Xenon 700S

Open-Path Gas Detection System

User Guide

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Legal Notice

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

The detector is 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 product warranty.

Release History

Rev	Date	Revision History	Prepared by	Approved by
1	June 2011	First Release	Ian Buchanan	Eric Zinn
2	August 2013	Second Release	Ian Buchanan	Eric Zinn
3	January 2014	Third Release	Ian Buchanan	Eric Zinn
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About this Guide

This manual describes the SafEyeTM Xenon 700S 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 appendices:

- **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,** describes 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 Conditions for Compliance with SIL-2 Requirements,** describes the special conditions for compliance with the SIL-2 requirements.

Abbreviations and Acronyms

Abbreviation	Meaning
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
Latched	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

1 Scope

In this chapter…

Product Overview *page 15*

1.1 Product Overview

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

The SafEye Xenon detects ambient combustible gases over a path length of up to 459ft/140m, 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.

The SafEye Xenon is manufactured only from stainless steel, with a heated optical window to improve performance in ice, snow, and condensation conditions. The programmable functions are available through an 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 IECEx certified Exd flameproof with an integral segregated rear, an Exe terminal compartment, which avoids exposure of the sensors and electronics to surrounding environment, and an internal Exia intrinsically safe circuit power for heating the window. The detector also has a plug interface for connection to a handheld PC, which meets intrinsically safe standards. Hence the combined approval of Ex d e ia [ia Ga] IIC T5 Gb.

This manual provides a full description of the detector and its features. It includes instructions on the installation, operation, and maintenance of the detector.

- To use the host software with the harness USB RS-485 converter to change the required functions, and for a description of its maintenance, please refer to *Manual TM 899050* for instructions.
- To use the Non I.S. Mini Laptop Unit, refer *to Manual TM777070* for instructions.

To use the HART Protocol to change the required functions and for a description of its maintenance, please 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 ice, condensation, and snow conditions
- Continuous operation in extreme or harsh environmental conditions
- Solar blind and immune to industrial environments
- Withstands extreme vibrations
- Interfaces with most commonly used control panels
- Standard 0–20mA and dry contact relay outputs
- HART Protocol: Communication Protocol (see *HART Protocol*, page 21)
- RS-485 Output Modbus compatible for PC Communications Network for a maximum of 247 systems
- Simple one-person installation, alignment, and calibration
- IECEx approved per Ex d e ia [ia Ga] IIC T5 Gb
- TUV approved per SIL-2 requirements
- Programmable configuration via the handheld unit
- Fast connection to I.S. approved handheld diagnostic/calibration unit
- New operation mode (3mA) "maintenance call"
- A 3-year warranty for the complete SafEye system
- A 10-year warranty for the 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 Principles of Operation

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

2.3.1 Definitions of Terms

The following list defines the gas concentration 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 3 IR sensors: 2 signals and 1 reference. The detection process involves 2 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 at specific wavelengths in the optical path between the radiating source and the detector unit. 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 and rain, 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 Xenon 700 Model uses wavelengths around the 3.4μ 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 and high sensitivity of 0–2 LEL.m, according to the function setup. However, since the desired detection information is air flammability and the actual measurement is radiation absorption around the 3.4μ spectral band, the detector has different sensitivities 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 3.4µ spectral band of the SafEye Xenon 700, the least sensitive gas is pure (100% volume) 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 2 extremes. Every SafEye has 4 built-in gas calibration settings that can be changed by function setup. 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, and 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 a methane mixture with heavier gases, where the methane component can vary between 100% and 95%. It is also good for protecting areas where a leak can be either pure methane or pure propane.

Models 721, 722, and 723 are calibrated to 1 gas only Gas 1 – ethylene 100%.

The 4 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 4 calibrations are appropriate, SPECTREX, through its 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 an extended operation life of up to 10 years.

2.3.8 Heated Optics

SafEye Xenon includes heated optics for the detector and source. To improve performance in conditions where there is ice, condensation, or snow, the heater increases the temperature of the optical surface by 5–8°F / 3–5°C above the ambient temperature. The heated optics are configured to automatically operate when the change in temperature requires heating (default).

However, the heated optics can be defined as 1 of the following modes:

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

See *System Setup*, on page 33.

When operated "per temperature change," the user can define the start temperature below which the window will be heated (default is 41°F/5°C). This temperature can be defined from 32°F/0°C – 122°F/50°C. The heating stops 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 setup
- Detector troubleshooting
- Detector health and status

For more details, refer to *Manual TM 899030*.

2.3.10 Modbus RS-485

For more advanced communications, the SafEye Xenon 700 has an 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, with local and remote diagnostic tools.

2.3.11 Tilt Mount

The newly designed stainless steel tilt mount provides a smaller installation footprint that can conform to limited space constraints, while the sturdy construction maintains alignment even with 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 is approved for the following certifications:

- 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 for use in hazardous zones 1 and 2 with IIC gas group vapors present.

2.5 Models and Types

The 700S series offers 2 groups 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 700S series models.

Table 3: Model Numbers and Installation Distances

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

The 700S Series has 3 wiring options:

- **Option 1**: Power, alarm relay, fault relay, 0–20mA
- **Option 2**: Power, alarm relay, fault relay, 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 is set at the factory and cannot be changed at the customer facility.

