment Shield for PG11	19
3.6 Sunshade	20
3.7 Mosquito net	21
4 Commissioning the Gas Detector	21
5 Operation	22
5.1 Function test	22
5.1.1 PG11 function check with the "Gas Test kit"	23
5.1.2 PG11 Function check with the "Gas Free Test kit"	24
5.1.3 PG11 Function check using the "Gas nozzle"	25
5.1.4 PG11 Function check with the "Remote Gas Test kit"	26
5.1.5 PGE11 short and medium Function check	27
5.2 Perform a check of the Gas Detector accuracy	28
6 Maintenance	29
6.1 Cleaning of optics - lens and mirror	29
6.2 Inspecting detector for damage	29
6.3 Keeping a stable Zeroing of the Detector	30
6.3.1 The OptoBAS™ function	30
6.3.2 Manual zero adjustment	30
6.4 Self Diagnostics	31
6.4.1 Downloading Self diagnostics datalog	31
6.5 The Blocking kit - Protection during site Maintenance	32
7 Signal outputs	33
7.1 Detector status flags	33
7.2 Light indicator	34

7.3 Analog Safety output	35
7.4 HART®	36
7.4.1 HART® electrical connection	36
8 Warranty	37
9 Certifications and standards	37
9.1 Directives and standards	37
9.2 Approvals and Certificates	37
9.3 Marking	38
9.3.1 Certification	38
9.3.1.1 Ex db ib IIC T5 Gb	38
9.3.2 Vendor information	38
9.3.3 Serial number and year of manufacturing	38
9.4 Specific conditions of use	39
10 Troubleshooting	40
11 Accessories and Spare Parts	42
12 Product coding and Ordering information	44
13 The OptoCom™ module	46
14 Abbreviations	47
15 Safety Manual	48
16 Support and Contact details	48

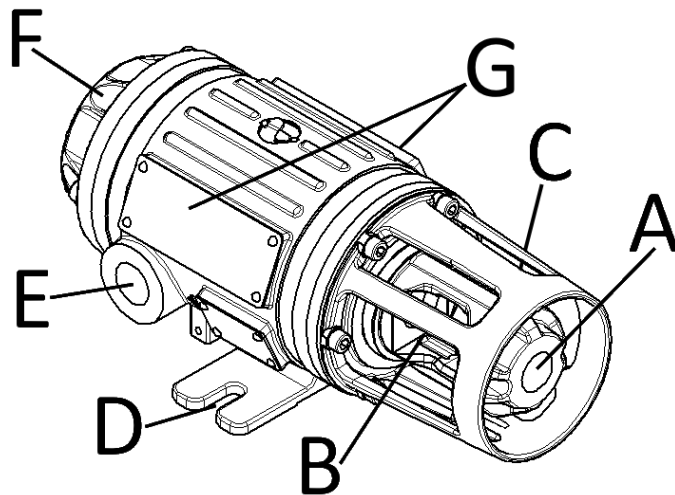
1 Product Description and detection principle

PG11 is an explosion proof rugged Optical Gas Detector for the detection of flammable gases and CO₂. The detector comes calibrated for life from the factory, and requires very little effort to install and maintain.

The PG11 is built for long maintenance intervals in very demanding environments such as extreme temperatures and tough vibrations. It has built in condition monitoring that enables better maintenance planning and less risk of unplanned shutdowns.

In the figure below, the PG11 Optical Gas Detector has the following parts:

- A. Multicolor indicator light.
- B. Sapphire lens
- C. Sapphire mirror with heating.
- D. Mounting leg.
- E. Two entries for cable glands M20. On request 1/2"NPT, 3/4"NPT and M25.
- F. Cover terminal compartment.
- G. Sign plates with certification details.



1.1 Technical Specifications

Detection technology	Gas Detection by Dual band Optical absorption in target gases. Solid-state Infrared SafeSource™ . Temperature compensated Optical Gas detection for rugged applications	
Gases and maximum measuring range	Detector configured from factory for one of the following gases with 100 %vol as maximum range: <ul style="list-style-type: none"> • Methane • Propane • Ethylene • Butane • CO2 • Biogas (mixture of CH4 in CO2) 	
Ambient conditions	Temperature	Storage: -60 to +85°C / -76 to +185°F Operating: -40 to +75°C / -40 to +167°F (Desert) -40 to +65°C / -40 to +149°F (Standard) -55 to +65°C / -76 to +149°F (Arctic)
	Humidity	0 - 99 %RH
	Vibration	Resistant to shock and vibration.
	Severe vibration conditions	Tested for mounting on applications such as diesel engines and compressors (vibrations up to 4G).
Electrical	Cable entry	M20 (standard), M25, 1/2" NPT or 3/4" NPT
	Maximum conductor size	2.5 mm ² (Stranded), 4 mm ² (Solid)
	Supply voltage	24 V DC, range 18-50 VDC
	Power consumption	< 3 W average (standard configuration) < 5 W average (arctic configuration)
	Start-up current	Soft boot-up to keep rush current less than 1 A
Performance key characteristics	Accuracy	± 3 %FS*
	Repeatability	± 1% FS*
	Response time	T90 ≤ 2 sec, with Environment Shield T20 ≤ 0.5 sec, with Environment Shield
Start-up time	Ambient above -20°C	< 2 minutes,
	Ambient below -20°C	< 20 minutes
Calibration	Calibrated at the factory, no field calibration shall be done.	
Signal outputs	Analog output	Current source or sink 4 - 20 mA HART® digital communication
	RS-485 serial port	Modbus RTU for OptoCom™ modules, Safety protocols or Condition monitoring.
	Status indicator light	Multicolor indicator light in front of detector.
Miswiring protection	The electronics have been designed to withstand powering up the detector with terminal wires accidentally being swapped.	
Self-test	Continuous self-verification of all important functions.	
Housing	Housing material	Stainless steel 316
	Weight	3.4 kg (3.9 kg with the optional steel rear lid)
	Ingress Protection	IP66 and IP67
Approvals	ATEX / IECEx	Ex db eb ib IIC T5 Gb
	North America	Class I, Division 1, Groups B, C and D (Pending)
	Various	MED, BV, LR, DnV GL, ABS type approvals
	Safety Integrity	SIL2, and SIL3 in 1oo2 redundancy setup (Pending)

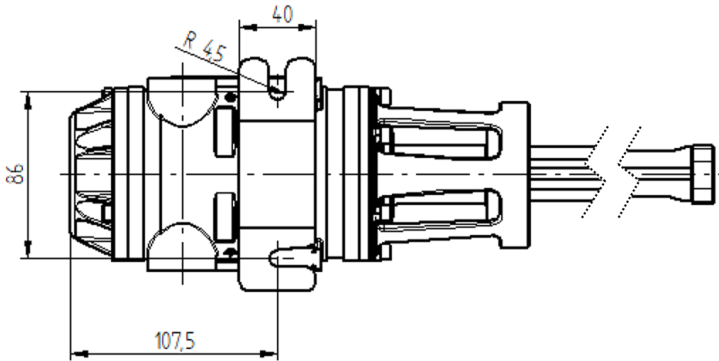
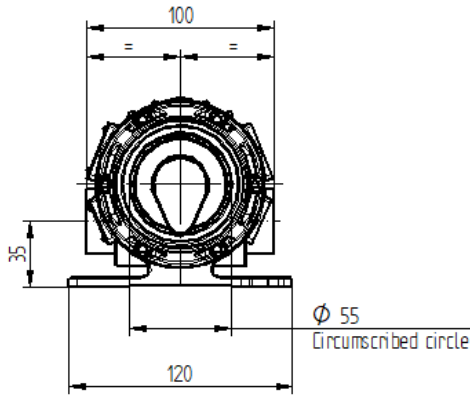
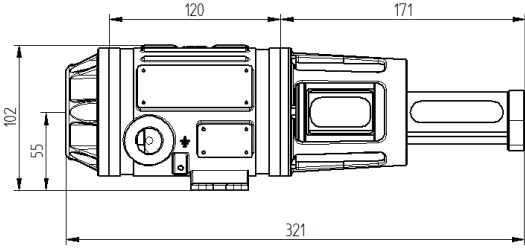
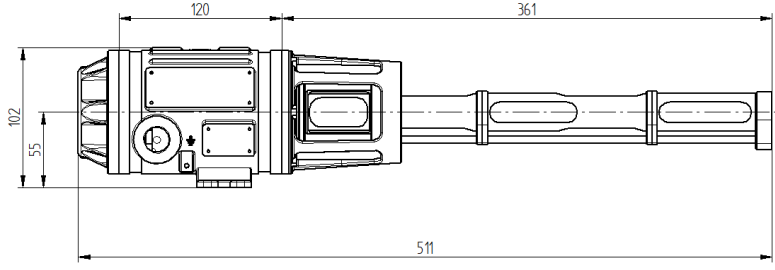
* The accuracy is specified for room temperature +25°C.

1.2 Dimensions PG11

<p>Mount</p>	<p>Technical drawing showing a side view of the PG11 device. Dimensions include a height of 86, a total length of 107,5, a width of 40 for a specific section, and a hole diameter of $\text{Ø } 9$ with a 12×1 chamfer.</p>
<p>Width</p>	<p>Technical drawing showing a top view of the PG11 device. Dimensions include a width of 100 for the main body and a base width of 120.</p>
<p>Length and height</p>	<p>Technical drawing showing a front view of the PG11 device. Dimensions include a total height of 102, a lower section height of 55, a main body width of 120, a total length of 238, and a right section width of 88.</p>

1.3 Dimensions PGE11

The PGE11 comes in three lengths with dimensions shown below.

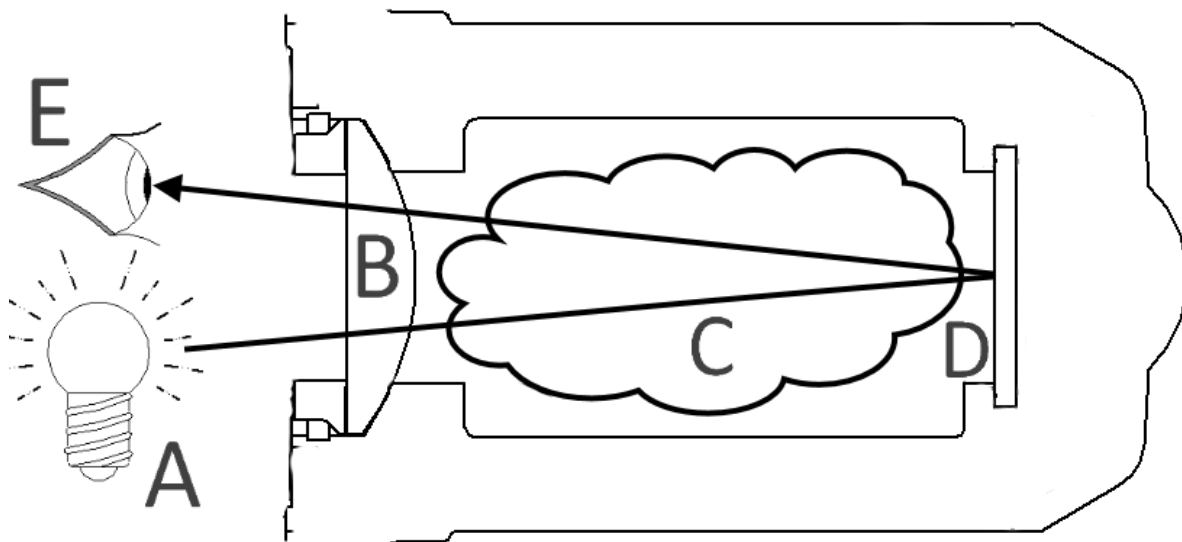
<p>Mount</p>	
<p>Width</p>	
<p>Length and height</p>	
<p>Length and height</p>	

1.4 Detection principle of PG11 and PGE11

PG11 is using an Optical Detection principle. The basic working principle is illustrated in the drawing below and consists of the following basic parts:

- A. Infrared light (2 - 6 μm region) is generated at the light source and directed at the
- B. sapphire lens focusing the light so it is passing through the
- C. gas to be measured. The gas will absorb some wavelengths depending on the type of gas. The higher concentration of the gas the more light is absorbed. After passing through the gas the remaining light is
- D. reflected by a mirror and back through the gas again reaching the lens directing the light at
- E. the light sensors. The light sensors will measure what wavelengths that have been absorbed and how much light has been absorbed. Based on this information the Gas Detector can decide if the target gas is above the alarm level.

