



Xenon 700 SIL

Open-Path Gas Detection System

User's and Maintenance Manual



ATEX, IECEx Approved

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Warning: This manual should be carefully read by all individuals who have or will have responsibility for using, maintaining or servicing the product.

The Source and Detector are not field-repairable due to the meticulous alignment and calibration of the sensors and the respective circuits. Do not attempt to modify or repair the internal circuits or change their settings, as this will impair the system's performance and void the Spectrex, Inc. Product warranty.

Release History

Rev	Date	Revision History	Prepared by	Approved by
A	June 2011	First Release	Ian Buchanan	Eric Zinn
B	August 2013	Second Release	Ian Buchanan	Eric Zinn
C	January 2014	Third Release	Ian Buchanan	Eric Zinn

About this Guide

This guide describes the SafEye™ Xenon 700S SIL Gas Detection System and its features and provides instructions on how to install, operate and maintain the detector.

This guide includes the following chapters and appendixes:

- **Chapter 1, Scope**, provides a general introduction and overview of the product and the guide, with a brief description of its content.
- **Chapter 2, Technical Description**, describes the Detector's theory of operation.
- **Chapter 3, Operation Mode**, describes the Detector's operation modes, user interface and indications.
- **Chapter 4, Technical Specifications**, describes the Detector's electrical, mechanical and environmental specifications.
- **Chapter 5, Installation Instructions**, describes how to install the Detector, including wiring and mode settings.
- **Chapter 6, Operating Instructions**, describes the operating instructions and power-up procedures.
- **Chapter 7, Maintenance Instructions**, contains the maintenance and support procedures.
- **Chapter 8, Troubleshooting**, describes the solutions to problems that may arise with the Detector.
- **Appendix A, Wiring Selection Tables**, describes the electrical wire selection according to the installation configuration.
- **Appendix B, Wiring Option Configurations**, provides wiring diagrams for installation.
- **Appendix C, Special Condition to Comply to SIL-2 Requirements**, describes the special conditions in order to comply with SIL-2 requirements.

Abbreviations and Acronyms

Abbreviation	Meaning
ATEX	Atmosphere Explosives
AWG	American Wire Gauge
BIT	Built In Test
EMC	Electromagnetic Compatibility
EOL	End of Line
FOV	Field of View
HART	Highway Addressable Remote Transducer-communication protocol
IAD	Immune at Any Distance
IECEX	International Electrotechnical Commission Explosion
IPA	Isopropyl Alcohol
IR	Infrared
JP5	Jet Fuel
Latching	Refers to relays remaining in the ON state even after the ON condition has been removed
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
mA	MilliAmps (0.001 amps)
MODBUS	Master-slave messaging structure
N.C.	Normally Closed
N.O.	Normally Open
N/A	Not Applicable
NFPA	National Fire Protection Association
NPT	National Pipe Thread
SIL	Safety Integrity Level
UNC	Unified Coarse Thread
VAC	Volts Alternating Current

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1 Scope

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Product Overview

page 1

1.1 Product Overview

The SafEye 'Xenon' IR Open-Path Gas Detector 700S employs an advanced Xenon Flash Source and integrated electronics package, both housed in improved, low-profile stainless steel housings to provide high quality and performance, fast response, line of sight gas monitoring. This high quality is backed by 3 years warranty for the complete SafEye system and 10 years for the Xenon Flash source bulb.

SafEye 'Xenon' detects ambient combustible gases over a path length of up to 459 ft. (140 m), even in harsh environments where dust, fog, rain, snow or vibration can cause a high reduction of signal. Due to its unique combination of triple optics, dual-spectrum reference sensor, and heated optics, the SafEye Xenon can maintain operation in up to 90% signal obscuration and ± 1 degree of misalignment.

SafEye Xenon is manufactured only in stainless steel with heated optical window to improve performance in icing, snow, and condensation conditions. The programmable functions are available through a RS-485 port used with Host software supplied by Spectrex and a standard PC or an I.S handheld unit.

The SafEye Source and Detector unit enclosures are ATEX and IECEx certified Exd flameproof with an integral segregated rear, Exe terminal compartment (which avoids exposure of the sensors and electronics to surrounding environment), and an internal Exia intrinsically safe circuit power for the heating of the window. The Detector also has a plug interface for connection to handheld PC, which is intrinsically safe. Hence the combined approval - Ex d e ia [ia Ga] IIC T5 Gb Ta.

This manual consists of a full description of the Detector and its features. It contains instructions on the installation, operation and maintenance.

- To use the Host software with the harness USB RS-485 converter change the required functions and for maintenance, refer to Manual TM 899050 for instructions
- To use the I.S Handheld Unit to change the required functions and for maintenance, refer to Manual TM 799060 for instructions.
- To use the non I.S Mini laptop Unit, refer to Manual TM777070 for instructions.
- To use HART Protocol to change the required functions and for maintenance refer to Manual TM 899030.

2 Technical Description

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2.1 Features

- Long Range Gas Detection up to 459ft (140m)
- Simultaneous detection of C1-C8 flammable gases
- High Sensitivity and fast response to Hydrocarbon gases
- Heated optics to improve performance in icing, condensation and snow conditions
- Continuous operation in extreme and harsh environmental
- Conditions
- Solar blind and immune to industrial environments
- Withstands extreme vibration conditions
- Interfaces with most commonly used control panels
- Standard 0-20 mA and Dry Contact Relays Outputs
- HART Protocol: Communication Protocol (see HART Protocol, p. 6)
- RS-485 Output Modbus compatible for PC Communication Network for a maximum of 247 systems
- Simple one person installation, alignment, and calibration
- ATEX & IECEx approved per Ex II 2(1) G, Ex d e ia [ia Ga] IIC T5 Gb Ta
- SIL-2 Approved by TUV per SIL-2 Requirement
- Programmable configuration via the handheld unit
- Fast connection to I.S. approved handheld diagnostic/calibration unit
- New operation **mode (3mA) "maintenance call"**
- Warranty 3 years for the complete SafEye system
- Warranty 10 years for Xenon Flash bulb

2.2 Applications

The SafEye Xenon system may be used to monitor flammable gas concentration in various applications, such as:

- Petrochemical, pharmaceutical and other chemical storage and production areas
- Flammable and toxic chemical storage sites and hazardous waste disposal areas
- Refineries, oil platforms, pipelines, refueling stations and fuel storage facilities
- Hazardous loading docks, transportation depots and shipping warehouses
- Engine rooms
- Compressor and pumping stations
- Test cells
- LNG-LPG Systems
- Offshore Floating Production Storage and Shipping vessels (FPSO), and fixed oil rigs

2.3 Principle of Operation

The SafEye system detects gases through a dual spectral range monitoring, analyzing the absorption of radiation caused by gases in the atmosphere and comparing it (ratio) to background atmospheric absorption.

2.3.1 Definitions of Terms

Table 1 defines gas concentrations measurement terms that are used in this manual.

Table 1: Gas Concentrations Measurement Terms

Term	Description
LEL	Lower Explosive Limit: The minimum concentration of a substance (gas/vapor) in air mixture that can be ignited. This mixture is different for every gas/vapor, measured in % of LEL.
LEL.m	Integral of Concentration in LEL units (1 LEL = 100% LEL) and the operation distance in meters (m).

2.3.2 Spectral Finger Print

Each hazardous material is detected at a specific wavelength selected according to its specific spectral absorption or "finger print". There are three IR sensors: two signals and one reference. The detection process involves two separate filters, one transmitting radiation that is absorbed by a particular gas and one that is not sensitive to it.

2.3.3 Optical Path

The presence of hazardous airborne vapors, gases, or aerosols in a monitored area is detected when the defined substance crosses/enters the optical path between the radiation source unit and the detector.

Hazardous gases /vapors present in the atmosphere cause absorption of the radiation pulse in the optical path between the radiating source and the detector unit at some specific wavelengths. This causes a change in the signal intensity received by the detector, which is translated into an output **related to the detector's measuring scale.**

The system analyzes the defined open path at the spectral bands specific to the materials being monitored. The Automatic Gain Control (AGC) unit compensates for environmental disturbances such as fog, rain, etc., through a constant comparison with its dual spectral beam.

2.3.4 Microprocessor Based

The incoming signals are analyzed by the built in microprocessor. A sophisticated mathematical algorithm calculates between the various functions of the detected signal thresholds. Statistics, ratio algorithms, data communications, diagnostics and other functions are performed.

2.3.5 Gas Sensitivity

The SafEye IR Model uses wavelengths around 3.4 μ spectral band to measure air flammability potential between the source and detector. At this wavelength, all hydrocarbon materials have a strong absorption peak. This peak enables the detector to achieve both regular sensitivity of 0-5 LEL.m or high sensitivity of 0-2 LEL.m according to functions set up. However, since the desired detection information is air flammability and the actual measurement is radiation absorption around the 3.4 μ spectral band, the detector has a different sensitivity to different gases or gas combinations.

This difference in sensitivity is irrelevant if in the protected area the gas composition is known. However, if in a protected area the gas composition can vary substantially, then the difference in sensitivity should be considered in determining the Detector calibration.

2.3.6 Gas and Mixture Selection and Setting

At the 3.4 μ spectral band of the SafEye, the least sensitive gas is pure (100% vol) methane and the most sensitive gases are various mixtures of Methane with heavier alkanes where the Methane percentage is less than 90%. For pure Ethane the sensitivity is close to the high sensitivity gases and for pure Propane it lies somewhere between the two extremes. Every SafEye has 4 built-in gas calibration settings that can be changed by function set up. The setting for each SafEye is detailed on the calibration datasheet provided with each unit.

The calibration settings are designed for use in various applications. Models 701, 702, 703 are calibrated to 4 different gases as follows:

Table 2: Gas Calibrations

Gas Type	Description
Gas 1	Pure methane and is for use in methane storage and piping applications
Gas 2	92% methane, 4% propane and 4% ethane (default) Universal oil and gas production mixture to be used in all cases where methane concentration in the mixture does not exceed 98%. It can also be used for pure Ethane applications.
Gas 3	LPG - 60% Propane and 40% Butane.
Gas 4	99% methane and 1% propane and is for use in detecting methane mixture with heavier gases where the methane component can vary between 100% to 95%. It is also good for protecting areas where a leak can be either pure methane or pure propane.

Model 721, 722, 723 are calibrated to one gas only Gas 1 – Ethylene 100%.

The four internal gas calibrations cover most of the flammable gas detection applications. Actual selections should be made by the user in consultation with experts to provide for safety requirements. However, for special cases where none of the four calibrations are appropriate, Spectrex, through local agents can advise how to calibrate a SafEye Detector to any specific gas.

2.3.7 Flash Source

The Xenon Flash Source was originally introduced in the first SafEye development and was designed to overcome false alarms, which were experienced by early generations of the open path system. The new SafEye Xenon 700S employs the latest generation of flash bulbs to provide even more power and extended operation life (10 years).

2.3.8 Heated Optics

SafEye Xenon includes heated optics for the Detector and source. The heater increases the temperature of the optical surface by 5-8°F (3-5°C) above the ambient temperature to improve performance in icing, condensation and snow conditions. The heated optics is configured to automatically operate when the change in temperature requires the heating (default).

However, the heated optics can be defined as one of the following modes:

- 1** Not operated (not an option on source unit)
- 2** On continuously
- 3** Automatic, per temperature change (default)

See System Set Up, on page 18.

When operated '**per temperature change**', the user can define the start temperature below which the window will be heated (default 41°F (5°C)). This temperature can be defined between 32°F (0°C) to 122°F (50°C). The heating will stop when the temperature is 27°F (15°C) above the start temperature.

2.3.9 HART Protocol

The Xenon 700S uses the HART Protocol.

HART Communication is a bi-directional industrial field communication protocol used to communicate between intelligent field instruments and host systems. HART is the global standard for smart instrumentation and the majority of smart field devices installed in plants worldwide are HART-enabled.

HART technology is easy to use and very reliable.

Through the HART connection, the SafEye is able to perform:

- Detector set-up
- Detector troubleshooting
- Detector health and status

For more details, refer to the HART Manual TM 899030.

2.3.10 Handheld Unit

The new I.S.-approved handheld diagnostics unit (Part no. 799810) is available to make installation and maintenance easier. This is an all-on-one diagnostic / calibration / interrogation plug-in unit that allows for one-person installation and maintenance.

The handheld unit can be used:

- For on-site function programming and set up changes to the Detector.
- During installation, the handheld unit **will display all the detector's** parameters and confirm that the installation has been completed successfully. It is also required to perform the necessary Zero calibration function.
- For Maintenance and Trouble Shooting – The handheld unit will provide recommendation of maintenance action to overcome and optimize the **Detector's performance.**

For more details, refer to Manual TM 799060.

2.3.11 Modbus RS-485

For more advanced communications, the SafEye Xenon has a RS-485 Modbus-compatible output that provides data communication from a network (up to 247 Detectors) to a host computer or universal controller for central monitoring. This feature enables easy maintenance, local and remote diagnostic tools.