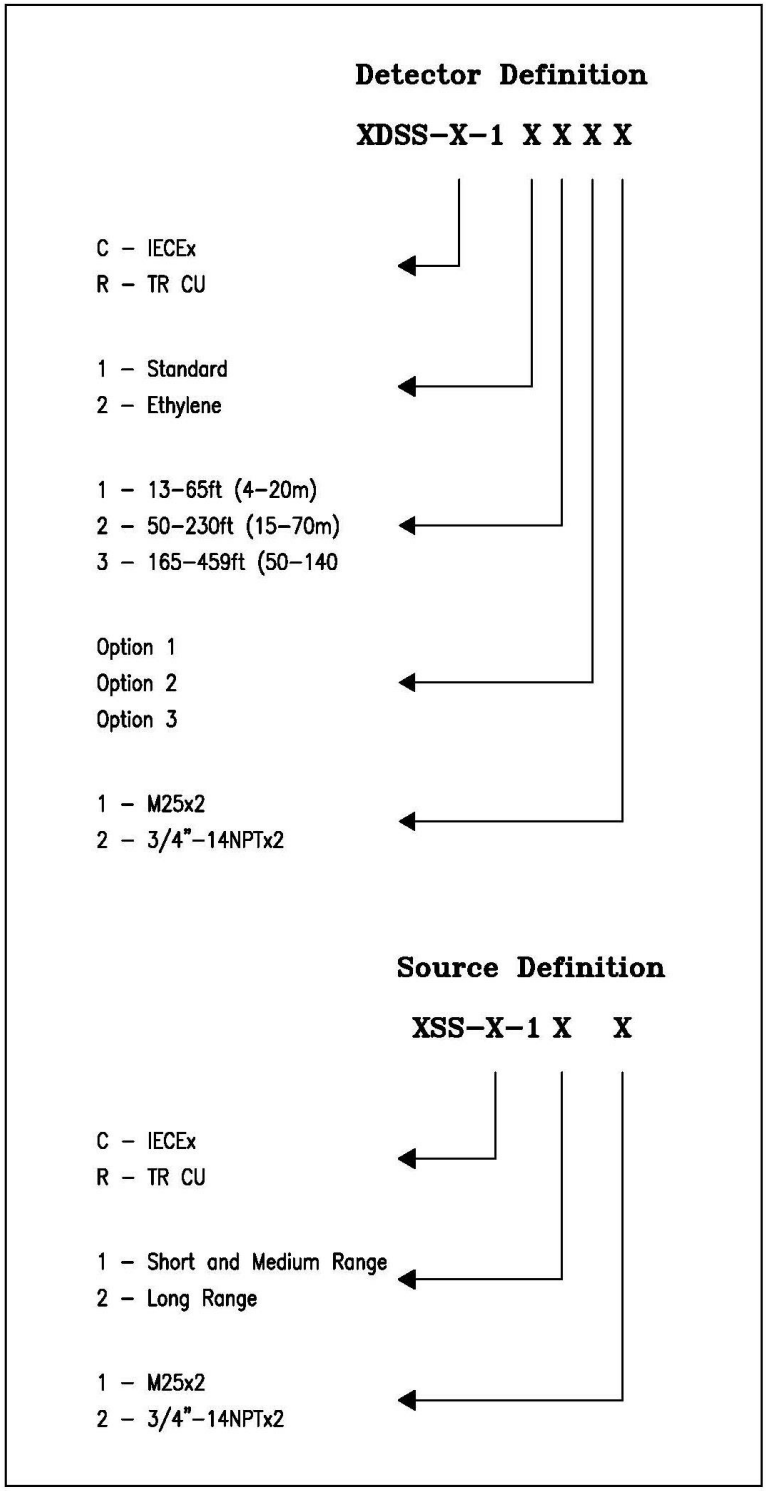


Figure 1: Wiring Options

2.6 Description

The SafEye is comprised of 2 main units:

- The Flash Source Unit
- The Detector Unit

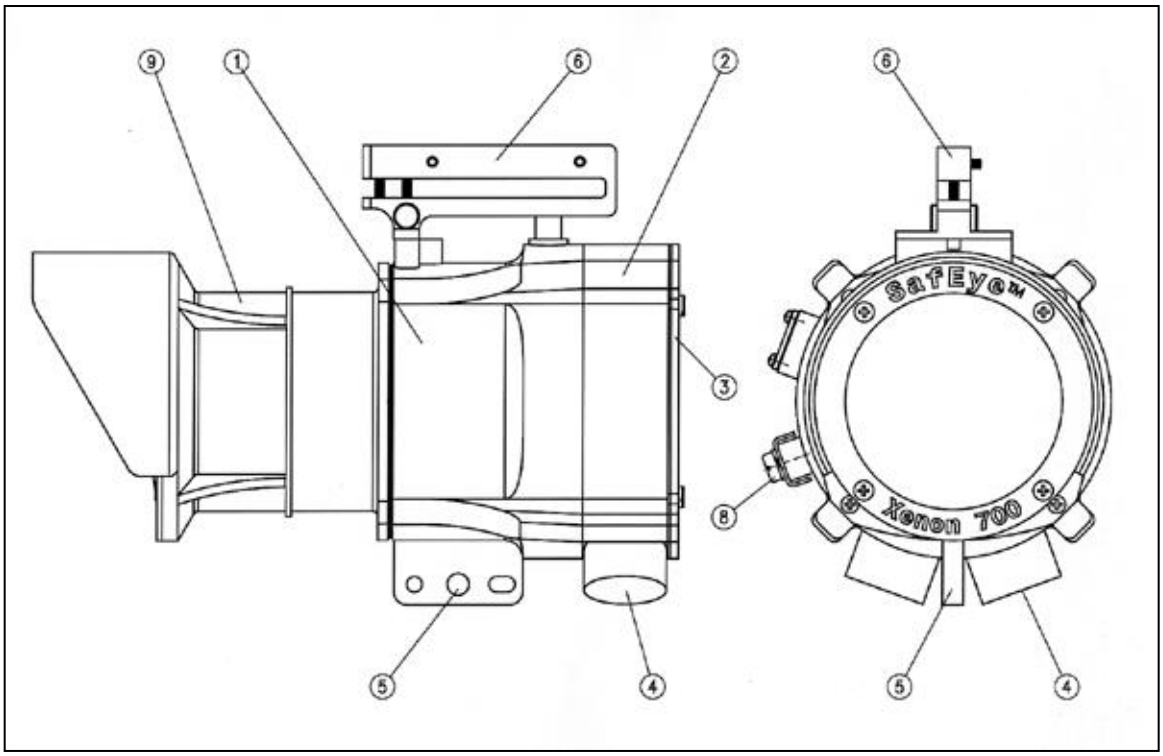
Xenon 700S detects gases over an open path transmitted from the flash source to the detector.