In addition to the basic principles described above there are more functions in the detector that are compensating for changes for example by temperature and component aging over time.



2 Safety and Warnings PG11

- PG11 Optical gas detector is certified for and intended for use in potentially hazardous areas. Install and use the gas detector in accordance with the appropriate local or national regulations.
- The gas detector shall be properly Earthed to protect against electrical shock and minimize electrical interference.
- Test gases may be combustible. Refer to Material Safety Sheets for appropriate warnings.
- The detector shall be installed and operated by trained and qualified personnel only.
- Do not open the detector housing, the warranty is not valid if it is open. There are no user serviceable parts or settings inside. Return to service point for service or repair.

3 Installation



The area for which the detector will be installed shall be in accordance with the certification of the detector and with the standards of the appropriate authority in the country concerned.



If the service temperature of the installation may exceed 70 °C, ensure the following:

- Cable glands are certified for the given temperature range.
- Cables are suited for use at temperatures above 78 °C.



The usage of unqualified glands, cables or conduits are considered hazardous.

3.1 Installation checklist

Below is the recommended procedure for installing the detector PG11:

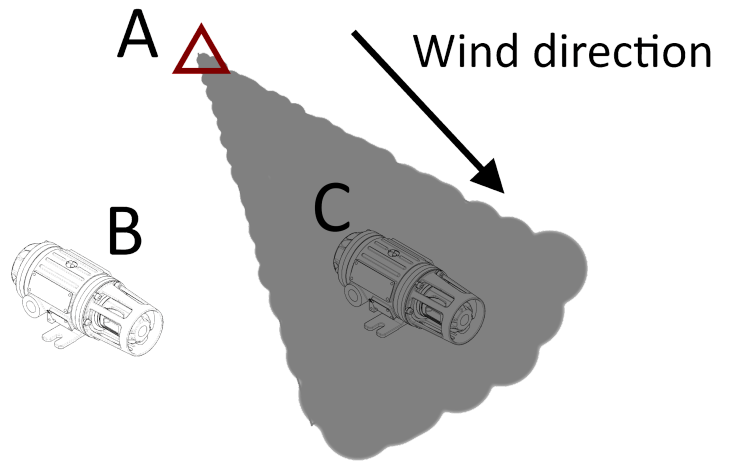
1. Check that the detector is mounted in a horizontal orientation with tight bolts as described in section "3.3 Mounting the detector".
2. Verify correct wiring of the terminals as described in "3.3 Electrical connections and Earthing".
3. Check that cable gland is suitable type and certification
4. Verify cable shielding has been correctly terminated.
5. Verify correct Earthing to external Earthing point on the Detector housing as described in "3.4 Electrical connections and Earthing".

3.2 Preparations and Positioning considerations

PG11 is a point gas detector, and should be placed as close to a potential leaking point as possible. However, each installation is different from another, and detailed considerations must be done locally in order to get the best coverage for detection. Below are some general matters to consider:

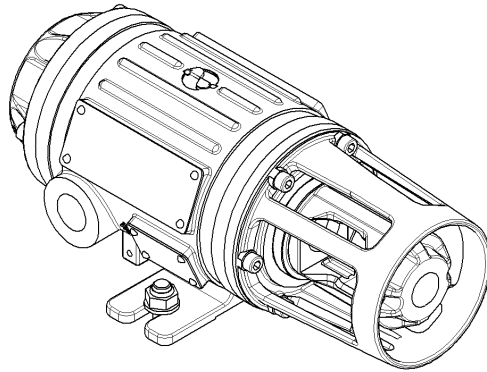
- The detector should be placed where maintenance, such as cleaning of optics can easily be performed.
- The relative weight of the target gas compared to air must be taken into account when deciding the optimum installation height. Methane is lighter than air and in this case the gas detector may have to be placed above a potential leak source. In case of the other hydrocarbons such as Propane being heavier than air, could accumulate lower levels and might be better detected by placing Detectors at lower levels - in many instances close to the floor.
- The concentration of a gas cloud will quickly reduce with the distance from the leak source. The detector should therefore be placed as close as possible to potential leakage sources.
- In spaces where there are two main components of gas then it is recommended to use two gas instruments in accordance with HAZOP studies or a Detector that is sensitive to both gases. The Optical Methane Detector will for most heavy hydrocarbons react very strongly and might be suitable.

- The detector should not be mounted in areas where it can be drenched by water.
- Also, the fact that gas quickly dilutes when released into the air, and the impact of wind must be considered. As illustrated below with a leak point at position A, the gas will spread in the direction of the wind and be detected at position C (down stream), but not detected at position B. The wind speed has no effect on the detector.

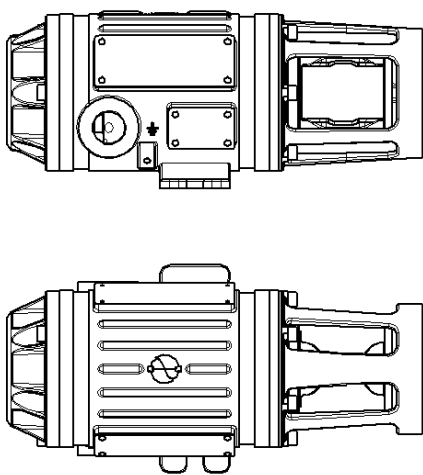


3.3 Mounting the detector

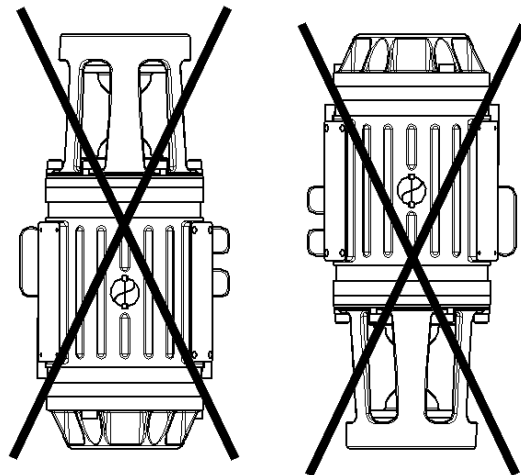
Below, PG11 is shown securely mounted with M8 mounting screws, nuts and washers. The PGE11 is mounted with the same solution.



PGxx11 should be mounted with the longitudinal axis in the horizontal direction as illustrated below. At the same time, it can be rotated in any direction around this longitudinal axis. The reason for these requirements is that such a position will reduce the accumulation of contamination on the optical parts (lens and mirror).

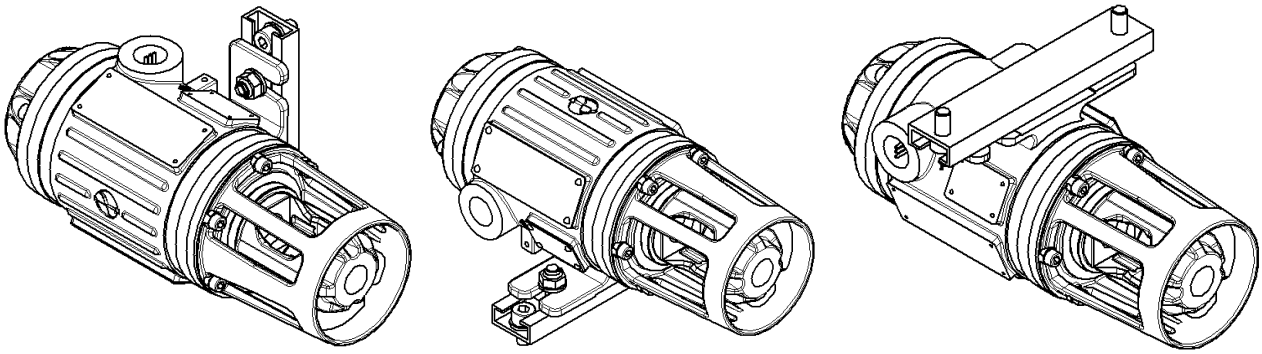


Correct



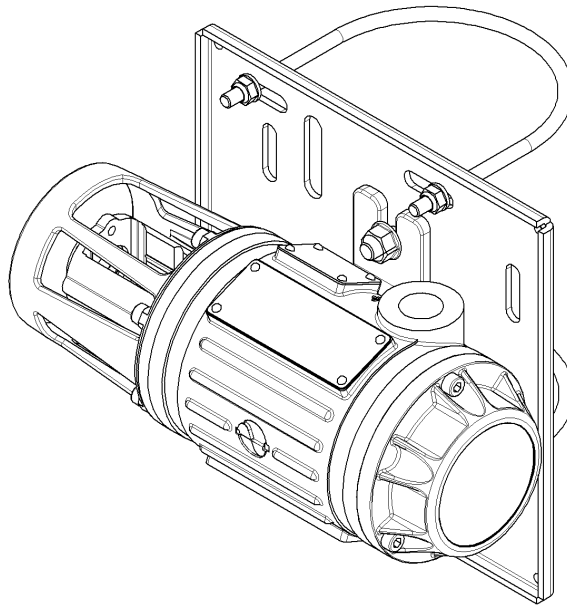
Incorrect

Wall mounting of the detector is most often seen, while it can also be mounted flat or in the roof as illustrated below. In the example below the detector is mounted in a C-bar structure.



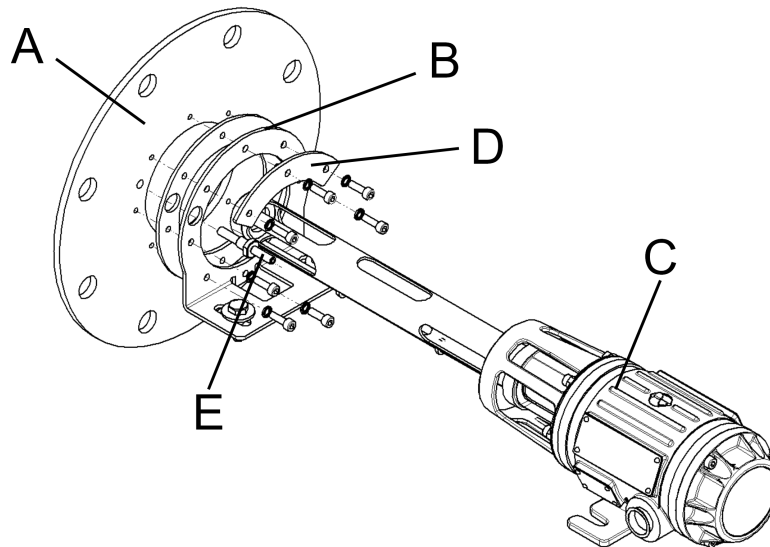
3.3.1 Pole mounting

Below is an illustration of the PG11 with the "Mount kit Pole" mounted to a pole with a diameter of about $\text{Ø}60$ mm or 3".