2.3.12 Tilt Mount

The new design stainless steel tilt mount provides a smaller installation footprint that can conform to limited space constraints, while the sturdy construction maintains alignment even in constant vibration. The improved 'X' and 'Y' axis worm-gear adjustments provide quick and easy alignment for installation and maintenance procedures.

2.4 Product Marking

The Xenon 700S open path gas Detector and source unit are certified to:

- ATEX Ex II 2(1) G per SIRA 03ATEX1406X
Ex d e ia [ia Ga] IIC T5 Gb Ta = -40°C to +55°C
- IECEx per IECEx SIR 10.0003X
Ex d e ia [ia Ga] IIC T5 Gb Ta = -40°C to +55°C

This product is suitable to use in hazardous zones 1 and 2 with IIC gas group vapors present.

2.5 Models and Types

Series 700S offers 2 families of detected gases:

- Models 701S, 702S and 703S used for methane, LPG and gases mixture for most offshore and onshore applications.
- Models 721S, 722S and 723S used for ethylene only.

Table 3 describes the installation distances for each of the Series 700S models.

Table 3: Model Numbers and Installation Distances

Model No.	Detector	Source	Min. Installation Distance	Max. Installation Distance
701S	XDSS-C-111XX	XSS-C-11X	13 ft. (4 m)	65 ft. (20 m)
702S	XDSS-C-112XX	XSS-C-11X	50 ft. (15 m)	230 ft. (70 m)
703S	XDSS-C-113XX	XSS-C-12X	165 ft. (50 m)	459 ft. (140m)
721S	XDSS-C-121XX	XSS-C-11X	13 ft. (4 m)	65 ft. (20 m)
722S	XDSS-C-122XX	XSS-C-11X	50 ft. (15 m)	230 ft. (70 m)
723S	XDSS-C-123XX	XSS-C-12X	165 ft. (50 m)	459 ft. (140m)

The 700S Series has 3 wiring options:

- **Option 1:** Power, Alarm Relay, Fault Relays, 0-20mA
- **Option 2:** Power, Alarm Relays, Fault Relays, Accessory Relay
- **Option 3:** Power, Alarm Relay, RS-485, 0-20mA, RS-485 RTN (default)

Note: SIL2 covers only 0-20mA outputs.

The wiring option must be set at the factory; cannot be changed at customer facility.

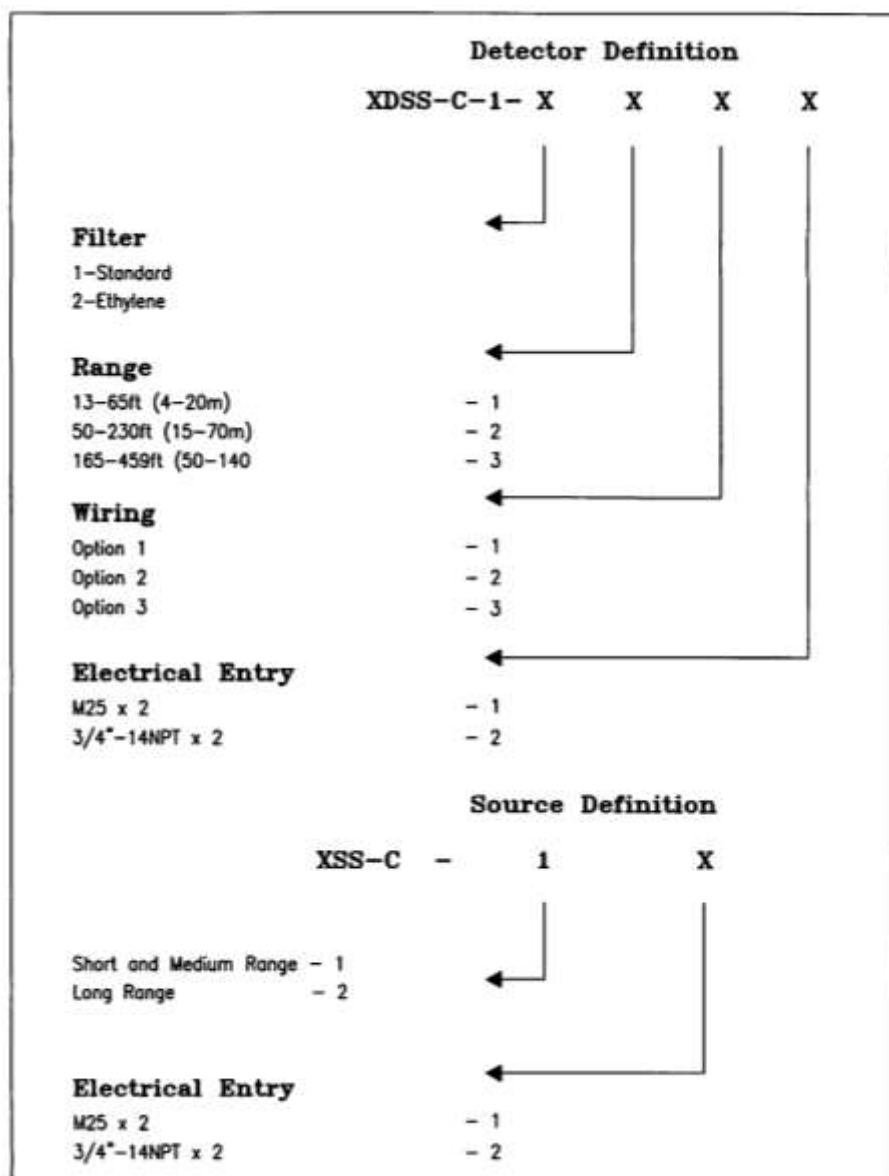


Figure 1: Wiring Options

2.6 Description

The SafEye is comprised of two main units:

- Flash Source Unit, page 11
- Detector Unit, page 12

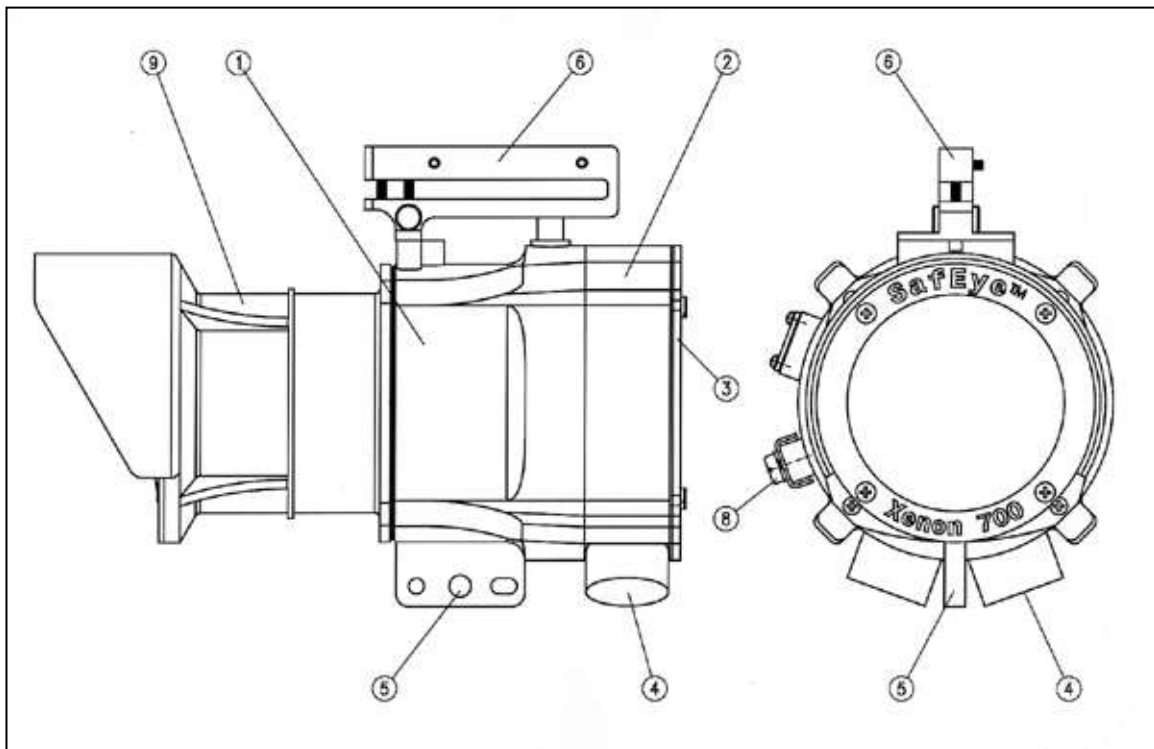
Xenon 700S detects gases over an open path transmitted from the Flash Source to the Detector.

2.6.1 Flash Source Unit

The Flash Source unit emits IR radiation pulses at the rate of two pulses per second. The pulse width (5-10msec) is very powerful. The front of the source SafEye has a coated lens that collimates the IR beam for maximum intensity. The coated lens blocks all the UV and visible lights from passing through the lens and prevents the flash pulse being visible to the eye. The lens is heated to improve performance in icing, condensation and snow conditions.

There are two source types:

- **Short and Medium Range:** For use in models 701S, 702S, 721S, and 722S
- **Long Range:** For use in models 703S and 723S



1	Main Housing	6	Telescope Site
2	Junction Box	7	N/A
3	Back Cover	8	Earth Terminal
4	Cable Inlet	9	Front Window/Lens Section
5	Holding Plate		

Figure 2: Flash Source Unit

2.6.2 Detector Unit

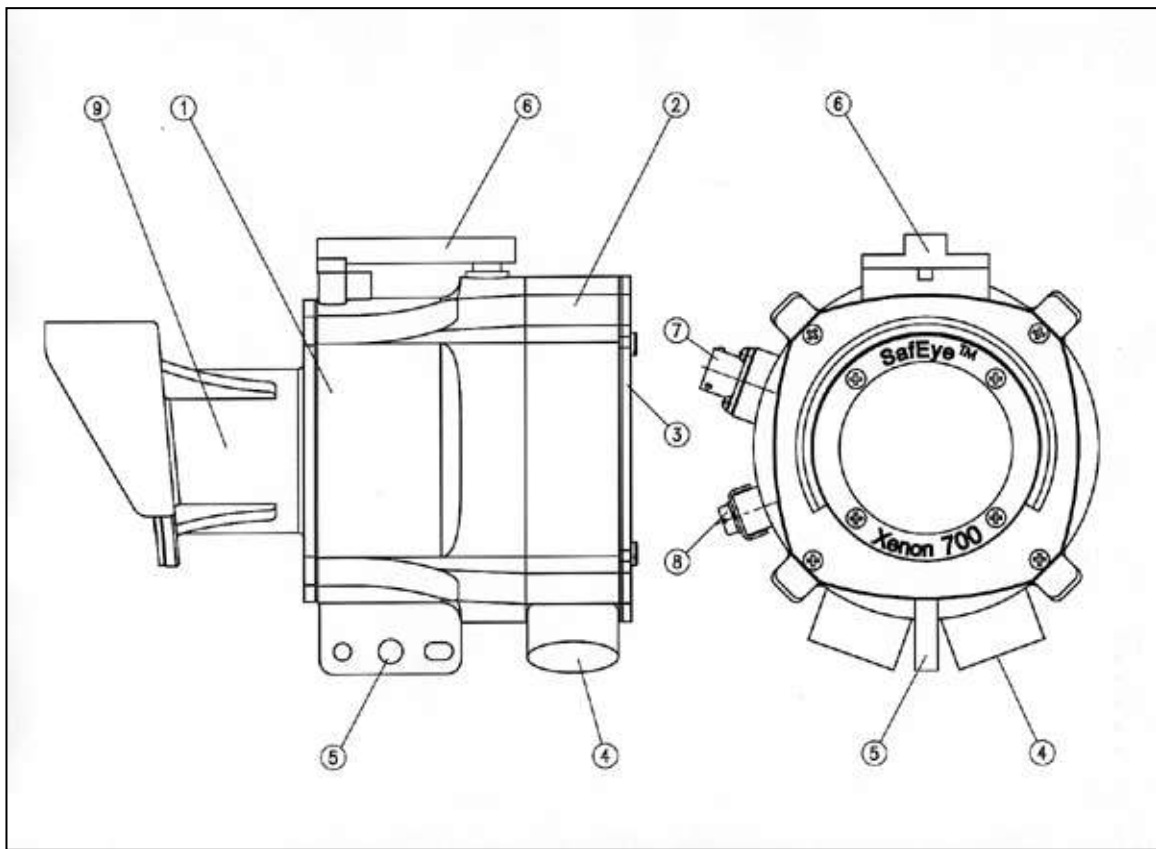
The Detector receives the transmitted pulsed radiation signals from the Flash Source. The signals are then amplified and fed into an analog to digital signal converter to be processed by the internal microprocessor. When the signals drop below a prescribed level, the internal microprocessor will compensate for them. This will allow the signal to be maintained even in severe weather conditions. The data is sent to the output interface section. The signals can be sent to a standard control panel or to a central computer.