2.6.1 Flash Source Unit

The flash source unit emits IR radiation pulses at the rate of 2 pulses per second. The pulse width (5–10msec) is very powerful. The front of the source unit 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 ice, condensation, and snow conditions.

There are 2 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

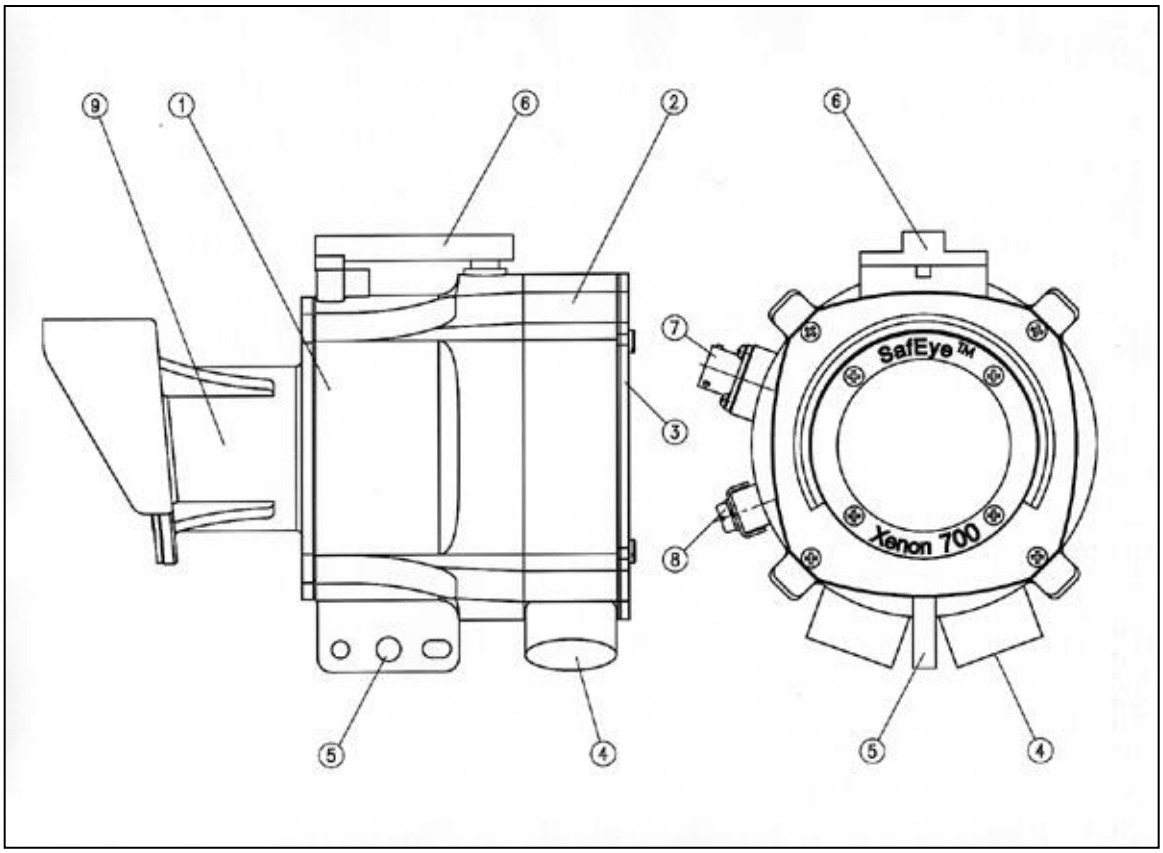
The detector receives the transmitted pulsed radiation signals from the flash source. The signals are then amplified and fed into an analog-to-digital signal converter to be processed by the internal microprocessor. When the signals drop below a prescribed level, the internal microprocessor will compensate for them. This allows the signals 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 ice, condensation, and snow conditions.

Table 4 describes the detector types and their ranges.