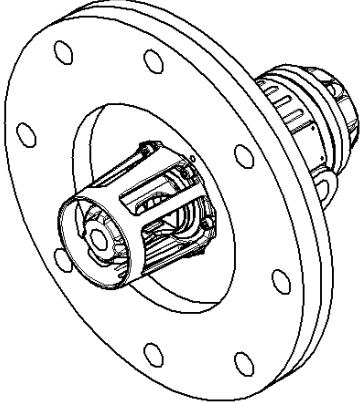
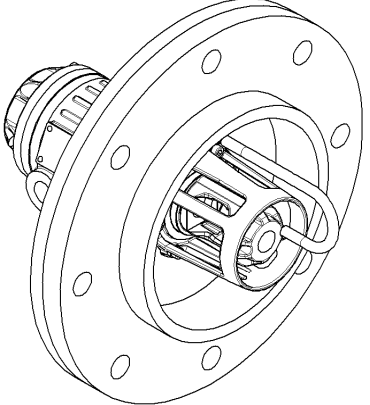
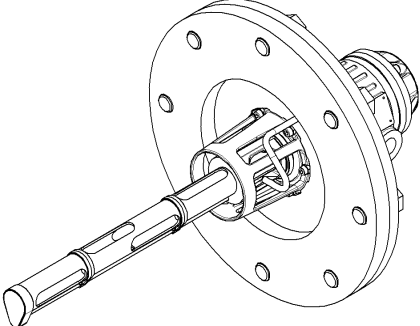
3.3.2 Duct or pipe mounting

If installed in a ventilation duct or pipe, it is recommended to use the “*Duct flange kit*” as shown in the illustration below. To get better gas coverage inside the duct it is recommended to use the PGE11 with the extended gas sensing section as shown below.



The mounting is done by fixing the *flange (A)* to the installation. Attach the *gasket* and the *mounting bracket (B)*. The *PGE11 (C)* is slid onto the *mounting bracket* and fixed with two bolts and the *support bracket (D)*. The *Duct flange kit* is supplied with a *nozzle (E)* to allow gas testing to be performed without removing the detector from the duct flange.

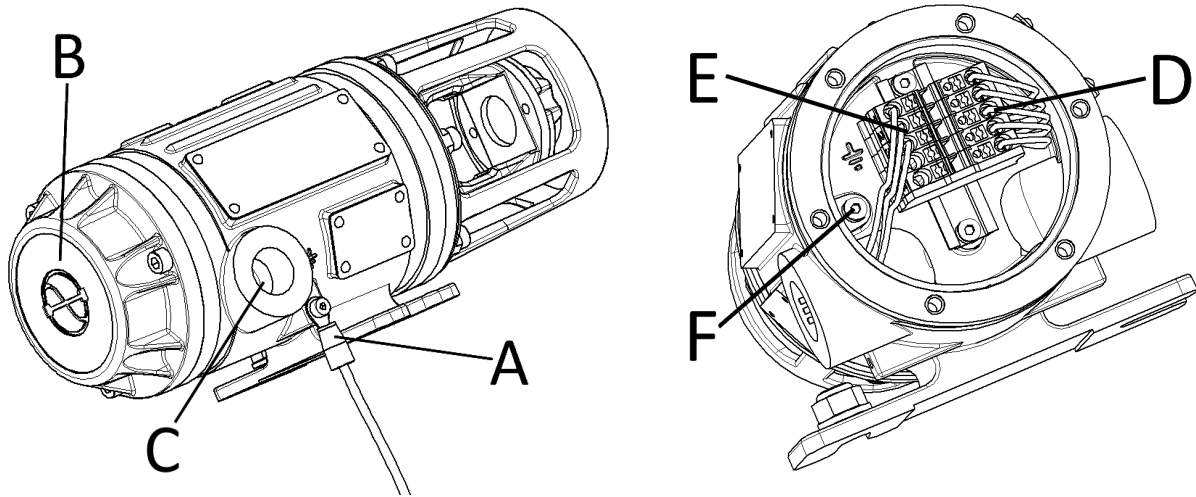
The below table shows three possible configurations mounting the Duct flange:

<p>PG11 mounted in the Duct flange kit</p>		<p>Detector can easily be removed from the duct to perform a Gas test. Nozzle not used for gas testing.</p>
<p>PG11 mounted in Duct flange with gas test line connected to the nozzle</p>		<p>Installed with the Nozzle installed in the front of the PG11, and a flexible tube connected from the nozzle to the Duct flange. With the Environment shield installed this solution works well doing gas with tests when the air is flowing in the duct. Without the <i>Environment shield</i> it is more difficult to do the Gas test since the gas is faster diluted and therefore very high flow on the test gas is required.</p>
<p>PGE11 Mounted in Duct Flange kit. Through the rigid gas pipe a gas test can be performed</p>		<p>Installed with a rigid gas pipe. Can be challenging to perform gas tests if there is air flow in the duct.</p>

3.4 Electrical connections and Earthing

The PGxx11 chassis shall be connected to local *Clean Earth*. Use one of the two external Earthing points (M4x5) illustrated in point **A** left drawing below using an *Earthing cable ring lug*. The electrical terminals are located inside the rear lid in point **B**, opened by unscrewing the three screws fixing it. M20 cable entries **C** on both sides of the Detector. The other dimensions M25, 1/2" NPT and 3/4" NPT are supplied on request at order. The right side of the terminals **D** are occupied with internal wiring, and on the left side **E** are the terminals (**pin 1 at the top** and **pin 5 at the bottom**) to be wired according to *table 1*. **F** is the internal Earth point for an M4x4 screw for the connection of a cable lug.

! To avoid the risk of corrosion, use quality fasteners for the connection of the earthing. Avoid the use of aluminium, magnesium, titanium or zirconium. A lockwasher or similar should be used to ensure secureness of the electrical connection.



The termination compartment inside the rear lid is equipped with Phoenix Contact MPT 2,5 - 3248125 Push in style connectors, accommodating wires of cross section 0.14mm² (AWG 26) to 2.5mm² (AWG14) (4mm²/12AWG for single conductor wire). Wires should be stripped to expose min 8mm, max 10mm conductor. Insert rigid conductors or conductors with ferrules into the conductor shaft. The contact spring opens automatically and provides the required pressure force against the current bar.

The wiring of the Detector shall be done in accordance with *table 1*.

Table 1. Specifications of terminals.

Terminal (detector wire color)	Signal type	Specification	Cable requirement
1 (white)	Power, Positive supply voltage	24 VDC	According to site requirements and Table 2. Min. cross section: 0.14mm ² Max. cross section: 2.5mm ² (Stranded) 4mm ² (Solid)
2 (brown)	Power, Supply voltage return	0 VDC	
3 (green)	Analog Safety signal	Analog 0 - 20 mA DC signal overlaid with a HART signal. Signals levels described in <i>table 4</i> . The HART signal is not interfering with the analog DC signal and is described in a separate chapter. <i>Maximum impedance 500 Ω.</i>	
4 (yellow)	RS-485 A	Two wires for connection to digital RS-485 serial communication, Modbus RTU.	Industrial communication cable with shielded twisted pair. Min/max cross section 0.14/2.5 mm ² (stranded) or max 4 mm ² (Solid)
5 (grey)	RS-485 B		
EARTH	External Earth point	External grounding shall be used when the detector is installed in an Ex zone.	
	Internal Earth point	Normally not used. Shield of the cable is typically connected to instrument earth in the central control cabinet, and is normally not terminated at the detector. If extra RFI protection is required, and the installation's grounding principles/regulations allow it, the shield can be terminated to local ground via the internal earth point at the detector.	

Table 2. Minimum voltage to PG11 shall be 18 VDC. Examples of cable and maximum length.

Cable cross section	0.5 mm ²	0.75 mm ²	1 mm ²	1.5 mm ²	2.5mm ²
Voltage drop	~5.8V				
Max cable length*	133 m	200 m	250 m	400 m	650 m

* For a nominal power of 24 V. Longer cable can be used with higher supply voltage.

3.4.1 Booting up the Gas Detector

When turning on the power to the Gas Detector it has a boot-up time of 60 seconds. During this time the Detector will run self diagnostics and if the indicator is configured to be active it will show yellow light. After this boot-up time the Detector is ready to detect gas, but for a very precise testing of gas accuracy the Detector should be allowed for another 20 minutes warm up time

3.4.2 Performing loop test

The PG11 can perform a loop test through the HART or MODBUS interfaces. The loop test allows for the Operator to Manually set the analog signal output to a selected value for a limited time. Please consult the corresponding HART chapter of this Manual for instructions.

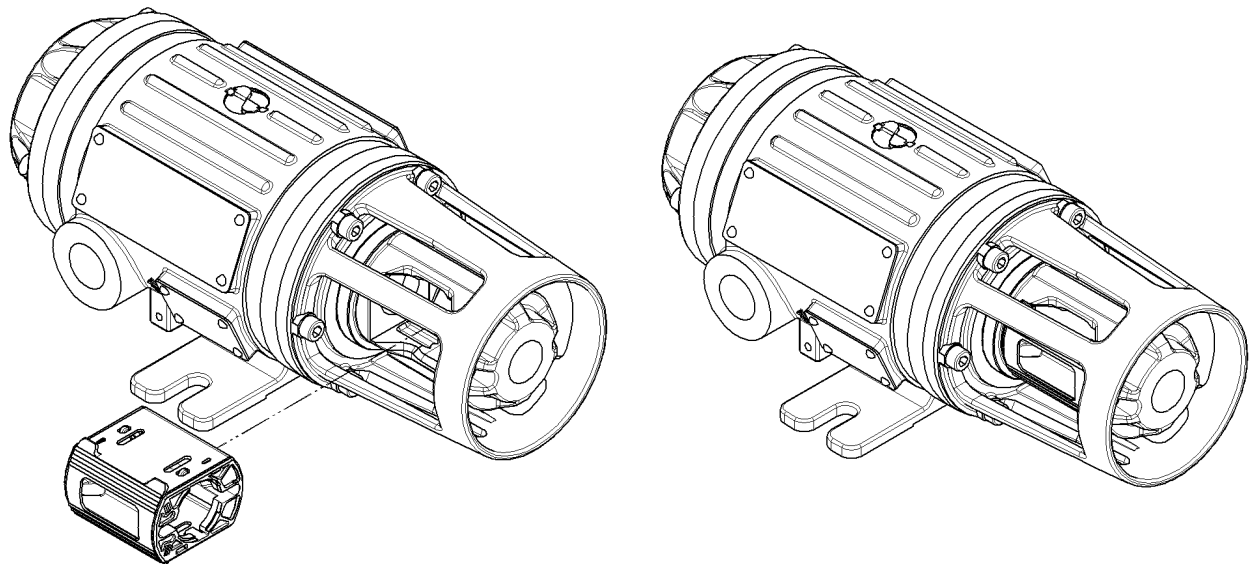
3.5 Environment Shield for PG11

Dirt, dust, snow and liquids gathered on the lens and mirror will reduce the amount of IR light used for detecting gas. If more than 55 % of the IR light is blocked due to contamination of the optics, the detector will give an EARLY CLEAN OPTICS WARNING. The optics should then be cleaned as described in section "Cleaning optics". If more contamination is allowed to accumulate without cleaning, the detector will go into FAULT when more than 70 % of the IR light is blocked. How fast dirt is accumulating on the Optics depends on how dirty the environment is.