The front window of the Detector is heated to improve performance in icing, condensation and snow conditions.

Table 4 describes the detector types and their ranges.

Table 4: Detector Types

Detector Type	Range (in ft.)	Range (in meters)
Short range	13 - 65 ft.	4 - 20 m
Mid-range	50 - 230 ft.	15 - 70 m
Long range	165 - 459 ft.	50 - 140 m



1	Main Housing	6	Telescope Site
2	Junction Box	7	Handheld Fast Connection
3	Back Cover	8	Earth Terminal
4	Cable Inlet	9	Front Window/Window Section
5	Holding Plate		

Figure 3: Detector Unit

3 Operational Modes

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<i>Output Signals</i>	<i>page 17</i>
<i>System Set Up</i>	<i>page 18</i>

3.1 Operation Modes

The SafEye 700S has four operational modes:

- Normal Mode, page 15
- Maintenance Call Mode (3mA Output), page 15
- Fault Mode, page 16
- Zero Calibration Mode (1mA Output), page 16

3.1.1 Normal Mode

This mode is used for gas detection. In normal mode, the following statuses are possible:

- **Normal:** Signal received from gas detection is at safe levels
- **Warning:** Gases have been detected at warning levels
- **Alarm:** Gases have been detected at alarm levels

Note: For the standard 0-20mA output, the Warning and Alarm levels are not relevant. The user chooses these alarm levels at the controller. The output Detector will be 4mA at zero reading and 20mA for full-scale reading.

Warning and Alarm states are relevant where the stepped 0-20mA output is used and will energize the warning and alarm relays.

If the RS485 output is used, the Detector changes its status from 'N' to 'W' at Warning level and to 'A' at Alarm.

3.1.2 Maintenance Call Mode (3mA Output)

This mode indicates low signal or low signal ratio that may be caused by a dirty window; misalignment; poor source or that one of the Detectors parameters is at the 'limit' value.

The Detector **continues** to function and reads any gas present, but provides a (3mA) pre-warning signal that a maintenance procedure is required.

3.1.3 Fault Mode

In the Fault status, there are three fault types:

- **Fault 1 (2mA Output) – Non critical:** If this occurs, it is due to blockage, poor alignment, very low signal or in the case of partial obscuration or full beam block and **detection is no longer possible**. The Detector's proper operation can be restored (Auto reset) during operation if the condition causing the problem is removed or resolved. This mode will occur after a delay of 60 sec. from the moment of the fault. This delay is important to eliminate momentary obscuration due to passing through the beam.
- **Low Voltage Fault (0mA Output):** In this case, **detection is disabled** due to low voltage being supplied to the Detector. The Detector returns to proper operation only when proper voltage level restored.
- **Fault 2 (0mA Output) – Critical:** In this case, **the detection is disabled** due to electrical / software operational failure or central device (memory, processor) fault. Such fault causes the Detector to cease operation.

3.1.4 Zero Calibration Mode (1mA Output)

This mode zeros the base level from which the Detector will read gas.

It should only be performed when there are:

- No combustible gases present
- Clear path between the Flash Source and Detector
- Clear weather conditions

Zero calibration must be done after installation, re-alignment and window cleaning, using the handheld unit (or Host software on PC)

3.2 Output Signals

The SafEye system provides the following outputs depending upon the wiring option selected (see Models and Types, page 9):

- Standard 0-20mA Current Output, page 18
- Dry Contact Relays, page 18
- RS-485 Interface, page 18

3.2.1 Standard 0-20mA Current Output

The 0-20mA output can provide the Detector status measurement in one of the two following methods:

- Default - It can be measured proportionally showing a continuous reading of the exact gas concentration (see Table 1).
- Option - It can be a discrete indication according to the Detector mode or the warning or alarm signal at a defined gas concentration (see Table 2). Setting of this method can be done by maintenance host or Handheld unit.

The 0-20mA functions as current sink but can be configured as Source – see Appendix B.

The maximum permitted load resistance for the 0-20mA output is 600Ω

Table 5: Standard (default) 0-20mA Current for the Gas Channel

Current Reading	Status and Description
0mA +0.3mA	Fault 2 or Low Voltage (Critical)
1mA ±0.3mA	Zero Calibration (In Progress)
2mA ±0.3mA	Fault 1 (non-Critical)
3mA ±0.3mA	"Maintenance Call"
4mA±0.5mA	No gas present
0-20mA	Continuous measuring of gas concentration at a range between 0 and full scale
21mA	Concentration is over the range limit (more than full-scale concentration).

Table 6: Optional - Discrete Reading of 0-20mA at Different Detector Modes

Current Reading	Status and Description	LEL.m Setting
0±0.3mA	Fault 2 or Low Voltage	-
1±0.3mA	Zero Calibration	-
2±0.3mA	Fault 1	-
3±0.3mA	"Maintenance Call"	-
4±0.5mA	Standby	-
14±0.5mA	Warning	1
19±0.5mA	Alarm	3
21mA	Concentration is over the range limit (more than full-scale concentration).	

3.2.2 Dry Contact Relays

The detector may include up to three of the following relays depending on the wiring configuration:

- Fault relay
- Alarm relay
- Accessory relay

Alarm and Accessory relays are normally non-energized open. When in the alarm or warning status the appropriate relay is closed.

Fault relay is normally energized closed, and when it is in the fault condition the relay is opened.

3.2.3 RS-485 Interface

The RS-485 input/output sends complete data information to a PC and receives data or control commands from the PC. The protocol is Modbus compatible. The communication with the PC that is operated through the interface is executed only when used with appropriate host software.

3.3 System Set Up

This section includes the following options:

- Detection Function Programming, page 19
- Detection Set-Up Function, page 19

3.3.1 Detection Function Programming

The SafEye 700S series incorporates several functions that can be set by the customer using:

- Handheld unit (P/N 799810). Refer to manual TM 799060 for programming instructions. The connection of the handheld to the detector is fast and intrinsically safe and allows function change with no need to open the detector.
- To use the non I.S mini laptop Unit, refer to Manual TM 777070 for instructions.
- Host software with harness USB RS-485 converter, refer to manual TM 899050 for programming instructions.

3.3.2 Detection Set-Up Function

For the default settings see Default Detector Set up, page 21

3.3.2.1 Gas Calibration

Four gas types can be selected for maximum compatibility to the required measured gas(es).

Gas Types for Models 701S, 702S, 703S:

- Methane
- Mixture 92% methane 4% ethane 4% propane (default)
- LPG – 60% Propane, 40% Butane
- Mixture 99% methane 1% propane

Gas Type for Models 721S, 722S, 723S:

- Ethylene 100%

These four calibrations are standard calibrations. The Detector can be calibrated up to eight (8) different types of gases or mixtures upon special request.

Each Detector will be supplied with a calibration sheet that will define the calibrated gas set up, full-scale, alarm and warning level.

3.3.2.2 Full Scale

Two full scales are available:

Table 7: Sensitivity Levels Options

Sensitivity	Full Scale	Warning Level	Alarm Level
Normal	5 LEL.m	1 LEL.m	3 LEL.m
High	2 LEL.m	0.4 LEL.m	1 LEL.m

When choosing a full scale, the warning and alarm level will change automatically per the table.

3.3.2.3 Zero Calibration

Zero Calibration can be enabled or disabled as follows:

- Enable – Zero calibration is performed according to background
- Disable – The Detectors are not updated due to change of background

3.3.2.4 Other Functions

Table 8: Other Functions

Function		
Accessory Relay	Accessory Relay is activated at warning level	Accessory Relay is activated at alarm level
Alarm Latching	No latching function at alarm relay	Alarm relay is latched. Latching reset can be performed by momentary power disconnection or when Detectors are set to alignment mode
4-20 mA mode	Continue reading of the 0-20mA per the gas concentration level (see Table 1)	Discrete reading of the 0-20mA output according to the Detector status (see Table 2)
Beam Block During Alarm	Non latching of alarm indication during blocking mode	Alarm outputs are latched when the Detector turns to blocking mode from alarm position. Latching reset can be provided only if the Detector turn to normal mode

3.3.2.5 Address Setup

The Detector provides up to 247 addresses that can be used in RS-485 communication link.

3.3.2.6 Heated Optic Operation

The heated optics for the Detector unit can be defined as one of the following modes:

- OFF – Not operated
- ON – Operated continuously
- AUTO – On, per temperature change (**default**)

When operated per temperature change, the user can define the start temperature below which the window will be heated between 0 to 50°C. The Detector will stop heating the window when the temperature will be 15°C above the defined temperature.

This feature relates to the Detector *only*.

The Source heated optic must be defined with the order in two options:

- Heated continuously
- Start heating below 41°F (5°C). (**default**)

3.3.3 Default Detector Set up

The Detector has 8 functions that can be programmed according to the customer requirement at factory or at customer facility using a software Host or a handheld unit. The standard set up is as follows:

Table 9: Detector Default Set Up

Function	Setting
Gas Type	2
Full scale sensitivity	5 LEL.m
BG Zero Calibration	Enabled
Accessory Relay	Warning*
Alarm Latching	No
0-20mA	Continuous**
Beam block during alarm	No latch
Heat mode	Auto
Heat on	5

* Only refers to wiring option with Accessory relay output

** Only refer to the wiring options with 0-20mA

Table 10: Source Default Set-Up

Function	Setting
Heat mode	Auto
Heat on	5

The Source default can be changed *only* at the factory.

4 Technical Specifications

➤ In this chapter...

General Specifications page 23

Electrical Specifications page 24

Mechanical Specifications page 26

Environmental Specifications page 26

4.1 General Specifications

Detected Gases: Simultaneous detection of C1-C8 flammable gases

Detection Distance range: Table 11

Table 11: Detection Distance Range

Model No.	Detector	Source	Min. Installation Distance	Max. Installation Distance
701S	XDSS-C-111XX	XSS-C-11X	13 ft. (4 m)	65 ft. (20 m)
702S	XDSS-C-112XX	XSS-C-11X	50 ft. (15 m)	230 ft. (70 m)
703S	XDSS-C-113XX	XSS-C-12X	165 ft. (50 m)	459 ft. (140m)
721S	XDSS-C-121XX	XSS-C-11X	13 ft. (4 m)	65 ft. (20 m)
722S	XDSS-C-122XX	XSS-C-11X	50 ft. (15 m)	230 ft. (70 m)
723S	XDSS-C-123XX	XSS-C-12X	165 ft. (50 m)	459 ft. (140m)

Response Time: 23 sec to T 90

Spectral Response: 3.0 - 4.0 micron

Sensitivity Range: 0-5 LEL.m
0-2 LEL.m

Field of View: Line of Sight

Alignment Tolerance: $\pm 1^\circ$

Drift: Long term $\pm 5\%$ of full scale

Temperature Range: -40°F (-40°C) to +131°F (+55°C)

Immunity to false alarm: Does not produce false alarm and is not influenced by Solar Radiation, Hydrocarbon Flames and other external IR Radiation Sources.

4.2 Electrical Specifications

Operating Voltage: 18-32 VDC

4.2.1 Power Consumption

Table 12: Detector and Source Maximum Power Consumption

	Without Heated Optic (Max.)	With Heated Optic (Max.)
Detector	220mA	300mA
Source	220mA	300mA

4.2.2 Electrical Input Protection

The input circuit is protected against voltage-reversed polarity, voltage transients, surges and spikes according to MIL-STD-1275B.

4.2.3 Electrical Interface

There are three output-wiring options. These options must be defined at factory per the customer order. See Appendix B for wiring/terminal diagram for each option.

Note: Option 3 is the default unless otherwise specified at time of order.

- Option 1: Power, Alarm Fault Relay, 0-20mA (Figure 9).
- Option 2: Power, Alarm, Fault & Accessory Relay(Figure 10)
- Option 3: Power, Alarm Relay, RS 485, 0-20mA, RS-485 RTN (Figure 11)

Note: SIL2 covers only 0-20mA outputs.

4.2.4 Electrical outputs

4.2.4.1 0-20mA Current Output

The 0-20mA is isolated sink option. This output can be configured as Source – see Appendix B.

The maximum permitted load resistance is 600 ohm.

Two 0-20mA options:

- Continuous reading – default (see Table 2)
- Discrete reading (see Table 3)

4.2.4.2 Communication Network

The Detector is equipped with an RS-485 communication link that can be used in installations with computerized controllers.

Communication is compatible with the Modbus protocol:

- This protocol is a standard and is widely used.

- It enables continuous communication between a single standard Modbus controller (Master device) and a serial Network of up to 247 Detectors.
- It enables connection between different types of Spectrex Detectors or other Modbus devices to the same Network.

4.2.4.3 Relays Output

The Detector may include up to three of the following relays depending on the wiring configuration selected.