Table 4: Detector Types

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



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 Operating Modes

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3.1 Operational Modes

The SafEye 700S has 4 operational modes:

- Normal Mode
- Maintenance Call Mode (3mA Output)
- Fault Mode
- Zero Calibration Mode (1mA Output)

3.1.1 Normal Mode

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

- Normal (N): Signal received from gas detection is at safe levels
- Warning (W): Gases have been detected at warning levels
- Alarm (A): 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 RS-485 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 a low signal or low signal ratio that may be caused by a dirty window, misalignment, poor source, or that 1 of the detector's parameters is at the "limit" value.

The detector continues to operate, reading any gas present, but provides a (3mA) pre-warning signal that a maintenance procedure is required.

3.1.3 Fault Mode

In the fault mode, there are 3 fault types:

- **Fault 1 (2mA output)**

  This is due to blockage, poor alignment, very low signal, partial obscuration, or full beam block. 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 is a delay of 60sec after the fault before switching to this mode. This delay is important to eliminate momentary obscuration due to passing through the beam.

- **Low Voltage Fault (0mA output)**

  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)**

  Detection is disabled due to electrical/software operational failure or central device (memory, processor) fault. A fault of this type causes the detector to cease operation.

3.1.4 Zero Calibration Mode (1mA Output)

This mode calibrates the base level, from which gas is detected, to zero.

It should only be performed when following criteria are met:

- No combustible gases are present
- A clear path exists between the flash source and detector
- Clear weather conditions

Zero calibration must be done after installation, re-alignment, or window cleaning, using the handheld unit or host software on a PC.

3.2 Output Signals

The SafEye system provides the following outputs depending upon the wiring option selected (see *Models and Types*, page 22):

- Standard 0–20mA Current Output
- Dry Contact Relays
- RS-485 Interface

3.2.1 Standard 0–20mA Current Output

The 0–20mA output can provide the detector status measurement in one of the following ways:

- **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). This can be defined by maintenance host or handheld unit.

The 0–20mA functions as current sink but can be configured as source – see *Wiring Option* Configurations, page 67.

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 3 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 the detector is in 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 detector has an RS-485 Modbus-compatible input/output that can send data communication to a PC loaded with the appropriate host software, and receive data or control commands from the PC.

3.3 System Setup

The customer can define various system settings, as described in the following sections.

3.3.1 Detection Function Programming

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

- The HART handheld unit (P/N 799810). Refer to *Manual TM 799060* for programming instructions. The connection of the handheld unit to the detector is fast and intrinsically safe, and allows for function change without opening 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 Setup Function

For the default settings see *Default Detector Setup*, page 35.

3.3.2.1 Gas Calibration

Four gas types can be selected for maximum compatibility with 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 4 calibrations are standard calibrations. The detector can be calibrated for up to 8 different types of gases or mixtures, per customer request.

Each detector will be supplied with a calibration sheet that will define the calibrated gas setup, full-scale, alarm, and warning levels.

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 levels will change automatically according to 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 conditions
- Disable – The detectors are not updated when there is a change in the background conditions

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 Latched	No latched function at alarm relay	Alarm relay is latched. Latched reset can be performed by momentary power disconnection or when detectors are set to alignment mode.
4–20mA 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. Latched reset can be provided only if the detector switches to normal mode.

3.3.2.5 Address Setup

The detector provides up to 247 addresses that can be used in an RS-485 communications link.

3.3.2.6 Heated Optic Operation

The heated optics for the detector unit can be defined as 1 of the following modes:

- Off – Not operated
- On – Operated continuously
- Auto – On, per temperature change (default)

When the detector is set "per temperature change," the user can define the start temperature below which the window will be heated, to be between 0–50°C / 32–122°F. The detector will stop heating the window when the temperature reaches 15°C/59°F above the defined temperature.

This feature applies only to the detector.

The source heated optic must be defined with the order, as 1 of 2 options:

- Heated continuously

  Or

- Start heating below 41°F/5°C (default)

3.3.3 Default Detector Setup

The detector has 8 functions that can be programmed according to customer requirements, either at the factory or at the customer facility, using a PC software host or a handheld unit. The standard setup is as follows:

Table 9: Detector Default Setup

Function	Setting
Gas Type	2
Full scale sensitivity	5 LEL.m
BG Zero Calibration	Enabled
Accessory Relay	Warning*
Alarm Latched	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 Setup

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 37*

Electrical Specifications *page 38*

Mechanical Specifications *page 40*

Error! Not a valid result for table. *page 41*

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 (ft/m)	Max. Installation Distance (ft/m)
701S	XDSS-X-111XX	XSS-X-11X	13/4	65/20
702S	XDSS-X-112XX	XSS-X-11X	50/15	230/70
703S	XDSS-X-113XX	XSS-X-12X	165/50	459/140
721S	XDSS-X-121XX	XSS-X-11X	13/4	65/20
722S	XDSS-X-122XX	XSS-X-11X	50/15	230/70
723S	XDSS-X-123XX	XSS-X-12X	165/50	459/140

Response Time:	3sec to T90
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:	± 1°
Drift:	Long term ± 5% of full scale
Temperature Range:	-40°F/-40°C to +131°F/+55°C
Immunity to false alarm:	Does not produce a false alarm and is not influenced by solar radiation, hydrocarbon flames, or other external IR radiation sources.

4.2 Electrical Specifications

Operating Voltage: 18–32VDC

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 3 output-wiring options. These options must be defined at the factory per the customer order. See *Wiring Option* Configurations, page 67 for wiring/terminal diagrams for each option.

Note: Option 3 is the default unless otherwise specified at the time of the 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: SIL-2 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 a source (see *Wiring Option* Configurations, page 67).