The PG11 comes by default with an *Environment Shield*. It is recommended to use the environmental shield in most cases. This will reduce the effects of rain, snow, dirt and water spray from eg. fire extinguishing systems. The optics of the PG11 is heated and the environmental shield will enhance the effect by keeping the heat more localized inside the sensing section of the PG11. The result is a more robust solution against thick mist and rapid temperature changes.

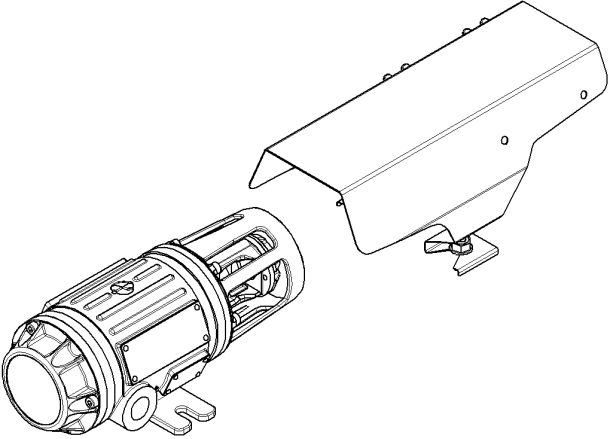
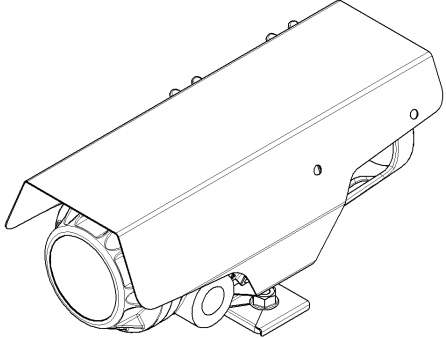
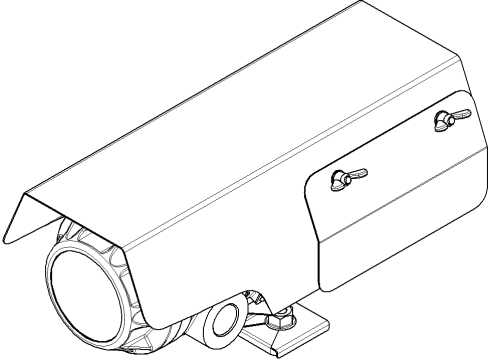
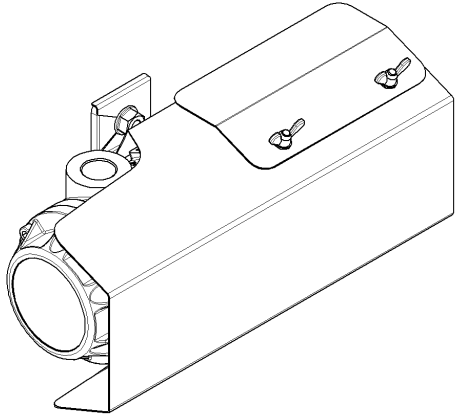
For severe humid applications (>99% RH), it is recommended to use the Hydrophobic filter. See the full list of accessories in chapter 11 Accessories and Spare Parts.

The Environment Shield for the PG11 consists of one compact unit fitting into the gas sensing section as illustrated below. The Environment Shield has been designed for optimal performance of the detector. The illustration below shows how the Environment Shield is easily slotted into the sensing section of the PG11. Before inserting the Environment shield visually inspect that it is free of dirt or any blocking substances. Make sure it is inserted all the way in.



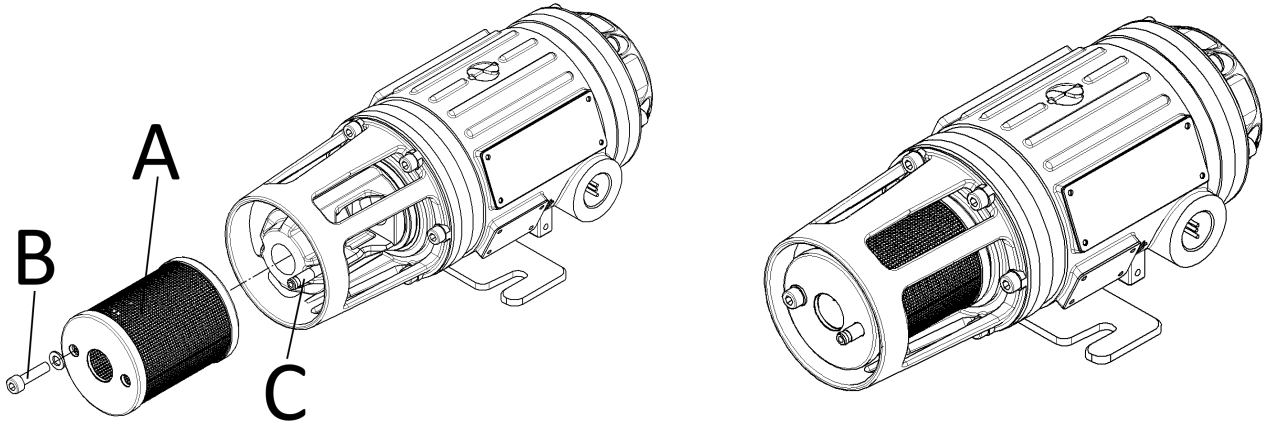
3.6 Sunshade

The PG11 can be fitted with a screen or roof keeping it from being exposed to direct sunlight heating the detector up, or from snow, sand or similar that can accumulate on the detector. The sunshade is fitted as illustrated below. The sunshade is fixed with the same screws as the Detector.

 <p>The Sunshade is slid in from the front.</p>	 <p>The Sunshade is secured with the same screws as the Detector mounting.</p>
 <p>The accessory <i>Sunshade extension</i> included in the Sunshade kit can be used to give extra shielding in some applications, but is normally not used for horizontal mounting.</p>	 <p>For wall or pole mounting it is recommended to use the <i>Sunshade extension</i> to shield the detector from direct sunlight, rain and snow.</p>

3.7 Mosquito net

The accessory *Mosquito net* can be fitted to the Gas Detector to prevent insects from blocking the optics. The Mosquito net (**A**) is fitted on the outside of the detector nose and secured with the screw (**B**). It is recommended to use the accessory *Gas nozzle* (**C**) for easier access when performing Function tests with gas. The Mosquito net can also be used in combination with the *Environment Shield* for a combined splash and insect protection.



4 Commissioning the Gas Detector

Below is the recommended procedure for commissioning the detector PG11:

1. Turn on power to the Gas Detector. The Detector will run self-diagnostics and warm up as described in section "3.4.1 Booting up the Gas Detector"
2. Verify Status indicator light alarm levels, and change if necessary. The default settings might be different from site alarm levels. Light indicator described in chapter 7.2 Light indicator.
3. Perform the *Gas Detector Safety Function test* as described in "5.1 Function test".
4. Verify that the Site Safety System is receiving the gas signal from the Gas Detector.
5. With all steps passed this concludes commissioning of the Gas Detector.

5 Operation

During operation there is very little to do with the detector other than performing the regular Function test of the detector and cleaning of lens and mirror if dirty. The cleaning of the lens and mirror is described in the chapter *Maintenance* and Function test is explained in the next chapter.

5.1 Function test

Function test of the Detector can be performed by applying gas or using the Gas Free test kit. This is a simple test carried out to make sure the gas detector will respond when exposed to gas, often referred to as *Bump testing* the Detector. This test is typically performed on a regular basis to verify the Safety Functions of the Detector. The *bump test* is used to confirm the detector is responding to gas presence and generating the correct outputs as prescribed. The Operator can select from one of the methods described below depending on the configuration of the detector and local preferences.

It is recommended to perform the Function test in non-condensing ambient conditions.

Proof Test interval

The time between two periodical tests of the Detector Safety Function is from a Safety context called the Test Interval. PG11 is certified in accordance with the standard IEC 61508 with a SIL2 rating. If used in an 1oo2 configuration the PG11 is rated for SIL3.

A gas being released from a Gas cylinder will give a very small “gas cloud” that will be diluted very quickly. This is challenging when testing a gas detector since the gas reaching the gas detector will have a much lower concentration compared to what is on the Gas cylinder. Especially if there are windy conditions it can be challenging to get any gas to the detector with a small amount of gas coming from a Gas cylinder. Therefore precautions have to be taken when testing a detector to get valid results.



For example using a 50 %LEL test gas and injecting it at 2 liters/min into a PG11 fitted with Environment Shield using the “*Gas test kit*”, can result in a gas reading as low as 20 %LEL if there is windy conditions.

Please refer to the chapter “*5.2 Perform a check of the Gas Detector accuracy*” if a more precise test is required.

5.1.1 PG11 function check with the "Gas Test kit"

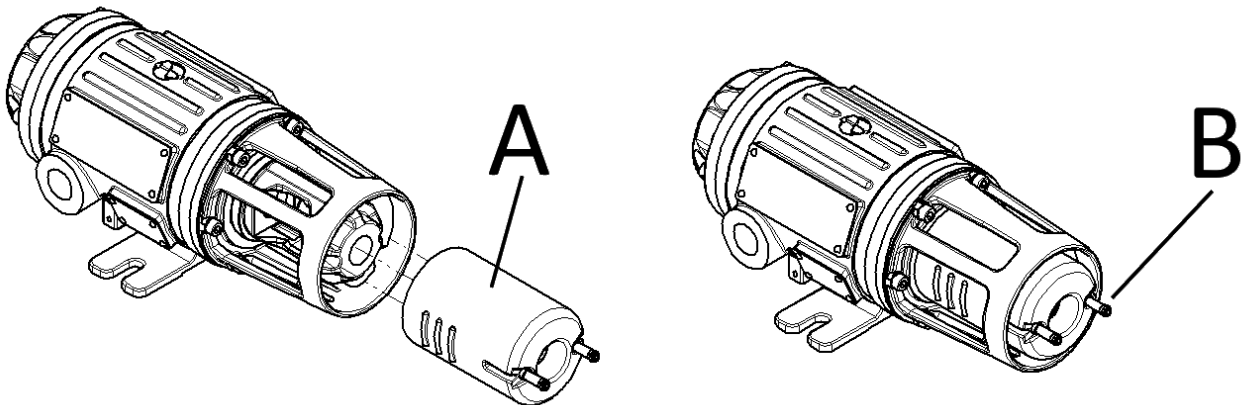
Using the PG11 *Gas Test kit* allows for quickly verifying the functionality of the Detector without having to remove the Environment shield if fitted. The Gas Test kit has an opening in the front between the gas nozzles that allows for the Operator to see the indicator showing the status of the Detector.