Table 13: Dry Contact Relays

Relay	Type	Normal	Maximum Ratings
Alarm	SPST	NO	5A at 30VDC
Accessory	SPST	NO	5A at 30VDC
Fault	SPST	NO	5A at 30VDC

Alarm and accessory relays are normally de-energized open. When in the alarm or warning status the appropriate relay is closed.

Fault Relay is normally energized closed, the contact will be closed, and when it is in Fault situation, the relay is opened.

4.2.4.4 HART Protocol

The HART Protocol is a digital communication signal at low level on top of the 0-20mA.

This is a bi-directional field communications protocol used to communicate between intelligent field instruments and the Host System.

Through the HART Protocol the detector can:

- Display set-up
- Reconfigure set-up
- Display detector status and definition
- Perform detector diagnostic
- Troubleshooting

4.3 Mechanical Specifications

Enclosure:	The Detector, Source and tilt mount are St. St. 316 Electro chemical and passivized coating.	
Explosion Proof:	ATEX	Ex II 2(1) G, Ex d e ia [ia Ga] IIC T5 Gb Ta Temp -40°F (-40°C) to 131°F (55°C)
	IECEx	Ex II 2(1) G, Ex d e ia [ia Ga] IIC T5 Gb Ta Temp -40°F (-40°C) to 131°F (55°C)
Water and Dust Tight:	IP 66 and IP 67 NEMA 250 type 6p	
Electrical Modules:	Conformal coated	
Electrical Connection:	(Two options - specified at time of order) 2 X M25 (ISO) 2 X 3/4" - 14NPT conduits	
Dimensions:	Detector	8.2 x 5.7 x 6 in (210 x 145 x 154mm)
	Source	10 x 5.3 x 6.9 in (255 x 135 x 175mm)
	Tilt Mount	4.7 x 4.7 x 5.5 in (120 x 120 x 140mm)
Weight:	Detector	9.2 lb. (4.2 kg)
	Source	10.1 lb. (4.6 kg)
	Tilt Mount	4.2 lb. (1.9 kg)

4.4 Environmental Specifications

The SafEye system is designed to withstand harsh environmental conditions. The Source and Detector units compensate for adverse conditions while maintaining accuracy.

4.4.1 High Temperature

Designed to meet MIL-STD-810C, method 501.1 procedure II

Operating Temperature:	+131 °F (+55 °C)
Storage Temperature:	+149 °F (+65 °C)

4.4.2 Low Temperature

Designed to meet MIL-STD-810C, method 502.1, procedure I

Operating Temperature:	-4 °F (-20 °C)
Storage Temperature:	-40 °F (-40 °C)

4.4.3 Humidity

Designed to meet MIL-STD-810C, method 507.1, procedure IV relative humidity of up to 95% for the operational temperature range.

4.4.4 Salt and Fog

Designed to meet MIL-STD-810C, method 509.1 procedure I. Exposure to a 5% salt solution for 48 hours.

4.4.5 Water and Dust

- IP67 per EN60529
- IP66 per EN60529

Dust:

Totally protected against dust

Liquids:

Protected against immersion between 15 cm and 1m in depth. Protected against all water jets from all directions.

4.4.6 Shock and Vibration

Vibration:

Designed to meet MIL-STD-810C, method 514.2, procedure VIII.

Mechanical Shock:

Designed to meet MIL-STD-810C, method 516.1, procedure I.

4.4.7 Electromagnetic Compatibility (EMC):

This product is in conformance with EMC directive 89/336/EC.

Radiated Emission:	EN61000-6-3
Conducted Emission:	EN61000-6-3
Radiated Immunity:	EN61000-4-3
Conducted Immunity:	EN61000-4-6
ESD:	EN61000-4-2
Burst:	EN61000-4-4
Surge:	EN61000-4-5

5 Installation Instructions

➤ In this chapter...

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<i>General Considerations</i>	<i>page 29</i>
<i>Preparations for Installation</i>	<i>page 30</i>
<i>Certification Instructions</i>	<i>page 32</i>
<i>Conduit/Cable Installation</i>	<i>page 33</i>
<i>Detector/Source Mounting</i>	<i>page 33</i>
<i>Detector Wiring</i>	<i>page 34</i>
<i>Detector Terminal Wiring</i>	<i>page 38</i>
<i>Flash Source Wiring</i>	<i>page 39</i>

5.1 Introduction

The Detector and Flash Source units can be installed and maintained with the use of general-purpose common tools and equipment. The installation procedure has to be performed by suitably qualified personnel.

This section does not attempt to cover all of the standard practices and codes of installation. Rather, it emphasizes specific points of consideration and provides some general rules for suitably qualified personnel. Special safety precautions are stressed wherever applicable.

5.2 General Considerations

5.2.1 Personnel

Only suitably qualified personnel, familiar with the local codes and practices, trained for gas detection maintenance should be employed. Wiring should only be performed or supervised by someone with knowledge of electronics and in particular wiring installation.

5.2.2 Tools Required

The SafEye system requires the following tools:

- Set of screwdrivers
- Set of hex keys/Allan wrenches (supply with commissioning kit)
- Voltage Multimeter

5.2.3 Site Requirements

The installation position of the SafEye system must take into account if the gas being monitored is heavier or lighter than air, and the individual site requirements. The site selected must give the Detector a direct view to the Source. The mounting point for each item should be secure and stable with minimal vibrations. Equipment should be either mounted in a position where it cannot be knocked out of alignment, or guarded from physical impact.

5.2.4 The Source and Detector

The appropriate Detector should be selected for the length of open path to be monitored. To allow for ageing of the Source and a reduction of the IR signal due to adverse weather we recommend using a Detector that is not at the limit of its operating range. As a guide, select a Detector that is installed at a distance from the Source of not more than 75% of the specified operating distance. In severe weather conditions such as offshore oil production and exploration, this should be reduced to 50%.

The open path between the Source and Detector and the immediate surroundings should be kept clear of obscuration that might hinder the free movement of air in the protected area or block the infrared beam.

5.2.5 Guidance Tips for Gas Detector Locations

Guidance Tips for Gas Detector locations in order to provide the best detection coverage:

- Below potential leak source for heavier than air gases
- Above potential leak sources for lighter than air gases
- Near to leak sources along the expected leak trajectory, taking into account prevailing wind directions
- Between leak source and potential ignition sources
- In area with expected heavy fog, rain or snow, consider the effect of long range installation and install the Detector at shorter range with the maximum intensity model available.

5.3 Preparations for Installation

Installation should comply with local, national and international regulations and norms as applicable to gas Detectors and approved electrical devices installed in hazardous areas. The Detectors can be installed with general-purpose common tools and equipment.

The System should include the following (in addition to this manual):

- Detector unit: XDSS-C-11XXX (See Models and Types on page 9)
- Source unit: XSS-C-XX (See Models and Types on page 9)

- Two Tilt Mount Bases P/N 799640
 - 1 base is used for the Detector
 - 1 base is used for the Flash Source.
- The Commissioning kit includes Function Check Filter and the Telescope Kit, which is used during each SafEye installation and then removed. They can be reused for all other SafEye installations on the site. Therefore, only one set is provided for several detectors.
- Telescope Kit P/N 799210
- Function Check Filter P/N 792260 (1-5)*
- Handheld Unit P/N 799810

* There are 5 options depending on full scale and type of calibrated gas.

5.3.1 Preparing for the Installation

The following procedure is used for preparing the installation of the 700S Gas Detector:

- 1** Verify the appropriate Purchase Order. Record the Part No. and the Serial No. of the detectors and source units and the installation date in the appropriate log book.
- 2** Open the container package immediately prior to detector installation and visually inspect the detectors; sources and accessories.
- 3** Verify that all components required for the detector installation are readily available before commencing the installation. In the event that the installation is not completed in a single session, secure and seal detectors and conduits.
- 4** For wiring, use color-coded conductors or suitable wire markings or labels. 12 to 20 AWG (0.5 mm² to 3.5 mm²) wires may be used for site wiring. The selection of wire gauge should be based on the number of detectors used on the same loop and the distance from the control unit, in compliance with specifications (See Appendix A, page 53)

5.4 Certification Instructions



Warning: Do not open the detector, even when isolated, when flammable atmosphere is present.

Use the following certification instructions:

- The cable entry point may exceed 158°F (70°C) suitable precautions should be taken when selecting the cable.
- The equipment may be used with flammable gases and vapors with apparatus groups IIA, IIB and IIC T5 in the ambient temperature range -40°F (-40°C) to +131°F (+55°C).
- Installation shall be carried out by suitably trained personnel in accordance with the applicable code of practice e.g. EN 60079-14:1997.
- Inspection and maintenance of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice e.g. EN 60079-17.
- Repair of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice e.g. EN 60079-19.
- The certification of this equipment relies upon the following materials used in its construction:
 - **Enclosure:** 316L Stainless Steel
 - **Window:** Sapphire Glass
 - **Window Cement:** Ciba Geigy epoxy putty AV 138M & HV 998
 - **Seals:** Buna-n
- If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection provided by the equipment is not compromised.
 - Aggressive substances: For example. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials.
 - Suitable precautions: For example, regular checks as part of routine inspections or establishing **from the material's data sheets that it is** resistant to specific chemicals.
- Special conditions for safe use: The series 700S Open Path Gas Detectors and Flash Source units shall not be used as safety related devices in accordance with directive 94/9/EC.

5.5 Conduit/Cable Installation

The conduit and cable installation must comply with the following guidelines:

- 1** To avoid water condensation in the detector, install the Detector with the conduits/cable entries facing downwards
- 2** Use flexible conduits/cables for the last portion connecting to the detector
- 3** When pulling the cables through the conduits, ensure that they are not tangled or stressed. Extend the cables about 12 inches (30cm) beyond the Detector location to accommodate wiring after installation.
- 4** After the conductor cables have been pulled through the conduits, perform a continuity test

5.6 Detector/Source Mounting

The Detector Source should be mounted with the Tilt Mount Kit, Model 799640. The Tilt enables the Detector to be rotated up to 45° in all directions and fine alignment of up to 3°.

5.6.1 Tilt Kit P/N 799640

The following contents are included with the Tilt Mount Kit:

Table 14: Tilt Mount Kit

Item	Qty	Type/Model
Tilt Mount	1	799220
Screw	1	5/16" – 18 UNC x 3/4"
Spring Washer	1	No. 5/16"

5.6.2 Detector/Source Installation

(Figure 4 and Figure 5)

➤ **To install the Detector/Source:**

- 1** Place the Tilt Mount holding plate (item 1) in its designated location and secure it with (4) fasteners through four (4) holes dia. 8.5mm.

Notes:

1. Skip this step if the Tilt Mount is already installed.
2. Detector removal for maintenance purpose does not require Tilt Mount removal.

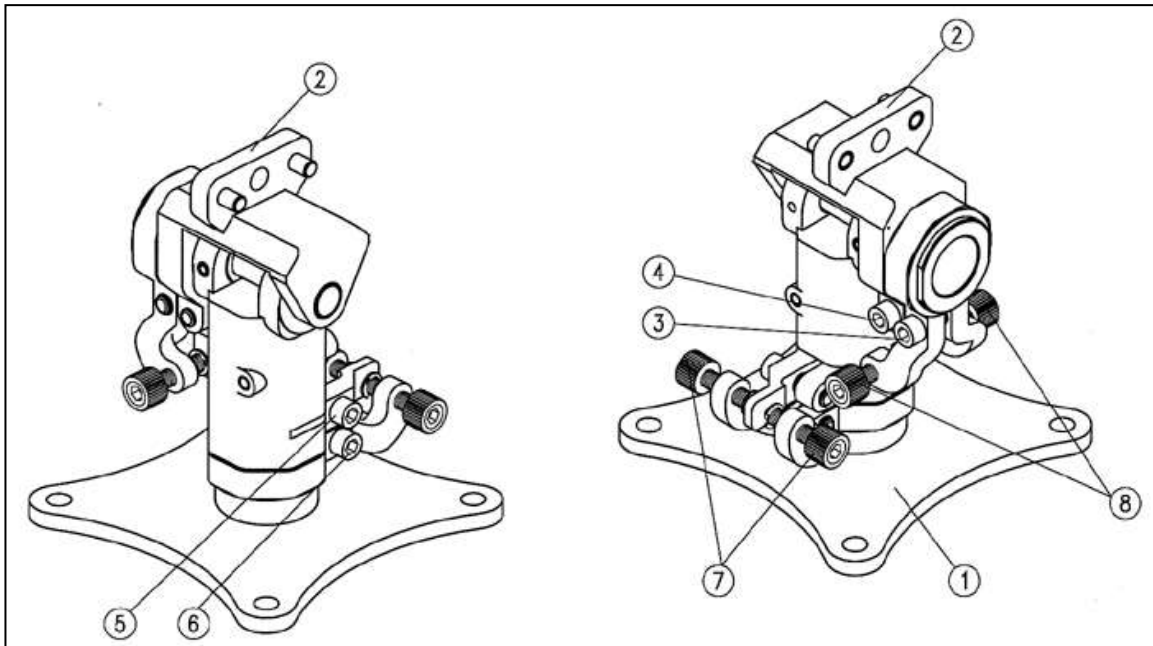
- 2** Place the Detector, with its conduit/cable inlets pointing downwards on the Detector holding plate of the Tilt Mount (item 2). Secure the **Detector with 5/16"-18UNC x 3/4" screw with No. 5/16" spring washers (9,10) to the Tilt Mount. Use 1/4" Hex Key for 5/16" screw (item 9).**
- 3** Repeat 1 – 2 to install the Source.