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 Communications Network

The detector is equipped with an RS-485 communications 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.
- The protocol enables continuous communication between a single standard Modbus controller (master device) and a serial network of up to 247 detectors.
- The protocol enables connections between different types of SPECTREX detectors or other Modbus devices to the same network.

4.2.4.3 Relay Output

The detector may include up to 3 of the following relays depending on the wiring configuration selected.

Table 13: Dry Contact Relays

Relay	Type	Normal	Maximum Ratings
Alarm	SPST	N.O.	5A at 30VDC
Accessory	SPST	N.O.	5A at 30VDC
Fault	SPST	N.O.	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 levels in addition to the 0–20mA.

This 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 setup
- Reconfigure setup
- Display detector status and definition
- Perform detector diagnostics
- Troubleshoot

4.3 Mechanical Specifications

Enclosure:	The detector, source, and tilt mount are St. St. 316 Electro chemical and passivized coating		
Explosion Proof:	IECEx Ex II 2(1) G, Ex d e ia [ia Ga] IIC T5 Gb Ta -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”	210 x 145 x 154 mm
	Source	10 x 5.3 x 6.9”	255 x 135 x 175 mm
	Tilt Mount	4.7 x 4.7 x 5.5”	120 x 120 x 140 mm
Weight:	Detector	9.2lb	4.2kg
	Source	10.1lb	4.6kg
	Tilt Mount	4.2lb	1.9kg

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:	+131ºF/+55ºC
Storage Temperature:	+149ºF/+65ºC

4.4.2 Low Temperature

Designed to meet MIL-STD-810C, Method 502.1, Procedure I

Operating Temperature:	-4ºF/-20ºC
Storage Temperature:	-40ºF/-40 ºC

4.4.3 Humidity

The SafEye system is 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

The SafEye system is 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:	Completely protected against dust.
Liquids:	Protected against immersion between 15cm and 1m in depth. Protected against 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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General Considerations	*page 43*
Preparations for Installation	*page 45*
Conduit/Cable Installation	*page 46*
Detector/Source Mounting	*page 46*
Detector Wiring	*page 48*
Detector Terminal Wiring	*page 52*
Flash Source Wiring	*page 53*

5.1 Introduction

The detector and flash source units can be installed and maintained using general-purpose common tools and equipment. The installation procedure must 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, and trained for gas detection maintenance, should be employed. Wiring should only be performed or supervised by someone with knowledge of electronics, particularly wiring installation.

5.2.2 Tools Required

The SafEye system requires the following tools:

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

5.2.3 Site Requirements

When selecting a site location and position for the SafEye system, the following points must be considered:

- Whether the gas being monitored is heavier or lighter than air
- The individual site requirements
- The detector should have a direct view of 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 it is guarded from physical impact

5.2.4 The Source and Detector

The model of detector suitable should be selected according to 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, it is recommended to use a detector that is not at the limit of its operating range. 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 Tips for Selecting a Gas Detector Location

The following are some tips for selecting gas detector locations, in order to provide the best detection coverage:

- For heavier-than-air gases: below potential leak sources.
- For lighter-than-air gases: above potential leak sources.
- Along the expected leak trajectory: near leak sources, considering prevailing wind directions.
- Between leak source and potential ignition sources.
- In areas with expected heavy fog, rain, or snow, consider the effect of long-range installation and install the detector at a 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.

In addition to this manual, the system should include the following:

- Detector unit: XDSS-X-11XXX (See Models and Types, page 22).
- Source unit: XSS-X-1XX (See Models and Types, page 22).
- Two Tilt Mount Bases P/N 799640.
    - One base is used for the detector
    - One 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 1 set is provided for several detectors.
- Telescope Kit P/N 799210.
- Function Check Filter P/N 792260 (1–5). There are 5 options depending on full scale and type of calibrated gas.

5.3.1 Preparing for Installation

➢ **To prepare for installation of the 700S Gas Detector:**

1. Verify the appropriate purchase order. Record the part number (P/N) and serial number of the detectors and source units and the installation date in an 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 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 the detectors and conduits.
4. For wiring, use color-coded conductors or suitable wire markings or labels. 12–20 AWG / 0.5–3.5 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 Wire Selection Tables, page 65).

5.4 Conduit/Cable Installation

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

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

5.5 Detector/Source Mounting

Mount the detector source with the tilt mount kit, (P/N 799640). The tilt enables the detector to be rotated up to 45º in all directions with a fine alignment of up to 3º.

5.5.1 Tilt Kit

The following contents are included with the tilt mount kit (P/N 799640):

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"

5.5.2 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 4 holes of an 8.5mm diameter.

Notes:

- Skip this step if the tilt mount is already installed.
- Detector removal for maintenance purposes 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 to the tilt mount with 5/16"-18UNC x 3/4" screw with No. 5/16" spring washers (9, 10). Use ¼" Hex Key for 5/16" screw (Item 9).

3 Repeat steps 1–2 to install the source.

5.6 Detector Wiring

(Figure 5 and Figure 6)

- **To install the detector wiring:**

1. Remove the 4 socket-head-screws (Item 14, Figure 5) that secure the detector back cover (Item 15, Figure 4). The chamber is now exposed.
2. Remove the protective plug mounted on the detector conduit/cable entry inlet and 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 52 and Figure 9, Figure 10, Figure 11 in Wiring Option Configurations, page 67.
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 connections 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 4 socket-head-screws (Item 14, Figure 5).