Requirements:

- Gas Test kit (A in illustration below)
- Gas cylinder with same type of gas as Detector is rated to detect
 - Concentration of test gas shall be higher than 30%FS
 - Flow rate of minimum 1 liters/min.
- Flexible gas hose

Procedure:

1. Connect the tube from the Gas cylinder to one of the Gas Test kit nozzles (B in illustration)
2. Slide the *Gas Test kit* on the outside of the detector sensor section as illustrated below.
3. Apply the gas from the Gas cylinder with at least 1 liters/min flow rate
4. Observe that the detector indicator is showing gas alarm or that a gas response is received at the control system
5. With a response of more than 20 %FS the Gas Detector has passed the test



5.1.2 PG11 Function check with the “Gas Free Test kit”

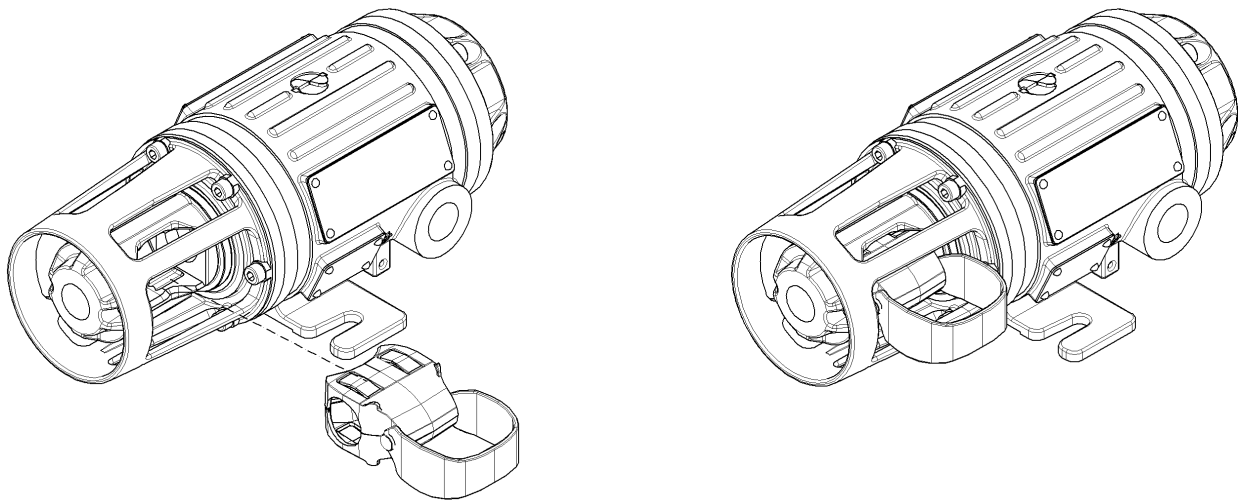
Using the *Gas Test kit Gas Free*, the Safety Function of the Gas Detector can be verified without the need of a bottle of test gas. The *Gas Free Test kit* comes in several types rated for different gases and with specified gas values. For example, to perform a Function test of an Alarm level at 30 %LEL for Methane gas, select a *Gas Free Test kit* rated for Methane and a gas concentration higher than the required Alarm level. Please see chapter 11 for an overview of the different types of *Gas Free Test kits*.

Requirements:

1. Gas Free Test kit.

Procedure:

1. Remove the *Environment Shield* if the detector is fitted with such.
2. Verify that the *Gas Free tester* is rated for this Gas Detector.
3. Insert the *Gas Free tester* into the sensor section of the detector.
4. Observe that the detector indicator is showing gas alarm or that a gas response is received at the site gas detection system.
5. With a response according to specification of the Gas Free tester the Gas Detector has passed the test.



5.1.3 PG11 Function check using the “Gas nozzle”

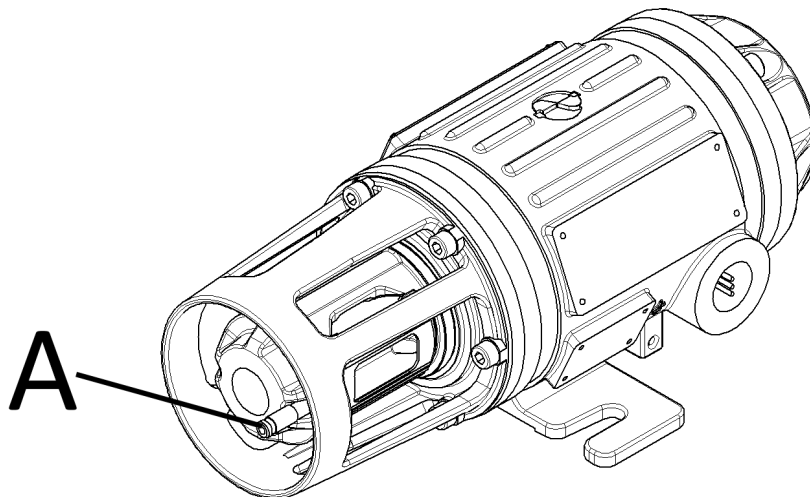
This procedure is used for gas testing of detectors mounted high up or in another not easily reachable location. Kit consists of a “*Gas nozzle*” on the nose of the detector. In between the Gas nozzle and Gas test box there will be a gas pipe to allow for the gas to flow from the Gas test box and into the Gas Detector through the Gas nozzle.

Requirements:

- Gas nozzle (if not already fitted)
- PG11 should be fitted with the Environment Shield especially if there is any wind.
- Gas cylinder with same type of gas as Detector is rated to detect
 - Concentration of test gas shall be above 40%FS
 - Flow rate of minimum 2 liters/min.
- Flexible gas hose

Procedure:

1. If PG11 is not already fitted with a *Gas nozzle*, please fit this to PG11 as illustrated below at point A.
2. Verify that PG11 is fitted with an Environment Shield. Not having an Environment Shield will make the gas dilute too quickly giving low gas reading, especially in windy conditions.
3. Connect the test Gas cylinder to the Gas nozzle as illustrated below.
4. Apply the gas from the Gas cylinder with at least 2 liters/min flow rate.
5. Observe that the detector indicator is showing gas alarm or that a gas response is received at the control system
6. With a response of more than 20 %FS the Gas Detector has passed the test.



5.1.4 PG11 Function check with the "Remote Gas Test kit"

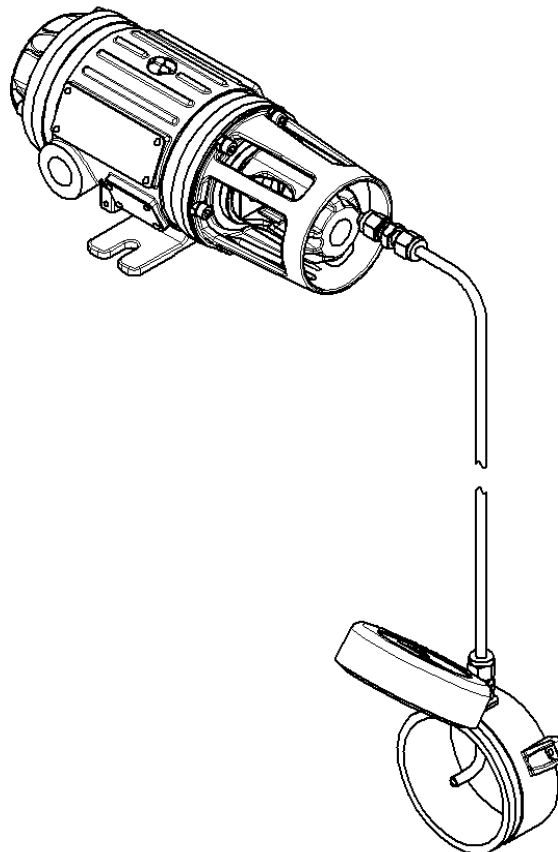
For gas testing of detectors mounted high up or another not easily reachable location. Kit consists of a "Gas nozzle" on the nose of the detector and a "Gas test box" to be mounted at a suitable location. In between the Gas nozzle and Gas test box there will be a gas pipe to allow for the gas to flow from the Gas test box and into the Gas Detector through the Gas nozzle.

Requirements:

- PG11 should be fitted with the Environment Shield especially if there is any wind.
- Gas cylinder with same type of gas as Detector is rated to detect
 - Concentration of test gas shall be above 40%FS
 - Flow rate of minimum 2 liters/min.
- Flexible gas hose

Procedure:

1. Connect the test Gas cylinder to the *Gas test box* (illustrated below).
2. Apply the gas from the Gas cylinder.
3. Observe that the detector indicator is showing a gas alarm or that a gas response is received at the site gas detection system. This might take several minutes depending on gas flow and the length and diameter of the gas line.
4. With a response of more than 20 %FS the Gas Detector has passed the test.



**Principal sketch of a remote gas test kit.*

5.1.5 PGE11 short and medium Function check

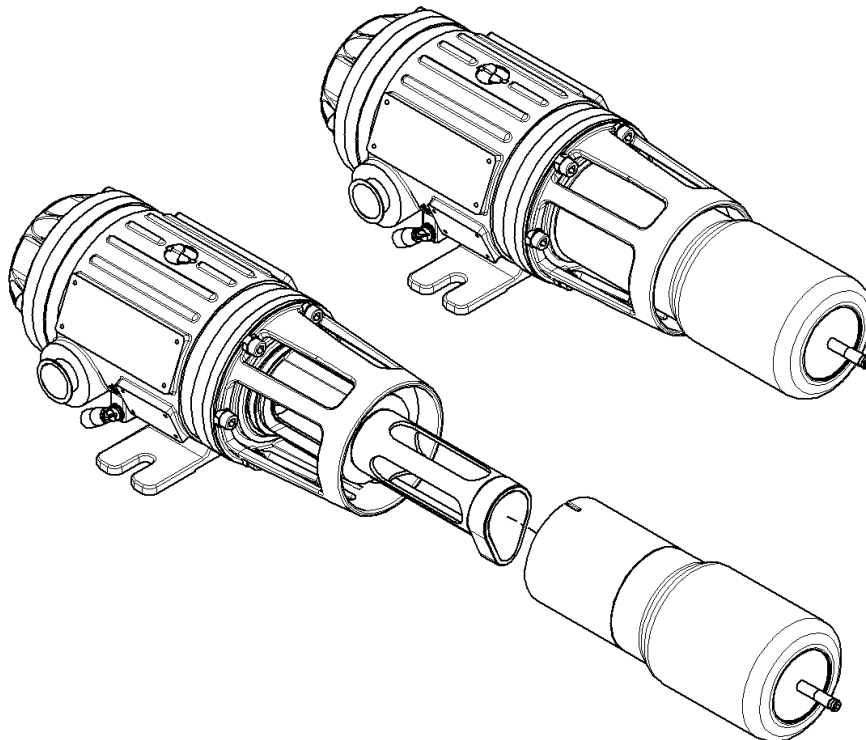
For the Function test of the PGE11 short and medium use the *PGE11 Gas Test kit* as described in the procedure below. The Function test is not taking into account variations in ambient pressure, wind or other factors so it is not expected to precisely verify the accuracy of the detector. For better accuracy the detector shall have been powered on in fresh air for more than 20 minutes, ambient should be around room temperature, no wind and deviations in ambient pressure from the ideally 1013 mBar should be accounted for in the gas measurement. This is explained in chapter 5.2 *Perform a check of the Gas Detector accuracy*.