5.7 Detector Wiring

(Figure 5 and Figure 6)

➤ **To install the Detector wiring:**

- 1** Remove the four (4) socket-head-screws (item 14, Figure 5) that secure the Detector back cover (item 15, fig. 4). The chamber is now revealed.
- 2** Remove the protective plug mounted on the Detector conduit/cable entry inlet; pull the wires through the Detector inlet (item 4, Figure 6).
Use a 3/4" – 14NPT or M25x1.5 explosion-proof conduit connection / cable gland to assemble the cable / explosion-proof conduit to the Detector.
- 3** Connect the wires to the required terminals (item 2, Figure 6) according to the wiring diagram. See Detector Terminal Wiring, page 38 and Figure 9, Figure 10, Figure 11 Appendix B.
- 4** Connect the grounding wire to the ground screw outside Detector (item 3, Figure 6). The Detector must be well grounded to Earth Ground.
- 5** Check the wires for secure mechanical connection and press them neatly against the terminal to prevent them from interfering while closing the cover (item 15, Figure 5)
- 6** Place and secure the Detector back cover using four (4) socket-head-screws (item 14, Figure 5)

**Figure 4: Tilt Mount****Table 15: Tilt Mount Description**

1	Tilt Mount Holding Plate	5	Vertical Fine Alignment Tightening Screw
2	Detector/Source Holding Plate	6	Vertical Crude Alignment Tightening Screw
3	Horizontal Crude Alignment Tightening Screw	7	Vertical Fine Alignment Screw
4	Horizontal Fine Alignment Tightening Screw	8	Horizontal Fine Alignment Screw

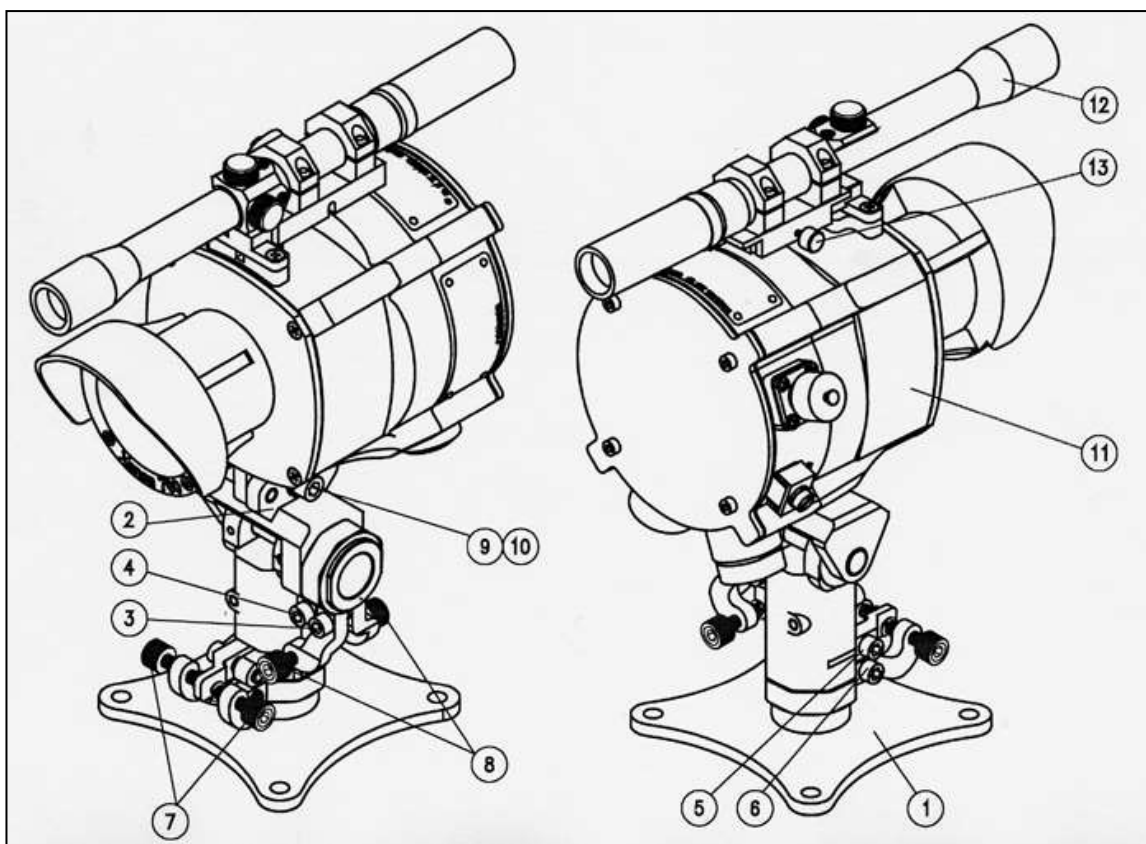


Figure 5: Detector and Tilt Mount Assembly

Table 16: Detector and Tilt Mount Assembly Description

1	Tilt Mount Holding Plate	9	Detector Tightening Screw
2	Detector/Source Holding Plate	10	Detector Tightening Washer
3	Horizontal Crude Alignment Tightening Screw	11	Detector
4	Horizontal Fine Alignment Tightening Screw	12	Telescope
5	Vertical Fine Alignment Tightening Screw	13	Telescope Tightening Bolt
6	Vertical Crude Alignment Tightening Screw	14	Back Cover Tightening Bolt
7	Vertical Fine Alignment Screw	15	Detector Back Cover
8	Horizontal Fine Alignment Screw		

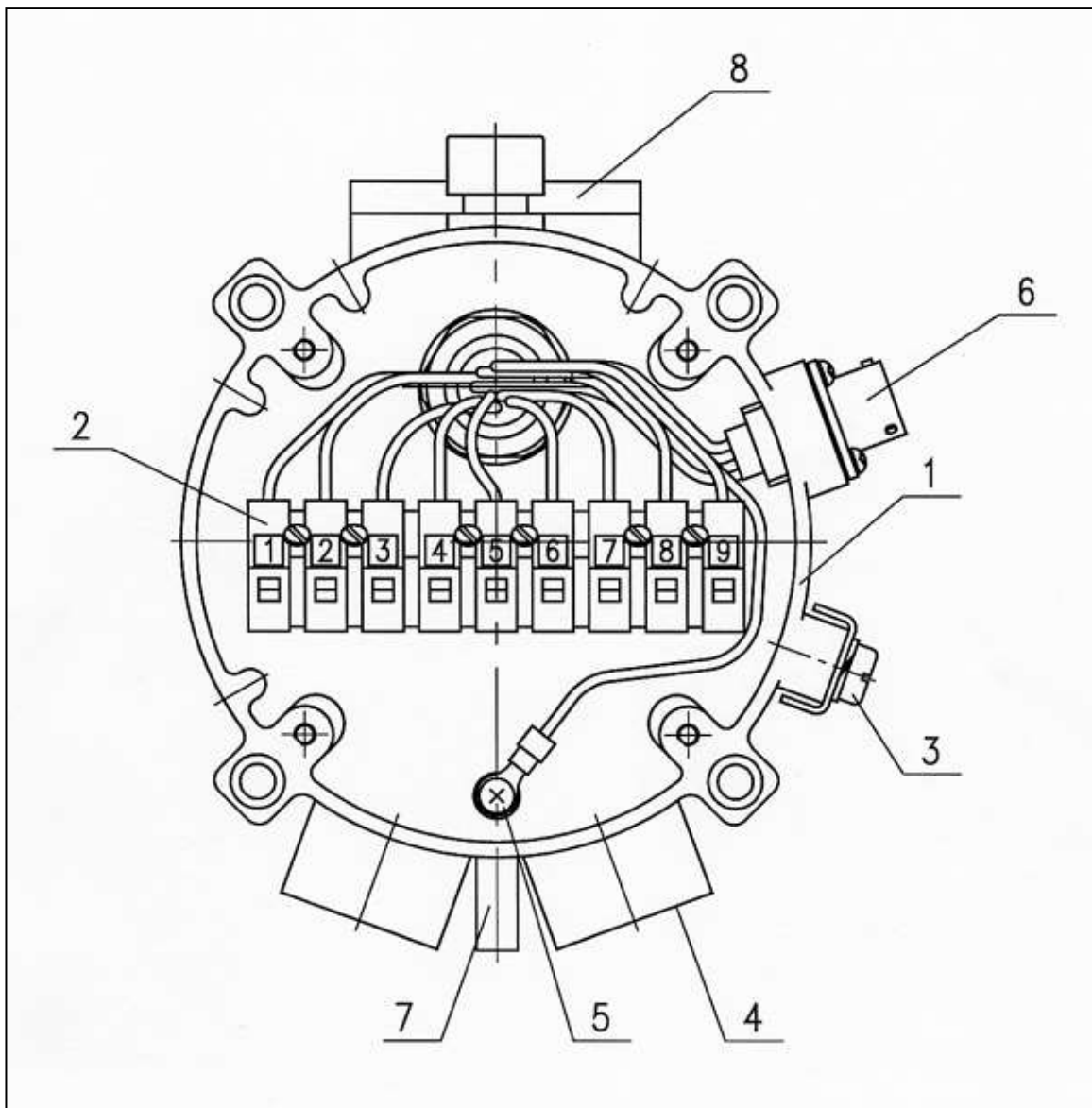


Figure 6: Detector with Cover Removed

Table 17: Detector with Cover Removed Description

1	Housing	5	Internal Earth Connection
2	Terminal Board	6	Connection to Handheld Unit
3	Earth Terminal	7	Detector Holding Plate
4	Inlet Conduit	8	Detector Telescope Site

5.8 Detector Terminal Wiring

The Detector has three output wiring options in the rear, segregated, "Exde" terminal section, with 9 Terminals, labeled 1-9.

Option 3 is the default unless otherwise specified at time of order

The following describes the function of each electrical terminal of the Detectors for all wiring options:

Table 18: Wiring Options

Wiring Option	Terminal Number								
	1	2	3	4	5	6	7	8	9
3 Figure 11 (Default)	24Vdc	0Vdc	Alarm Relay ⁽¹⁾		RS-485+ ⁽³⁾	RS-485- ⁽³⁾	0-20mA + ⁽⁴⁾	0-20mA - ⁽⁴⁾	RS-485 RTN ⁽⁶⁾
2 Figure 10	24Vdc	0Vdc	Alarm Relay ⁽¹⁾		Fault Relay ⁽²⁾		Accessory Relay ⁽⁵⁾		not used
1 Figure 9	24Vdc	0Vdc	Alarm Relay ⁽¹⁾		Fault Relay ⁽²⁾		0-20mA + ⁽⁴⁾	0-20mA - ⁽⁴⁾	not used

Notes:

- 1** The Alarm output is a N.O. contact relay (SPST).
The contacts are closed in Gas Alarm state.
- 2** The Fault output is N.C. SPST relay. The contacts are closed when the Detector is in its normal operational condition.
- 3** Used for communication network as specified in Appendix B.
- 4** See Appendix B for more details
- 5** The Accessory output is N.O. (SPST) relay. The Accessory Relay may act in parallel with the ALARM relay to activate another external device or it may provide a warning signal, depending on Function Set Up.
- 6** Used as RTN to the RS-485 communication port.