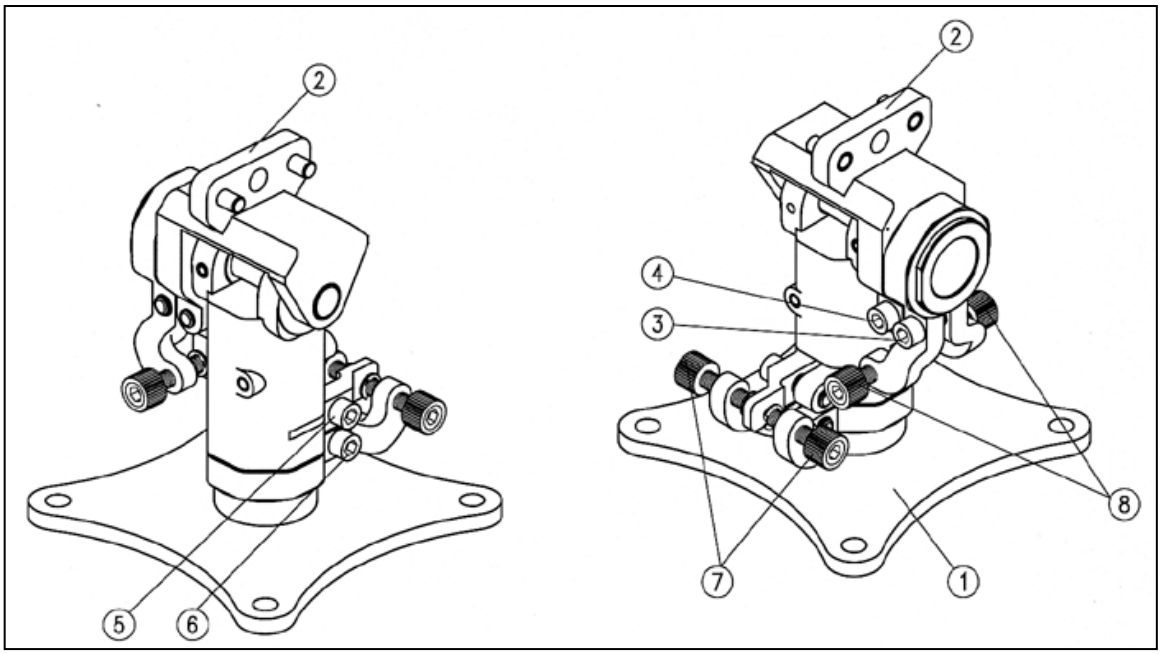

Figure 4: Tilt Mount

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

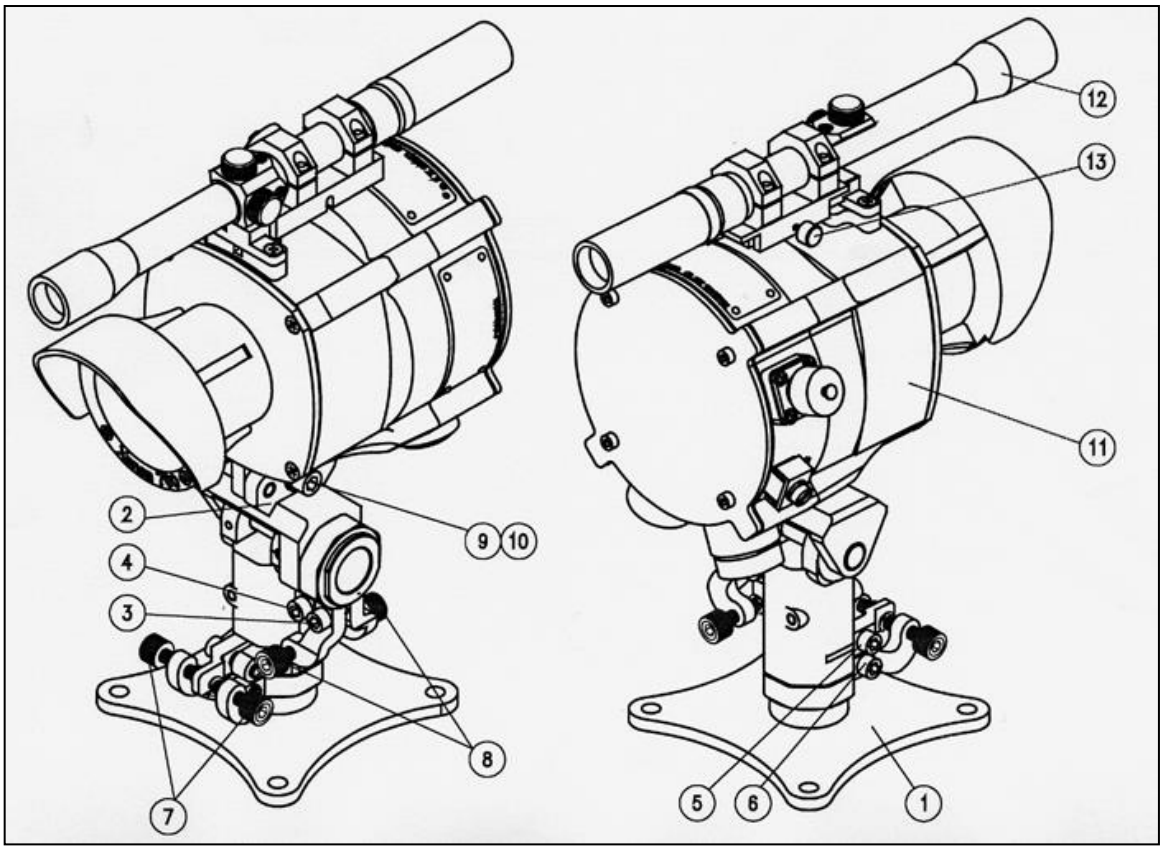

Figure 5: Detector and Tilt Mount Assembly

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		

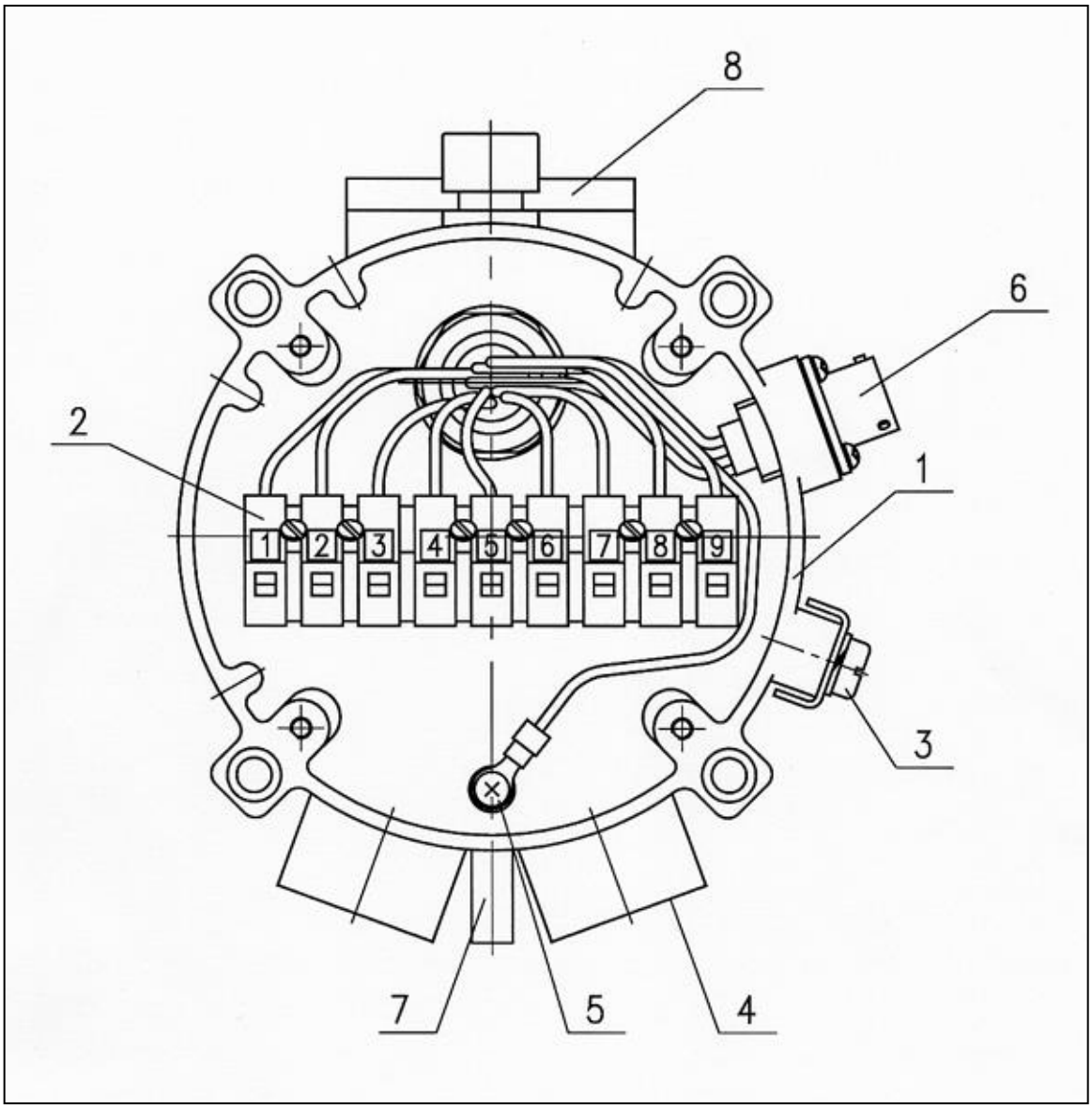

Figure 6: Detector with Cover Removed

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

5.7 Detector Terminal Wiring

The detector has 3 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 the time of the 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:

- The Alarm output is a N.O. contact relay (SPST).
- The contacts are closed in gas alarm state.
- The fault output is N.C. SPST relay. The contacts are closed when the detector is in its normal operational condition.
- Used for communications network as specified in *Wiring Option* Configurations, page 67.
- See *Wiring Option* Configurations, page 67 for more details.
- 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 the function setup.
- Used as RTN to the RS-485 Communications port.

5.8 Flash Source Wiring

5.8.1 Wiring

➢ **To install the wiring:**

1. Remove the 4 socket-head-screws (Item 14, Figure 5) that secure the source back cover (Item 15, Figure 5). The chamber is now exposed.
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 53).
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 4 socket-head-screws (Item 14, Figure 5).