Requirements:

- PGE11 Gas Test kit. Be aware that the correct type of kit is selected
 - PGE11 short Gas Test kit
 - PGE11 medium Gas Test kit
- Gas cylinder with same type of gas as Detector is rated to detect
 - Concentration of test gas recommended to 50 ± 10 %FS
 - Flow rate between 1 and 10 liter/min.
- Flexible gas hose to connect between gas cylinder and *Gas Test kit*

Procedure:

1. Connect the tube from the Gas cylinder to the gas nozzle of the *PGE11 Gas Test kit*.
2. Attached the *PGE11 Gas Test kit* to the PGE11 as shown below.
3. Apply the gas with a flow between 1 and 10 liter/min
4. Observe that the detector indicator is showing gas alarm or that the expected gas response is received at the control system
5. With a response of the test gas concentration ± 10 %FS, the Gas Detector has passed the test



5.2 Perform a check of the Gas Detector accuracy

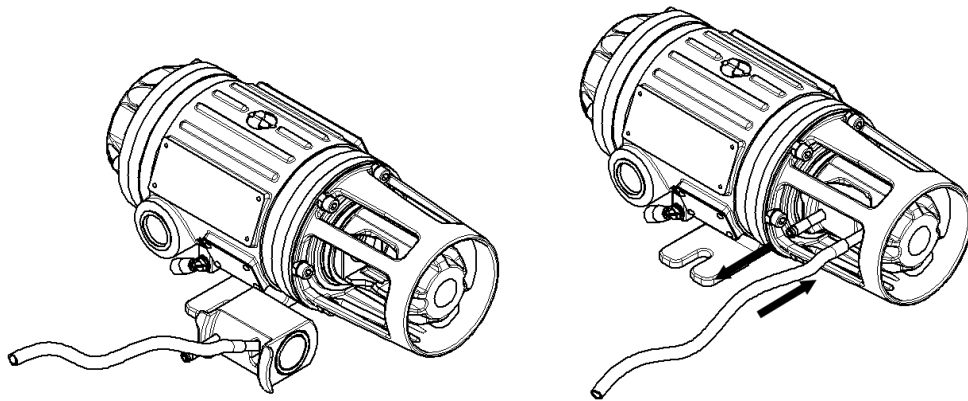
The PG11 and PGE11 have been calibrated for life at the Factory and do not require to be recalibrated. At the Factory great care has been taken to take into account environmental effects such as gas concentration, the temperature of the gas, ambient pressure and humidity to make a very precise calibration of the Detectors. Calibrating in field it is very difficult to take such considerations so it is therefore not possible to calibrate the Detector in field since it would not improve the accuracy. Below is the procedure to verify the Detector accuracy.

Requirements:

- *Gas Sample kit*
- Gas cylinder with calibrated test gas
 - Concentration of test gas recommended to 50 ± 10 %FS
 - Flow rate shall be between 0.5 and 1.1 liters/min.
- Flexible gas tube between Gas cylinder and Gas Sample kit
- Data logger connected to the 4.20 mA.

Procedure to verify accuracy of the Detector:

1. Power up and allow the Gas Detector to warm for at least 20 minutes.
2. Insert *Gas Sample kit* as shown in illustration below.
3. Connect the tube from the Gas cylinder to one of the nozzles on the *Gas Sample kit*.
4. Slide the *Gas Sample kit* on the outside of the detector sensor section as shown below.
5. Apply the gas from the Gas cylinder with a gas flow between 0.5 - 1.1 liters/min.
6. Allow for gas reading to stabilize for at least one minute.
7. Start the data logger and perform logging for two minutes.
8. Calculate average gas value and standard deviation from the data logger and compare with the specifications of the detector for Accuracy.



The accuracy of the calibration gas has to be taken into account when calculating the accuracy for the Gas Detector.



The ambient pressure will affect the calibration gas and has to be taken into account. The Gas Detector is calibrated for an average ambient having a pressure of 100 kPa (0.987 atm). The ambient pressure can vary a few percentages depending on the weather conditions and will influence the pressure of the gas leaving the gas cylinder.

A 1% change in ambient pressure from 100 kPa, will result in a 1 % change in gas reading and should be accounted for.

6 Maintenance

Very little Maintenance is required for PG11. The detector does not have any internal functions that require regular monitoring or maintenance. Regular maintenance consists only of cleaning the optics and inspecting the detector exterior for damage. Any damage to the internal of the detector is handled by the detector Self Diagnosis described in a separate chapter.



Please note that maintenance of the optics where parts of the optics may be physically blocked, may lead to false alarms or warnings. This is also valid when you insert or remove the Environment Shield.

Always inform operations before doing any maintenance on safety critical equipment.

6.1 Cleaning of optics - lens and mirror

If installed, remove the Environment Shield. Then clean the lens and mirror with a soft, clean tissue. Both these optical parts are made of sapphire and as such are resistant to scratching.

Avoid cleaning with liquids containing hydrocarbons such as acetone. After such cleaning, make sure the solution has dried fully and residues have been wiped away before any functional testing is performed.

6.2 Inspecting detector for damage

Following should be checked:

- Blocked sensor section
- Any bag around the detector will prevent detection of gas.
 - Recommend using the DETECTOR BLOCKING KIT during work around the detector such as paint work and sandblasting that might pollute and damage the optics.
- Rusted flame joints
- Terminal compartment
 - O-ring shall be in place and without damage.
 - Shall be free from dirt and water.
 - Do not add any drying bags or such inside the terminal compartment since this can lead to short circuiting electrical wiring. The O-ring shall be sufficient to keep the terminal compartment dry and free of dust.

6.3 Keeping a stable Zeroing of the Detector

6.3.1 The OptoBAS™ function

The OptoBAS™ function of PG11 is keeping the Maintenance requirements of the detector to a minimum by taking away the need to do manual zeroing of the detector. This will make sure the detector will show zero gas value when there is no gas present. The OptoBAS™ function will make minor adjustments to the zero level over a long period of time to keep the Detector stable. If there is any gas present the OptoBAS™ will not perform any adjustments.

6.3.2 Manual zero adjustment

Warning! This procedure should only be performed by trained Operators. If this is not done in a proper way, the performance of the detector can be jeopardized.

Normally this is not needed, but for some special applications this might be useful. For example if the detector is used in an application requiring the OptoBAS be deactivated due to a low background level of gas present at all times. Also the OptoBAS™ has a limited range it will handle and a Manual zeroing of the Detector might in some cases be needed.

Requirements:

- Gas Sampling kit
- Nitrogen or clean air
- The Detector shall prior to starting the procedure below be powered up for at least 20 minutes in a stable environment between 15 - 30°C.

Procedure:

1. Clean the Detector optics, both mirror and lens.
2. Connect to the detector through *HART®* or *Modbus RTU* as described in those chapters
3. Connect the tube from the Gas cylinder to one of the nozzles on the Gas Sampling kit
4. Fit the *Gas Sampling kit* as illustrated in "Performing a Calibration check".
5. Apply the nitrogen or clean air at a flow rate above 0.3 liters/min
6. Wait for 1-2 minutes until the reading stabilizes
7. Start Zeroing from the HART interface.
8. Wait for confirmation.

6.4 Self Diagnostics

All Safety critical electronic components are monitored and stored in the Diagnostics log if outside specification. In addition vibration, temperature and optical signals are analyzed and stored in the Diagnostics log. The Diagnostics log is downloaded at the vendor during any Service or inspection of the Detector. The Diagnostics log can also be downloaded by the user and sent to the vendor for analysis and troubleshooting.

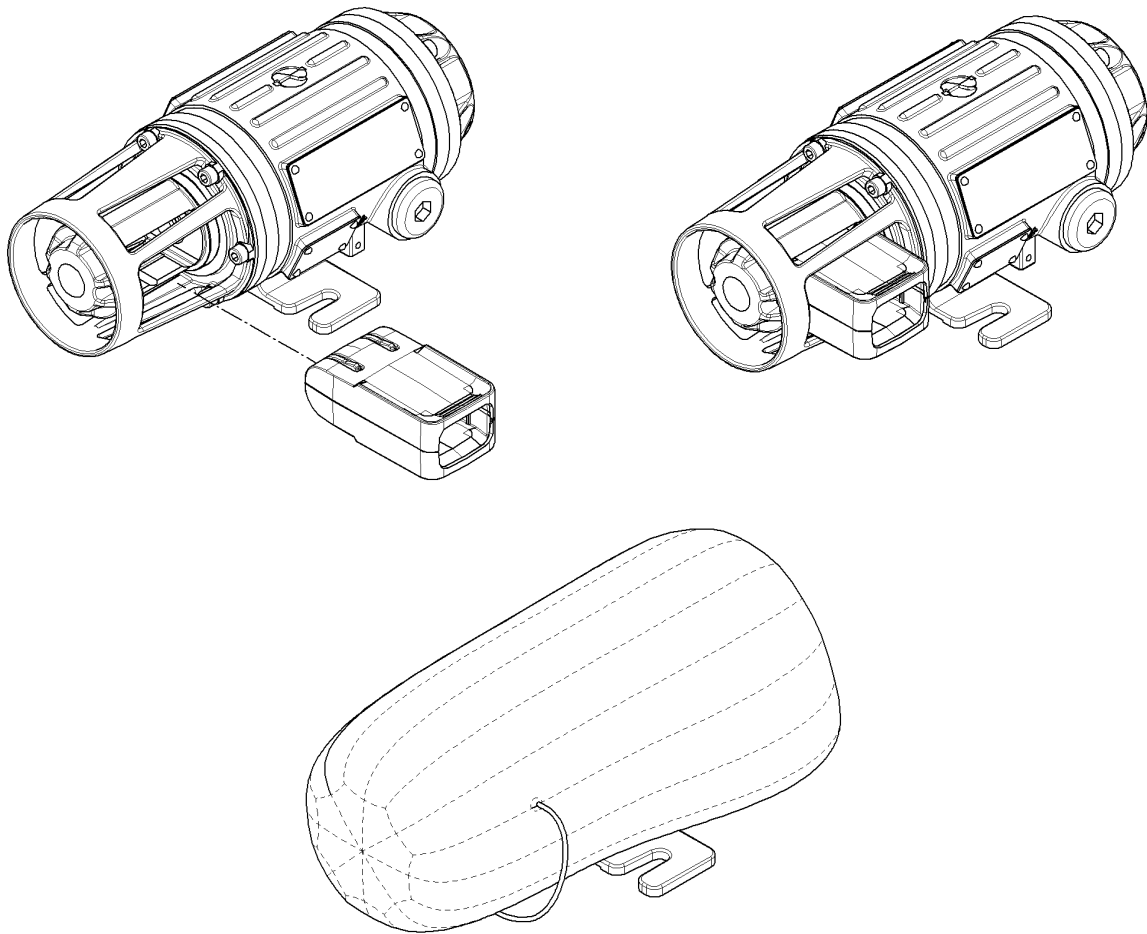
6.4.1 Downloading Self diagnostics datalog

1. Connect PC with Service software to modbus on terminals 4 and 5.
2. Start Service SW.
3. Follow instructions for Service SW to download diagnostics file from the Detector.
4. Store the Diagnostics file in a suitable place. The Diagnostics file can be sent to the vendor for analysis.

6.5 The Blocking kit - Protection during site Maintenance

Site Maintenance such as sand blasting and painting might damage the detector. To protect the Detector during such work it is recommended to use the *Blocking kit* accessory. The *Blocking kit* will fit into the Detector as illustrated below, protecting both the Optics and Detector from pain, sandblasting and dirt. The Blocking kit will fit into the nose section and will block the Optics forcing the detector into sending a Fault signal so the Detector is not forgotten being covered with the Blocking kit.

Shown in the third image below is the protection bag that will fit over the housing. This protection bag is packed inside the Blocking kit.



7 Signal outputs

7.1 Detector status flags

In the table below are the status flags for the PGxx11. Not all status flags below will have any impact on the 0-20 mA Safety output. All statuses will be available through HART or the independent MODBUS digital output:

- All FAULT status flags will lead to the 0-20 mA output going into FAULT mode.
- WARNING statuses means that the detector is still inside specification, but the user or vendor might be interested in this information. Most WARNING flags are optional if they should have any impact on the 0-20 mA output. For example EARLY CLEAN OPTICS is very useful for planning Maintenance.
- SERVICE flags means the detector is in service mode and might not measure gas.