5.9 Flash Source Wiring

5.9.1 Wiring

➤ **To install the wiring:**

- 1** Remove the four (4) socket-head-screws (item 14, Figure 5) that secure the Source back cover (item 15, Figure 5). The chamber is now open.
- 2** Remove the protective plug mounted on the source conduit/cable entry inlet; pull the wires through the source inlet (item 4, Figure 7). Use a **3/4" – 14NPT** or **M25x1.5** explosion-proof conduit connection / cable gland to assemble the cable / explosion-proof conduit to the source.
- 3** Connect the wires to the required terminals (item 2, Figure 7) (See Terminal Wiring, page 39)
- 4** Connect the ground wire to the ground screw outside the source (item 3, Figure 7). The source must be well grounded to earth ground.
- 5** Check wires for secure mechanical connection and press them neatly against the terminal to prevent them from interfering while closing the cover (item 15, Figure 5)
- 6** Place and secure the source back cover using four (4) socket-head-screws (item 14, Figure 5)

5.9.2 Terminal Wiring

The Flash Source contains a three-wire strip terminal:

- Terminal 1 – positive (+) power supply
- Terminal 2 – common return
- Terminal 3 – GND (ground)

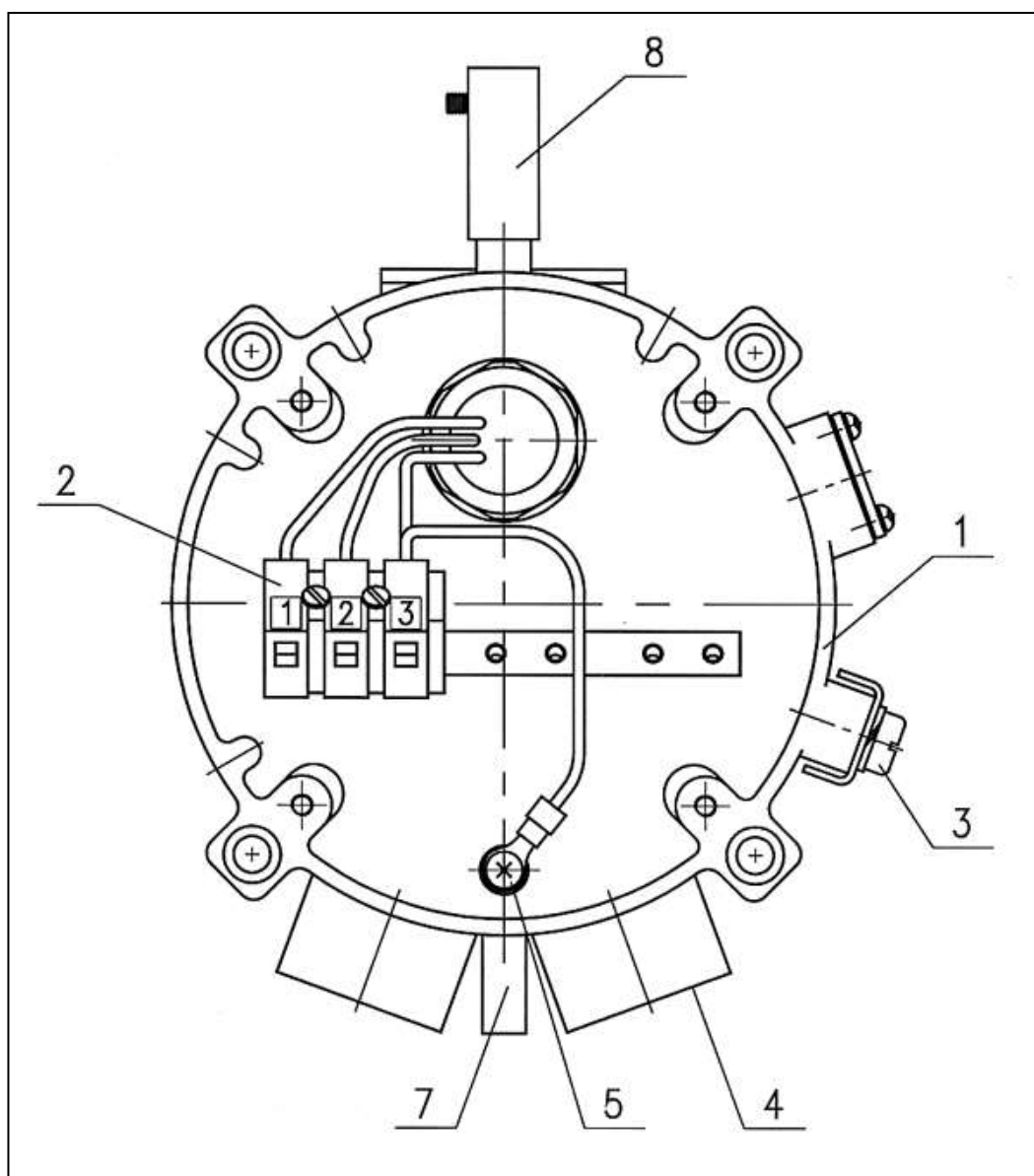


Figure 7: Source with Cover Removed

Table 19: Source with Cover Removed Description

1	Housing	5	Internal Earth Connection
2	Terminal Board	6	N/A
3	Earth Terminal	7	Detector Holding Plate
4	Inlet Conduit	8	Detector Telescope Site

6 Operating Instructions

➤ In this chapter...

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<i>Alignment of Unit</i>	<i>page 41</i>
<i>Powering up the System</i>	<i>page 42</i>
<i>Safety Precautions</i>	<i>page 43</i>
<i>Signal Verification</i>	<i>page 43</i>
<i>Zero Calibration</i>	<i>page 44</i>
<i>Functional Check of Unit</i>	<i>page 45</i>

6.1 SafEye Operation

After the system is positioned, it will monitor for possible specified gases automatically sending signals to a standard control panel or to a PC. This section describes the alignment, calibration and operation.

Important! Accurate Alignment is essential for proper operation of the SafEye system.

6.2 Alignment of Unit

Using the Telescope performs full alignment.

Alignment procedure should be performed in two stages: Crude alignment and fine adjustment.

The Telescope includes a Periscope that consists of a prism and an ocular located vertical to the Telescope assembly. This allows the user to observe into the opposite unit perpendicularly to the alignment when access from the rear of the unit is impossible. For installations where rear access is possible the Periscope is not necessary. In this case it can be removed by releasing the Periscope Fastening Screw.

Important Notes

- 1 Prior to Telescope Installation, verify that the Telescope and Its Sight Mounting are free from any dirt to ensure proper alignment according to factory calibration.
- 2 Do not attempt to change any factory calibration at the Telescope or its mounting. This may prevent optimal alignment.

➤ To align the unit (see Figure 10):

- 1 Make sure that the Detector and the Flash Source are installed properly. Installation instructions are described in section 5 of this document.

- 2 Install the Telescope Assembly (12) on the Telescope Site Mounting of the Source according to the drawing. Fasten the Telescope with Fastening Screw (13).
- 3 Crude Alignment:
 - a. Use ¼" Allen screw driver for all alignment screws.
 - b. Loosen screws 5, 6.
 - c. Approximately aim the source horizontally toward the detector.
 - d. Tighten screw 6.
 - e. Loosen screws 3 and 4.
 - f. Approximately aim the source vertically toward the detector.
 - g. Tighten screw 3.
- 4 Repeat step 3 for the Detector.
- 5 Fine Alignment:
 - a. Aim the Source to the Detector within horizontal axis using screws 7. Aim the cross to the upper level of the telescope site or the Detector.
 - b. Tighten screw 5.
 - c. Aim within the vertical axis using screw 8.
 - d. Tighten screw 4.
 - e. Make sure the telescope cross is pointing at the top of the telescope site of the Detector.
- 6 Repeat step 5 for the Detector alignment.

6.3 Powering up the System

Important! Prior to any operation or maintenance, follow the Safety Precautions in Safety Precautions, page 43 .

➤ **To power up the system:**

- 1 Make sure that the Source and Detector are connected to power.
- 2 Make sure that the 0-20mA meter is connected to the Detector.
- 3 Power up the system 18-32VDC.
- 4 After 60 seconds, the current meter will indicate 4mA.

Note: Zero calibration should be performed after powering up the system (see Zero Calibration, page 44).

6.4 Safety Precautions

After powering up the system, the Detector requires minimal attention in order to function properly, but the following should be noted:

- 1 Follow the instructions in the Manual; refer to the drawings and specifications issued by the manufacturer.
- 2 Do not open the detector/source housing while power is supplied.
- 3 Disconnect external devices, such as automatic extinguishing systems before carrying out any maintenance task warranty.

6.5 Signal Verification

The signal verification can be done through Host software supplied by Spectrex (see Detection Function Programming, page 19).

6.5.1 Signal Values Limitation

Table 20 describes the maintenance data channels limitation values.

Table 20: Maintenance Channels Limited Values

Channel	Installation Distance			Maintenance
	Min	Med	Max	
Reference	1V Gain1	1V Gain2	1V Gain3	The minimum signal allowed is 2.5V at Gain4
Signal 1	1V Gain1	1V Gain2	1V Gain3	The minimum signal allowed is 2.5V at Gain4
Signal 2	1V Gain1	1V Gain2	1V Gain3	The minimum signal allowed is 2.5V at Gain4
Ratio 1	0.6-2	0.6-2	0.6-2	0.5-3
Ratio 2	0.6-2	0.6-2	0.6-2	0.5-3
NQRat 1	0.95 – 1.05			Must be 0.95 – 1.05
NQRat 2	0.95 – 1.05			Must be 0.95 – 1.05
LEL	0 LEL x m			0 LEL x m
Temp.	Up to 25° C beyond room temp.			Up to 25° C beyond room temp.
Voltage	32VDC > V > 17VDC			32VDC > V > 17VDC
Ref/Noise	More than 80			More than 30
Sig 1/Noise	More than 80			More than 30
Sig 2/Noise	More than 80			More than 30

Note: The installation information refers to the installation distance.

- **Min:** The minimum distance as defined on the model no.
- **Med:** Half of the maximum distance as defined on the model no.
- **Max:** The maximum distance as defined on the model no.

6.6 Zero Calibration

Zero calibration must be done after:

- Installation
- Realignment
- Window Cleaning
- Any change in Detector or Source position

Precise alignment must be performed prior to the zero calibration procedure. Zero calibration should be performed in good weather conditions with insignificant gas concentrations in the surrounding environment or indoors.

➤ **To perform the zero calibration procedure:**

- 1 Switch from Normal to Alignment mode indication.
- 2 Switch from Alignment to Standby mode.
- 3 Switch from Standby to Zero Calibration mode.

The 0-20mA output should now be at 1mA.

- 4 Wait up to 60 seconds until it switches to Normal mode. The Detector reading is now set to normal. The 0-20mA output should now indicate 4mA.

Switching from each position (above first three instructions) can be done by HOST HART (refer to TM888030) or RS485 (refer to TM888050 or TM799060), or by moving the magnetic mode selector above the magnetic switch (see Figure 8).

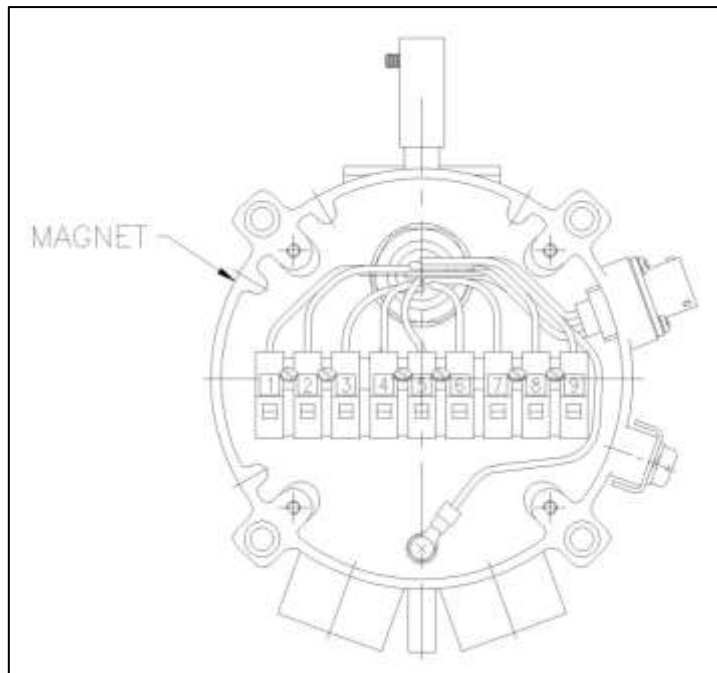


Figure 8: Magnetic Mode Selector

6.7 Functional Check of Unit

The SafEye system has been calibrated at the factory for the User's specific gas or vapor detection requirements. The following procedure validates the functional operation of the system. The Functional Check Filter is a convenient operational check used to confirm that response has not changed from previous readings. The filter is not used for calibration, which is unnecessary, nor does it equate to a particular quantity of gas.

Caution: Automatic activation or any external device that should not be activated during the calibration check should be disconnected.

Notes:

- 1 This functional verification procedure is for a standard 0-20mA output.
- 2 Prior to starting the functional check, verify that the power to the units is on and that the current of the 0-20mA channel is stable. Record the reading.

➤ **To perform the functional check:**

- 1 Position the Functional Check filter in front of the SafEye Detector.
- 2 The functional check filter's window must be centered over the viewing window of the Detector.
- 3 Wait 20 seconds.
- 4 Read the 0-20mA current. Determine the difference between the reading taken with and without the Functional Check Filter. This difference is the 0-20mA current variance.
- 5 Record the 0-20mA current variance in the Maintenance Logbook. If the variance is more than a 30% change when compared to the previous check (see delivery form), repeat the alignment.

7 Maintenance Instructions

➤ In this chapter...

<i>General Maintenance</i>	<i>page 47</i>
<i>Periodic Maintenance</i>	<i>page 47</i>

7.1 General Maintenance

The SafEye Xenon system requires only simple periodic maintenance to provide satisfactory service and achieve maximum performance. The Detector and Source units can be maintained with the use of common tools and equipment. Record the periodic test results in Maintenance Logbook with a copy of the delivery form inside.