Status flag	Descriptive tag	Explanation/situation
FAULT	NO CALIBRATION	Should be the status before the detector has been through Manufacturing. Should not happen in the field. Please send the detector back to the vendor for examination.
FAULT	DIRTY OR BLOCKED OPTICS	Transmission less than 70%. Detector cannot measure gas, probably due to dirt or something else blocking the optics. Perform service by removing weather protection and cleaning optics. Weather protection should be inspected to verify containing no objects blocking the optical path.
FAULT	ANALOG SAFETY OUTPUT	The 4-20 mA analogue Safety port of the detector is outside specification. This might be due to calibration of analogue channel is wrong and might need correction. This can only be done by the vendor.
FAULT	Vendor issue [#err]	Please contact vendor and supply the #err code.
WARNING	EARLY CLEAN OPTICS	Transmission less than 55%. Probably due to dirt on optics. Detector still works fine and detects gas within accuracy, but it should be planned to clean the lens and mirror.
WARNING	EARLY ISSUE INDICATION	There is detected noise in internal signals higher than expected that might indicate that there might be an issue later
WARNING	TOO HIGH TEMPERATURE	Temperature detected to be above the certified temperature range of the gas detector. Detector is measuring gas, but cannot guarantee accuracy and risk of the detector going into fault. Keeping the detector at too high temperature can reduce the life-time of the detector.
WARNING	TOO LOW TEMPERATURE	Temperature detected to be below certified temperature range of the gas detector. Detector is measuring gas, but

		cannot guarantee accuracy and risk of the detector going into fault.
WARNING	INDICATOR	Indicator has issues and might not work. Detector is measuring gas fine.
WARNING	ANALOG SAFETY OUTPUT	The 0-20 mA analogue Safety port of the detector is slightly outside specification. This might be due to calibration of analogue channel is wrong and might need correction. Only zero value can be recalibrated by the operator.
WARNING	Minor issue [#warn]	Please contact vendor and supply the #warn code. Detector is still measuring gas inside specification, but the vendor should be informed to verify status.
SERVICE	SERVICE MODE	Detector is in service mode and does not detect gas. This is due to the detector being set to service mode for example during testing, change of settings, loop testing or other services manually started.
SERVICE	BOOT	Detector is booting up.
SERVICE	WARM UP	Arctic detector is warming up electronics at extreme temperatures before booting up the rest of the electronics.

7.2 Light indicator

The PG11 has a built in multicolor light indicator with the following settings:

Status type	Indicator	Description and typical applications
Normal Operation	GREEN	Detector is Measuring gas and no issues detected.
Maintenance Request	GREEN BLINKING	Optics is getting dirty and it is recommended to clean it soon. Detector is still detecting gas inside specification.
Out of Specification	GREEN BLINKING	Signalled if temperature is above or below rating of this Detector. Detector will measure gas, but the accuracy of the Gas Detection might be outside specification.
Function Check	YELLOW	Activated if the Operator has set the detector into Service mode.
Failure	YELLOW BLINKING	No gas detection due to one of the following: <ul style="list-style-type: none"> • Detector is booting up • Beam Block • Faulty detector
Alarm 1	RED	Gas concentration is above the first alarm set point. Default setting: 20% FS - non-latching.
Alarm 2	RED BLINKING	Gas concentration is above the highest gas alarm set point. Default setting: 20% FS - non-latching.

7.3 Analog Safety output

All analogue output values in the table below have a ± 0.25 mA range applied, and are in accordance with recommendations by NAMUR NE043 (2003) and NE107 (2017).

Table 4. Description of the Detector analog output.

Status type	Output Priority*	Default output setting	Configurable values**	Comment
Over range	4***	20 mA	20 or 21 mA	Signalled if gas concentration is measured above the configured range. Default the detector is to signal 100 %FS (20 mA) and not over range since high concentrations of gas do not have a negative effect on the detector.
Normal Operation	3***	4 - 20 mA	Not configurable	The current loop output is configured such that 4 mA represents 0%FS and 20 mA represents 100% FS.
Maintenance Request	5	3 mA	1 - 3.5	Output if optics is getting dirty and it is recommended to clean it soon. Detector is still detecting gas inside specification. ***Will output gas value if detection above 7 %FS.
Out of Specification	6	3 mA		Signalled if temperature is above or below rating of this Detector. Detector will measure gas, but the accuracy of the Gas Detection might be outside specification. ***Will output gas value if detection above 7 %FS.
Function Check	2	2 mA		This value is activated if the Operator has set the detector into Service mode. For example if a loop test is performed by the Operator.
Failure	1	1 mA		No gas detection due to one of the following: <ul style="list-style-type: none"> • Detector is booting up • Beam Block • Faulty detector. Please consult chapter "10 Troubleshooting".
< 0.5 mA	Power supply fault or not booted up. No gas detection and no HART communication.			

*A lower number will be prioritized first.

**Configurable through HART or Modbus RTU.

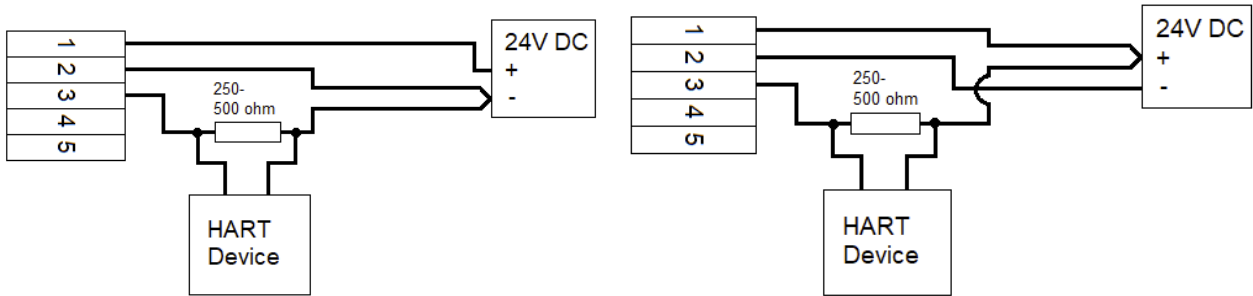
7.4 HART®

PG11 has a HART digital protocol superimposed on the current loop output. The HART® commands are described in the document [PGxx11 HART interface instruction](#).

7.4.1 HART® electrical connection

A HART Master requires a minimum loop resistance of 250ohm for communication.

PG11 connection scheme for HART on source config (left) and sink config (right)



8 Warranty

- 6 (six) years warranty for manufacturing defects
- 15 (fifteen) years warranty for IR source

PG11 warrants for normal use within gas detection, in accordance with the technical manual.

Contact your supplier for further instructions on warranty and claims procedures.

- ! Every detector has a red warranty sealing to avoid tampering.
- The removal of the warranty sealing is considered an automatic warranty void.

9 Certifications and standards

9.1 Directives and standards

PG11 has been tested and certified according to requirements in the following directives:

- ATEX Directive 2014/34/EU
- EMC Directive 2014/30/EU
- MED Directive 2014/90/EU

9.2 Approvals and Certificates

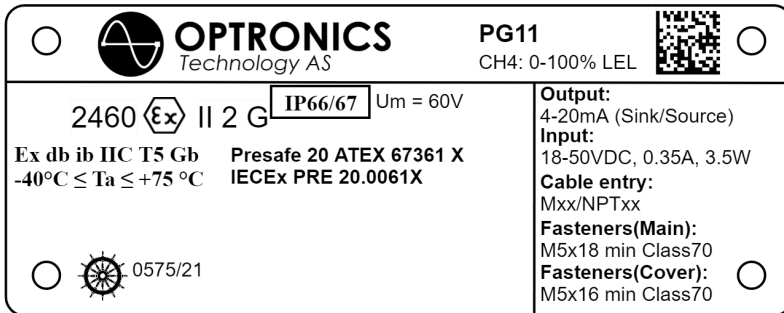
PG11 has the following approvals/certificates:

- Presafe 20 ATEX 67361 X
- IECEx PRE 20.0061X
- MEDB00006D2

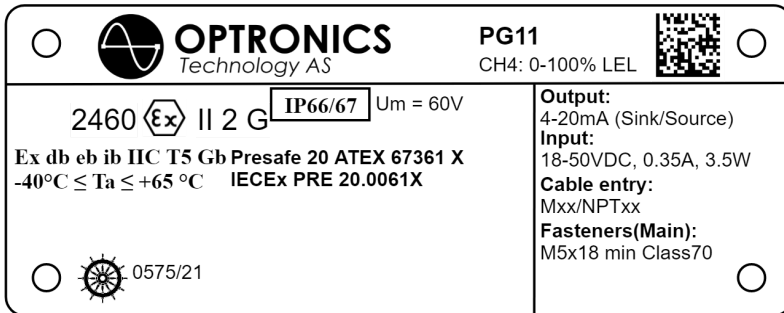
9.3 Marking

9.3.1 Certification

9.3.1.1 Ex db ib IIC T5 Gb



Ex db eb ib IIC T5 Gb



9.3.2 Vendor information



9.3.3 Serial number and year of manufacturing



9.4 Specific conditions of use

- Flameproof joints are not intended to be repaired.
- The user must always ensure that the measuring function complies with the requirements from the relevant harmonized standards which provide guidance on the performance of Gas detection equipment and Safety devices.
- The equipment shall be connected to a power supply with an output of maximum 50 VDC complying with:
 - a SELV or PELV system, or
 - via a safety isolating transformer complying with the requirements of IEC 61558-2-6, or technically equivalent standard, or
 - directly connected to apparatus complying with the IEC 60950 series, IEC 61010-1, or a technically equivalent standard, or
 - fed directly from cells or batteries.

10 Troubleshooting

Do not return the Gas detector to the supplier for repair if the procedure below has not been performed. Below is the Fault finder diagram. Before performing the Fault finder it is recommended to check the Detector Error code by connecting with HART or MODBUS interfaces and look up the recommended fix in *table 5*.

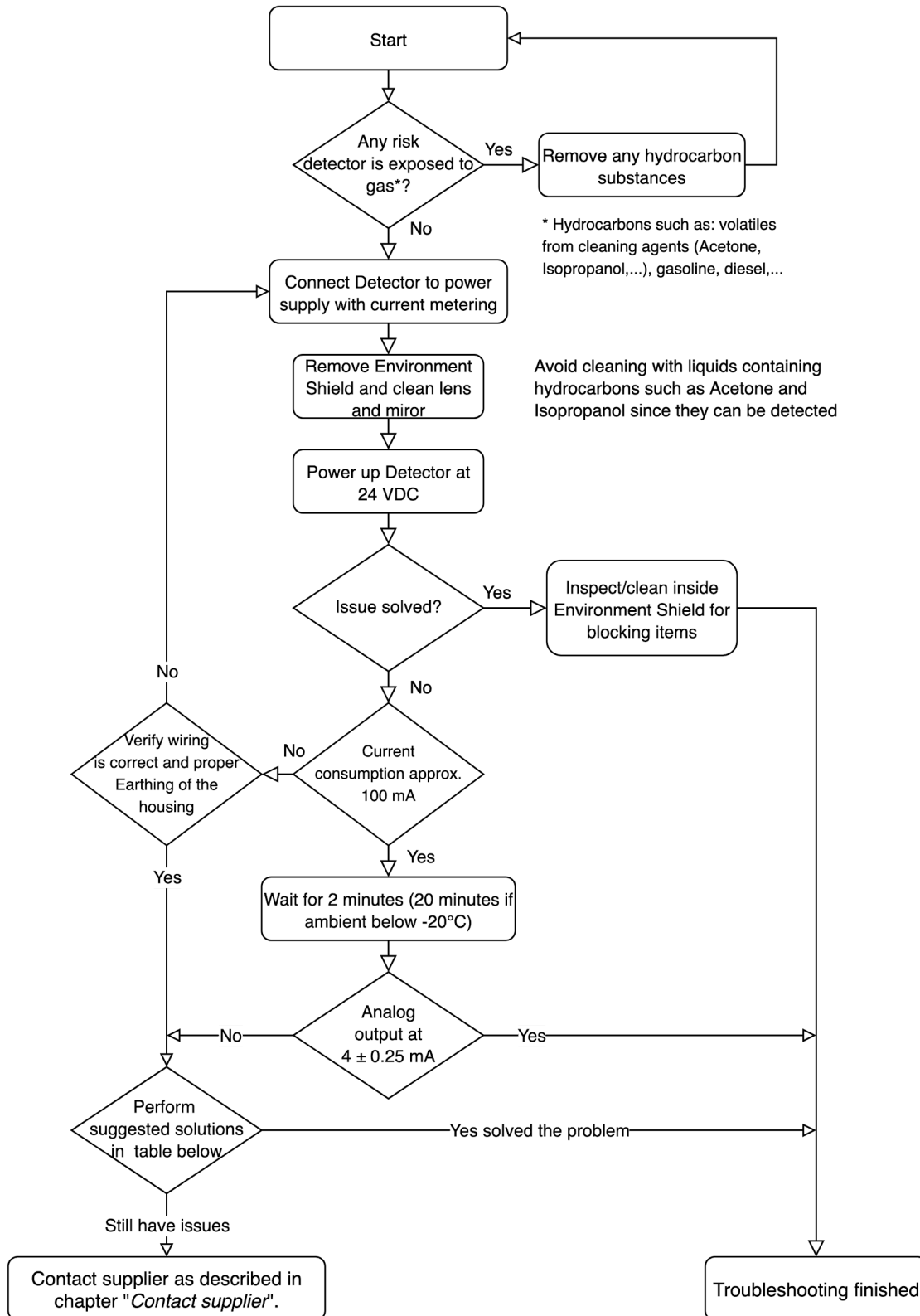


Table 5. Overview of possible issues and suggestions for solutions. Error codes can be found through the HART or MODBUS interfaces. Please consult the corresponding chapter for instructions.

Issue type	Issue description	Suggested cause/solution
Signal	Unstable detector reading	Verify that the detector has sufficient local Earthing.
Gas reading during test	Too low gas reading when exposed to test gas	<ul style="list-style-type: none"> • Weather conditions not taken into consideration (wind and ambient pressure has impact) • Too low flow of test gas • Too short test time to let test gas reach detector and fill test area
Fault reading in control room	Detector passed troubleshooting	
Frequent service	Frequent cleaning of optics required	Check that the detector has been mounted in correct orientation as stated in the Manual. If it is mounted vertically, dust and water will accumulate on the optics.

11 Accessories and Spare Parts

Below is an overview of accessories and spare parts for the PG11. Use the ordering number to refer to these parts when in contact with the Supplier.

Ordering number	Part	Description
ACC-ENV-STD	Environment Shield	To prevent water and other liquids from spraying directly onto the optics
ACC-ENV-MOSQ	Mosquito net	Mesh fitted over the measuring section of the detector to keep insects from blocking the Optics.
ACC-GT-BAS-KIT	Gas Test kit	To perform a quick gas test of the Safety Function of the PG11 detector. Small container with gas connection that is fitted on the outside of the detector nose, and removed after the "Bump test" is finished.
ACC-GT-E15-KIT	PGE11 Short Gas Test kit	To perform a quick gas test of the Safety Function of the PGE11 15 cm detector. Small container with gas connection that is fitted on the outside of the detector nose, and removed after the "Bump test" is finished.
ACC-GT-E35-KIT	PGE11 Medium Gas Test kit	To perform a quick gas test of the Safety Function of the PGE11 35 cm detector. Small container with gas connection that is fitted on the outside of the detector nose, and removed after the "Bump test" is finished.
ACC-GT-REM-KIT	Remote Gas Test kit	For gas testing of detectors mounted high up or another not easily reachable location. Kit consists of a Gas nozzle on the nose of the detector and a "Gas test box" to be mounted at a suitable location. When performing Gas test the Operator connects the test Gas cylinder to the "Gas test box", and gas will pass from the box in a gas pipe to the Gas nozzle and into the detector.
ACC-GT-GF-KIT*	Gas Free Test kit	Kit to perform Gas testing without needing to use real gas. Test of Safety function / Bump testing is done by swapping the Environment Shield with the "Gas Test kit Gas Free". *Available in different variants.
ACC-GT-NOZ-KIT	Gas nozzle	Small accessory that is fixed to the front of the Gas Detector. Used as a temporary or permanent set-up to allow for gas to be injected straight into the sensor section of the Detector.
ACC-GS-KIT	Gas Sampling kit	A flow cell attachment for incorporation with Gas Sampling systems. Designed with minimum volume to optimize for short response time. The <i>Gas Sampling Kit</i> is also used to perform a precise calibration check.
ACC-CLEAN-KIT	Cleaning kit	For easier cleaning of the optics.
ACC-DF-KIT	Duct Flange kit	To mount the detector through wall type of applications, typically a ventilation shaft.

ACC-MB-KIT	Maintenance Blocking kit	Kit to block the gas detector and prevent damage during for example sandblasting or paint work. The kit will be very visible showing that the detector is blocked. The kit can be set to force the detector into FAULT as long as the kit is bocking.
ACC-MNT-UNI-KIT	Mount kit Universal	Enables detectors to be mounted in already existing mounting screws. Simplifying replacing other products.
ACC-MNT-POLE-KIT	Mount kit Pole	Bracket and U-bolts to mount the detector to a pole.
ACC-SHADE-KIT	Sunshade kit	To protect the detector from direct sunlight in warm climates, and to shield from snow building up. For horizontal installation
	OptoCom modules	Several types to be launched from 2022.

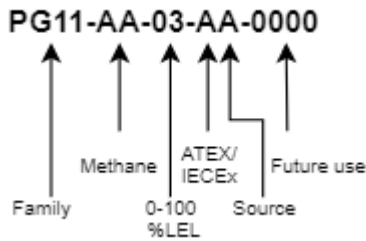
12 Product coding and Ordering information

Commercial codes for products are made by various main elements that each are separated with a hyphen in the following way:

1. Product family, alphanumeric text string with variable length (e.g. "PG11")
2. Gas type, two letters (each combination represents one unique, several different or one unique with immunity to one or several)
3. Scale, two digits
4. Certification, one letter
Connection variant, one letter
5. Variant, four digits for future use

Model	Configuration			
PG11	**	**	**	****
PGE11	**	**	**	****
	AA	Methane		
	AB	Propane		
	BA	CO2		
	nn	Other		
	03	100 %LEL		
	29	100 %Vol		
	31	1 ppm		
	nn	Other		
	A*	ATEX/IECEX		
	B*	FM		
	*A	Source		
	*B	Sink		
	nn	Other		
		0000	Default	
	nnnn	Other		

Example:



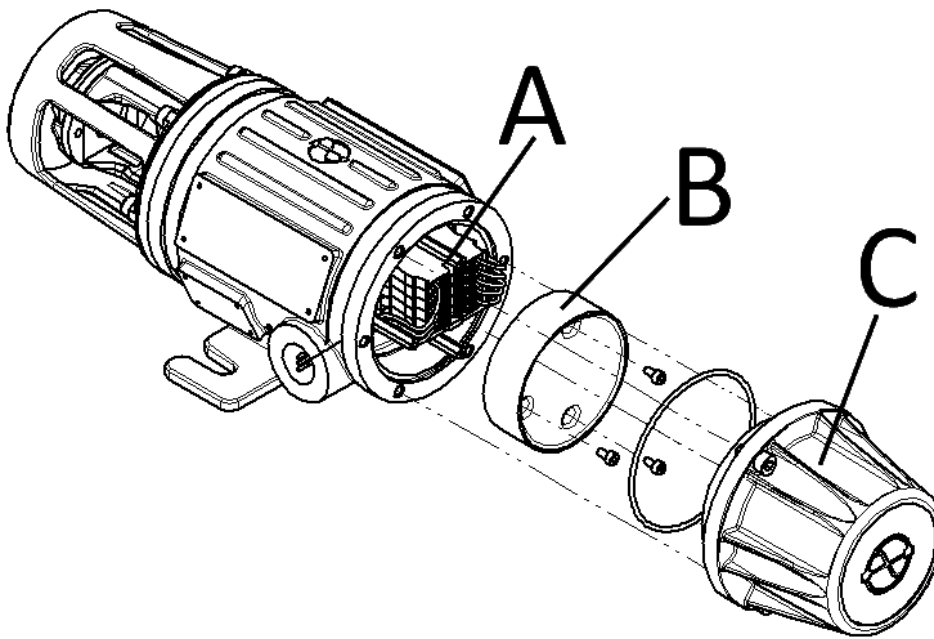
Typical variants are given in the table below.

Ordering number	Description
PG11-AA-03-AA-0000	PG11, Methane, 0-100 %LEL, ATEX/IECEX, Source
PG11-AA-29-AA-0000	PG11, Methane, 0-100 %Vol, ATEX/IECEX, Source
PG11-AB-03-AA-0000	PG11, Propane, 0-100 %LEL, ATEX/IECEX, Source
PG11-AW-03-AA-0000	PG11, Ethylene, 0-100 %LEL, ATEX/IECEX, Source
PG11-BA-21-AA-0000	PG11, Carbon Dioxide, 0-1 %Vol, ATEX/IECEX, Source
PG11-BA-25-AA-0000	PG11, Carbon Dioxide, 0-10 %Vol, ATEX/IECEX, Source
PG11-BA-27-AA-0000	PG11, Carbon Dioxide, 0-25 %Vol, ATEX/IECEX, Source
PG11-BD-29-AA-0000	PG11, Biogas, 0-100 %Vol, ATEX/IECEX, Source
PG11-AE-03-AA-0000	PG11, n-Butane, 0-100 %LEL, ATEX/IECEX, Source

13 The OptoCom™ module

PG11 is designed so it can be upgraded with additional functionality such as wired and wireless digital communications, relays, display and other future options. Such expansion modules are called OptoCom™ modules and can be installed without having to do any changes in existing wiring. Please consult with the Supplier for an overview of OptoCom™ modules and launch schedule. In the below illustration

To install an OptoCom™ module the rear lid of PG11 is removed. In the illustration below the OptoCom™ module **B** is slotted into terminal **A**. The original lid is replaced by the OptoCom™ lid **C**.



14 Abbreviations

ATEX	Atmosphere Explosives
EC	Electrochemical detection technology.
EMC	Electromagnetic Compatibility
FS	Full Scale. Full gas range for the detector, for example 0 - 100 %LEL or 0 - 100 %vol.
HART	Highway Addressable Remote Transducer communication protocol
IR	Infrared light.
IECEX	International Electrotechnical Commission Explosion
LEL	Lower Explosive Limit
MODBUS	Master-slave messaging structure
SIL	Safety Integrity Level. This is used in accordance with the standard IEC 61508.
vol	Volume. Normal used as %vol for volume fraction.
1oo1	"One out of one". Used in a SIL context, where only one detector is used to decide if the detection of gas is valid.
1oo2	"One out of two". Used in a SIL context. Two detectors are set up in a voting configuration where if any of the two or just one detector are detecting gas, the system will treat it as a Gas incident.

15 Safety Manual

This is a separate document:

[022-80043-SM PGxx11 Safety Manual](#)

16 Support and Contact details



If there are any issues with the detector, please check the *Troubleshooting* chapter. Do not return the Gas detector to the Supplier for repair if it has not been troubleshooted according to the procedure in the troubleshooting chapter.

- Contact your supplier/dealer to consult for troubleshooting in case the issue can be solved without returning the product.
- Detector shall be packaged in a secure manner, preferably in the same box as it was received in.
- Description of the issue shall be included in the package.