7.2 Periodic Maintenance

Recommended cleaning of optical surfaces to be performed periodically.

Note: The frequency of cleaning operations is ultimately dependent upon the existing environmental conditions and the applications used.

➤ To perform periodic maintenance:

- 1 Proper maintenance will allow the SafEye system to retain maximum performance and reliability.
- 2 The optical surfaces of the Source and Detector viewing windows should be kept as clean as possible as it is an active device.
- 3 Alignment procedures must be performed each time that the Source or the Detector unit has been opened or moved for any reason.
- 4 The Signal Verification Check corroborates the current signals from the Flash Source compared to that of previous alignments. It is recommended to perform this check every 6-12 months. The signal should be checked according to threshold levels (see. Signal Verification, page 43).
- 5 The functional check should be performed every 6 months (see Functional Check of Unit, page 45).
- 6 Alignment procedure should be performed only if the signals are below Threshold value (see Signal Verification, page 43).
- 7 Zero calibration (see Zero Calibration, page 44) must be done every time the Detector or Source is realigned or windows cleaned.

7.2.1 Routine Optical Surface Cleaning

The SafEye system, being an optical device, must be kept as clean as possible. The optical surfaces concerned are the Source and Detector viewing windows.

➤ **To clean the optical window, proceed as follows:**

- 1** Turn off the power to the SafEye detector and source.
- 2** In places where dust or dirt has accumulated on the optical surface, clean the surface with a small, soft-bristle brush.
- 3** The surfaces must then be washed thoroughly with water and a mild non-abrasive detergent.
- 4** Thoroughly rinse the glass surface with clean water; ensuring no residue is left behind.
- 5** Dry the glass with a clean dry soft cloth.
- 6** Enter in the Maintenance Logbook: Date, name of person and company who performed the maintenance service.
- 7** Turn on power to the SafEye detector and source.
- 8** Perform signal verification (see Signal Verification, page 43).
- 9** Perform zero calibration (see Zero Calibration, page 44).
- 10** Perform functional check (see Functional Check of Unit, page 45)

7.2.2 Signal Verification

The signal verification check determines the proper operation of the open path. It checks the alignment and cleanliness of the window or any problem in Source or Detector. Use the PC Host software to measure the signal verification.

Refer to Manual TM 799060 or use I.S handheld unit. Refer to Manual TM 777070 for non I.S Mini laptop Unit.

7.2.3 Function Check of Unit

The SafEye Xenon system has been calibrated at the factory per the user's specific gas or vapor detection requirements. This procedure validates the functional operation. The functional check must be done periodically. Refer to Functional Check of Unit, page 45 for instructions.

Caution: Automatic activation or any external device that should not be activated during the calibration check should be disconnected.

8 Troubleshooting

➤ **In this chapter...**

Troubleshooting Problems

page 49

8.1 Troubleshooting Problems

Table 21: Troubleshooting Problems

Problem	Cause	Solution
"Maintenance call" status or R, S1 and S2 are below 2.5V DC at Gain 4	Poor alignment	Perform alignment
	Dirt on the window	Clean the window
	Poor light source	Replace the light source
	Detector fault	Replace/repair Detector
NQRat1 and NQRat2 below the permitted limit	Gas in the path	Make sure that the path is clean and the weather conditions are good
NQRat1 and NQRat2 above the permitted limit	Poor alignment	Perform alignment
R/N, S1/N, S2/N below 50	Poor alignment	Perform alignment
	Dirt on the window	Clean the window
	Poor light source	Replace the light source
	Detector fault	Replace/repair Detector
Temperature higher than 25° C beyond the room temperature	Electronic problem	Replace/repair Detector
Ratio1 and Ratio2 out of the limit	Poor alignment	Perform alignment
	Dirt on the window	Clean the window
	Detector fault	Replace/repair Detector
Voltage less than 16V DC. The Detector at "V" fault	Low input voltage	Check the power supply and installation

Appendices

A Wire Selection Tables

➤ **In this appendix...**

General Instructions For Electrical Wiring *page 53*

A.1 General Instructions For Electrical Wiring

Refer to Table 22 to determine the required wire gauge for general wiring, such as relay wiring. Calculate the permitted voltage fall with respect to loads current, wire gauge and length of wires.

Refer to Table 23 to select wire gauge for power supply wires. DO NOT connect any circuit or load to Detectors' supply inputs.

Table 22: Maximum DC resistance at 68° F for copper wire

AWG #	mm ²	Ohm per 100 ft.	Ohm/100 meter
26	0.12 - 0.15	4.32	14.15
24	0.16 - 0.24	3.42	11.22
22	0.30 - 0.38	1.71	5.60
20	0.51 - 0.61	1.07	3.50
18	0.81 - 0.96	0.67	2.20
16	1.22 - 1.43	0.43	1.40
14	1.94 - 2.28	0.27	0.88
12	3.09 - 3.40	0.17	0.55
10	4.56 - 6.64	0.11	0.35

- 1** Select "Number of Detectors" connected in one circuit.
- 2** Select "wiring length" per your installation requirements.
- 3** Refer to "power supply range" for voltage extreme applied.

Table 23: Wiring length in feet (meter)

No. of Detectors	Recommended Wire Diameter					Power Supply Range (VDC)
	18	16	14	-	-	
24	18	16	14	-	-	22-32
20	18	16	14	-	-	22-32
16	20	18	16	14	-	22-32
12	20	18	16	14	-	20-32
8	20	18	16	14	-	20-32
4 and less	20	18	16	16	14	20-32
Feet	164	328	492	656	820	
(Meters)	(50)	(100)	(150)	(200)	(250)	
	Max. Length from Power Supply to Last Detector					

B Wiring Option Configurations

➤ In this appendix...

RS-485 Communication Network

page 60

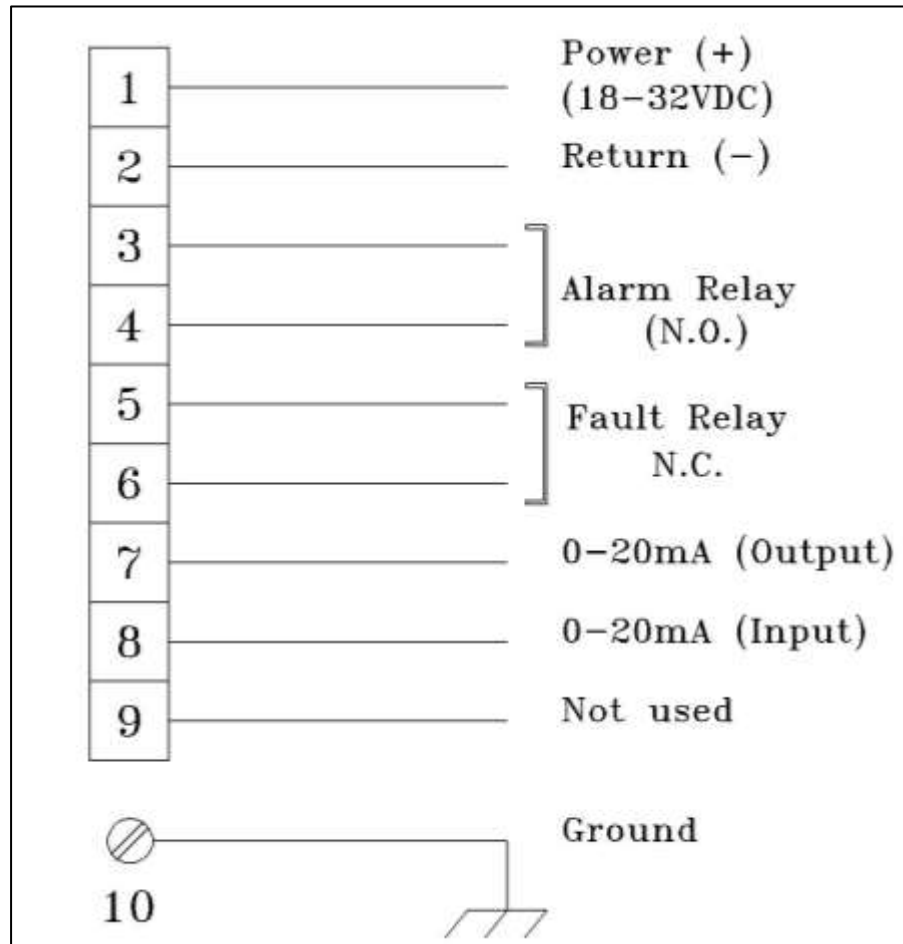


Figure 9: Wiring Option 1

Note: Only 0-20mA is SIL2 approved.

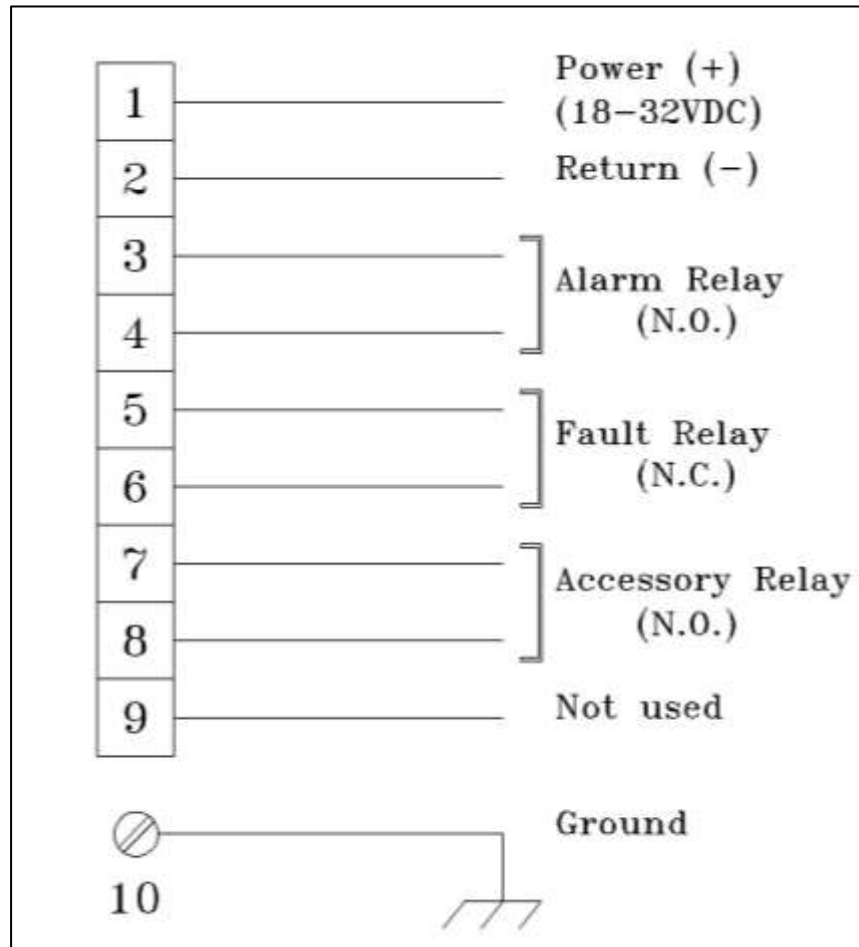


Figure 10: Wiring Option 2

Note: This option does not comply with SIL2 requirements.

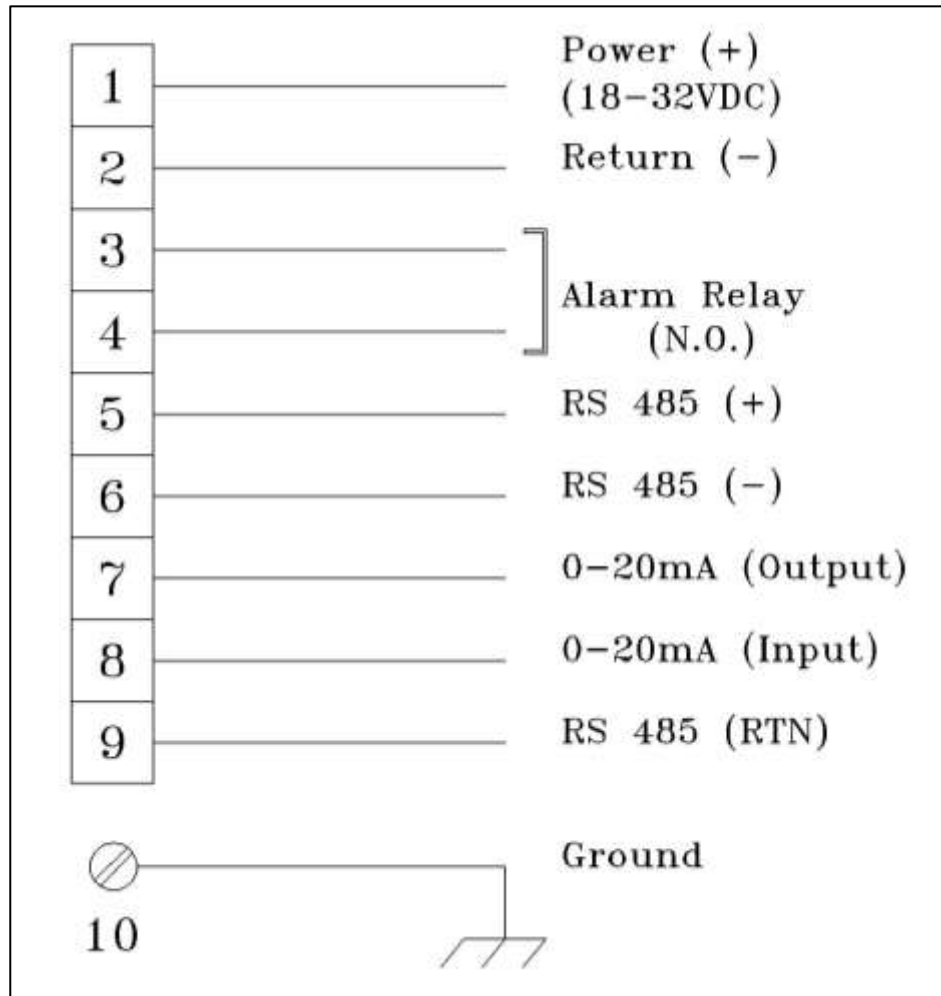


Figure 11: Wiring Option 3 (Default)

Note: Only 0-20mA is SIL2 approved.

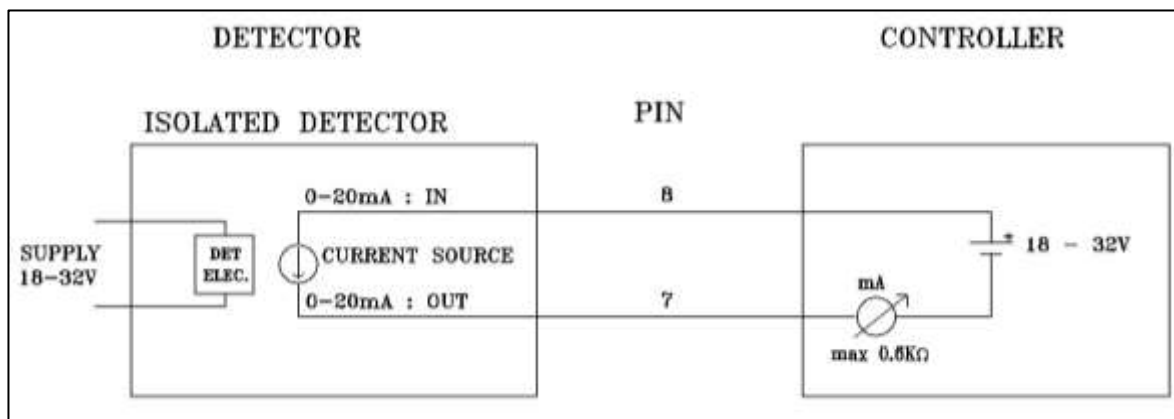


Figure 12: 0-20mA Wiring (Sink) For Wiring Option 1 and 3

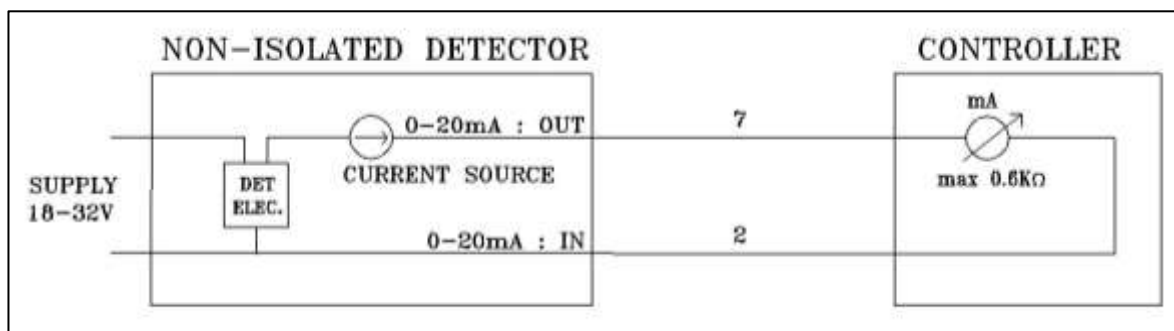


Figure 13: 0-20mA Wiring (Source) For Wiring Option 1 and 3

Notes:

- The Detectors are factory set to isolated 0-20mA-sink version.
- For non-isolated 0-20mA version (Source), connect Terminal 8 to Terminal 1. The 0-20mA meter is connected between Terminal 7 and Terminal 2.

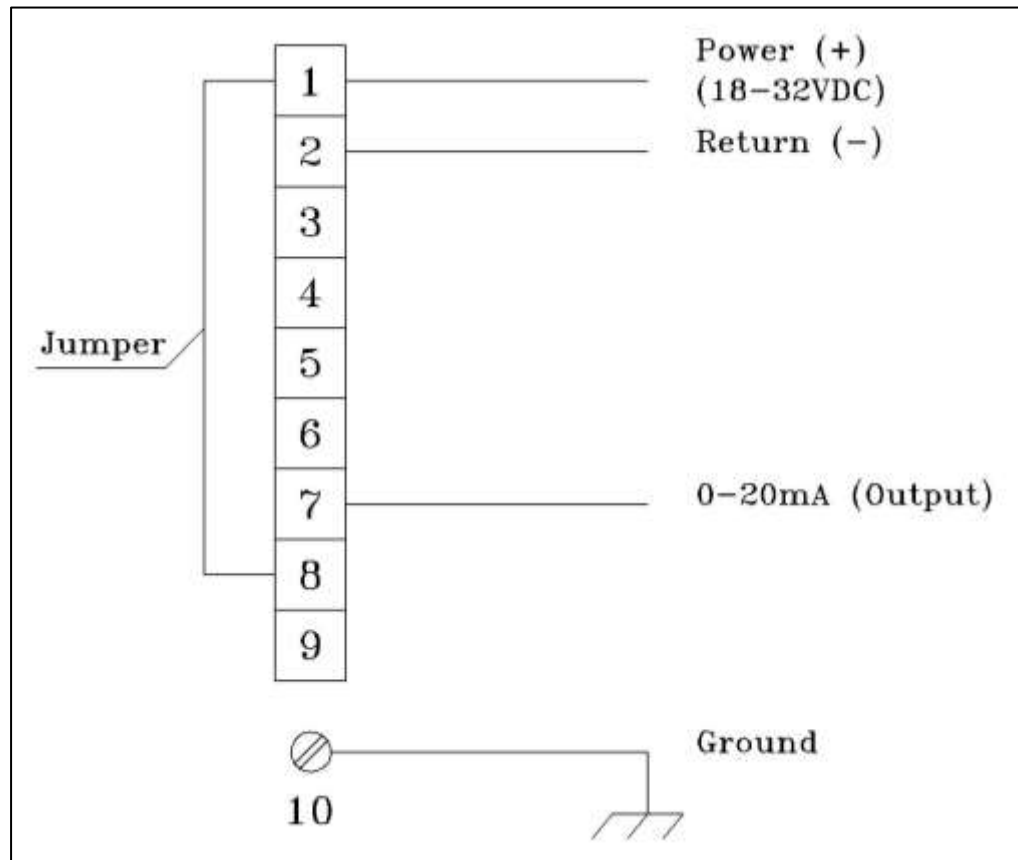


Figure 14: 0-20mA 3 Wire Connection for Option 1 and 3

B.1 RS-485 Communication Network

By using the RS-485 network capability of the SafEye Xenon 700S Detector and additional software, it is possible to connect up to 32 Detectors in an addressable system with four (4) wires only (2 for power and 2 for communication). Using repeaters, the number of Detectors can be much larger (32 Detectors for each repeater) up to 247 on the same four (4) wires. When using the RS-485 network, it is possible to read each Detector status (FAULT, WARNING, and ALARM).

For more details, consult the factory.

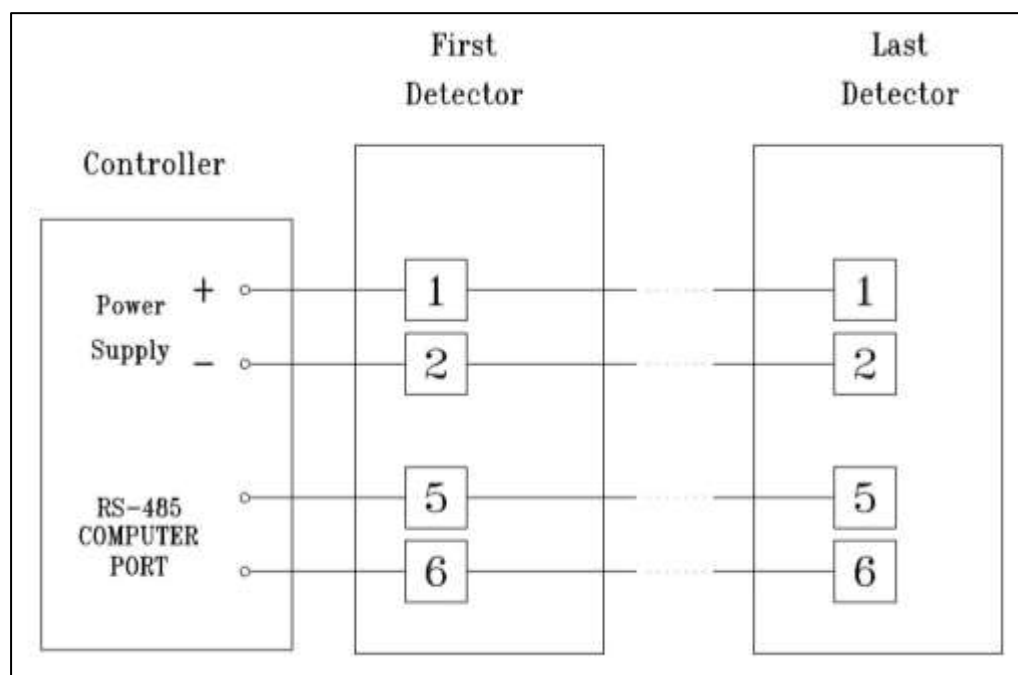


Figure 15: RS-485 Networking for Wiring Option 3

C Special Conditions to Comply to SIL-2 Requirements

➤ In this appendix...

Safety relevant parameters (700S) page 61

Guidelines for Configuration, Installation, Operation and Maintenance page 61

Miscellaneous page 62

Special conditions to comply with the requirements of EN 61508 for SIL-2

This appendix details the special conditions to comply with the requirements of EN 61508 for SIL-2. The SafEye 700S can be used in low or high demand mode applications, see IEC 61508.4, Chapter 3.5.12.

C.1 Safety relevant parameters (700S)

Perform the following functional check of the detector half yearly:

(see chapters Periodic Maintenance *and* Function Check of Unit)

- HFT: 0
- PFD: 3.3×10^{-4} (3.3% of SIL-2)
- PFH: 1.5×10^{-4} (15% of SIL-2) - For 0-20mA signal current application.
- SFF: Fulfills the conditions of EN 61508 for SIL-2.

C.2 Guidelines for Configuration, Installation, Operation and Maintenance

Alarm conditions complying with SIL-2 can be implemented only with 0-20mA outputs.

C.2.1 Conditions for Safe Operation

- The SafEye 700S shall consist only of the approved hardware and software modules
- The 24C power supply must comply with the conditions for "safe low voltage" according to EN 60950 (PELV / SELV).
- After installation and configuration the set-up parameters must be verified and the function of the SafEye 700S (gas detection, function of the 0-20mA interface, relay functions) must be checked completely.

C.2.2 Alarm Operation using the 0-20mA Signal Current

The connected controller has to monitor the 0-20mA signal current for valid values: (see cap. Output Signals)

Mode	Normal	Warning	Alarm
Continuous current with low sensitivity (Full Scale: 5 LEL.m)	4 mA (0 LEL.m)	7.2 mA (1 LEL.m)	13.6 mA (3 LEL.m)
Continuous current with high sensitivity (Full Scale: 2 LEL.m)	4 mA (0 LEL.m)	7.2 mA (0.4 LEL.m)	12 mA (1 LEL.m)
Discrete current	4 mA	14 mA	19 mA

The connected controller has to monitor the 0-20mA signal current for values below 4mA and above 20mA.

C.2.3 Relay Outputs

Relay outputs don't comply with SIL2 requirements.

C.3 Miscellaneous

The complete functional performance of the gas detector has to be verified half-yearly (gas detection, fault detection, performance of the 0-20mA signal current and the relays), gas alarms ON and OFF.

The HART® and RS 485 interface are not allowed to be used for the transmission of safety related data.

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