5.8.2 Terminal Wiring

The flash source contains a 3-wire strip terminal:

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

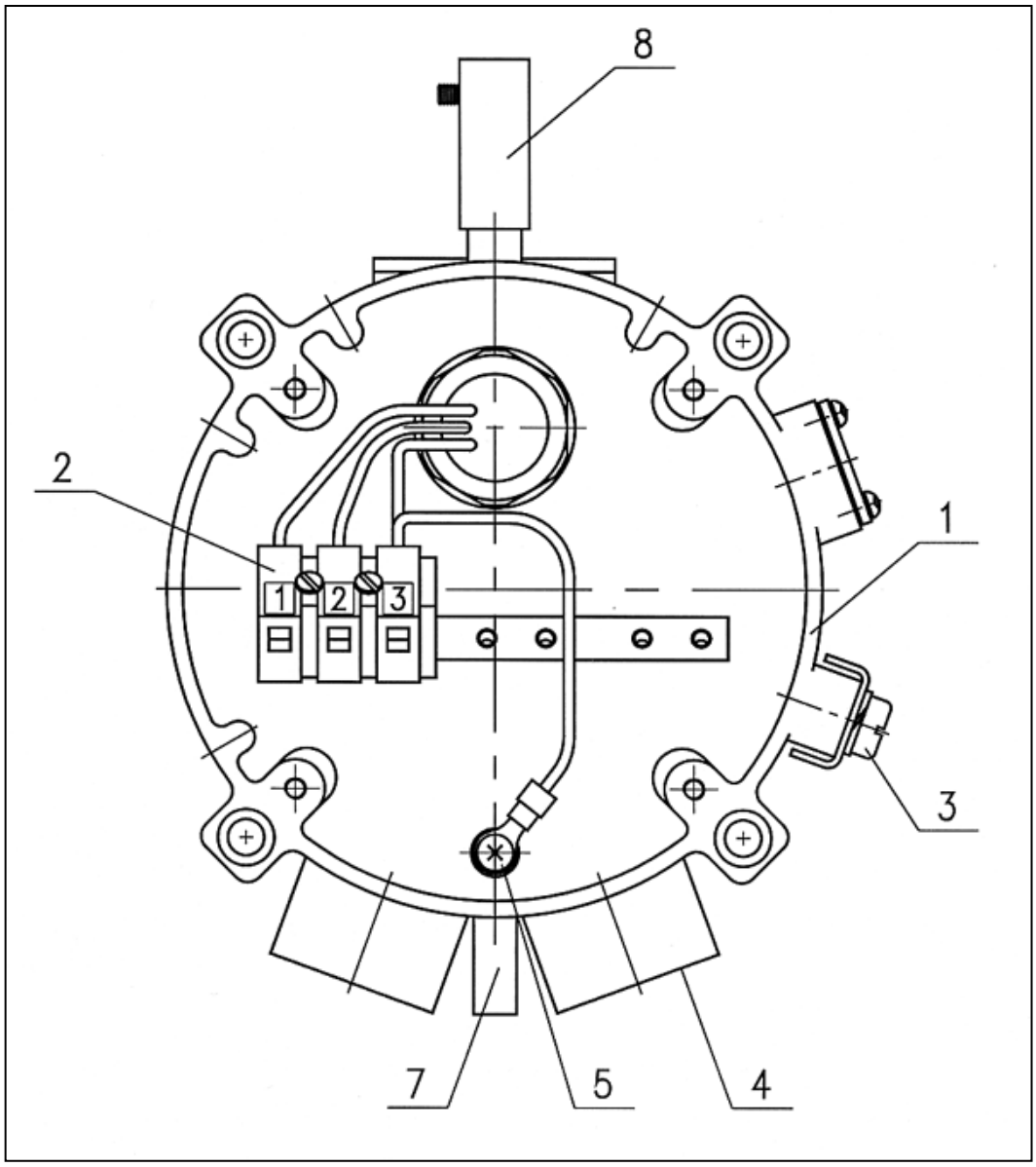

Figure 7: Source with Cover Removed

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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Alignment of Unit	*page 55*
Powering Up the System	*page 57*
Safety Precautions	*page 57*
Signal Verification	*page 57*
Zero Calibration	*page 58*
Functional Check	*page 60*

6.1 SafEye Operation

Once the system is in place, it automatically monitors for the specified gases, and sends signals to a standard control panel or PC. This section describes the alignment, calibration, and operation.

Note: Accurate alignment is essential for proper operation of the SafEye system.

6.2 Alignment of Unit

The telescope is used to perform full alignment.

Alignment procedure should be performed in 2 stages: crude alignment and fine adjustment.

The telescope includes a periscope that consists of a prism and an ocular that are located vertical to the telescope assembly. This allows the user to observe into the opposite unit perpendicularly to the one being aligned when access from the rear of the unit is impossible. For installations where rear access is possible, the periscope is not necessary and it can be removed by releasing the periscope fastening screw.

Notes:

- To ensure proper alignment according to factory calibration, prior to telescope installation, verify that the telescope and its sight mounting are free of dirt.
- To ensure optimal alignment, do not attempt to change factory calibration of the telescope or its mounting.

➢ **To align the unit (see Figure 10):**

1 Ensure that the detector and the flash source are installed properly. Installation instructions are described in Installation Instructions, page 43.

2 Install the telescope assembly (Item 12) on the telescope site mounting of the source according to the drawing. Fasten the telescope with fastening screws (Item 13).

3 Crude alignment:

- Use ¼" Allen screw driver for all alignment screws.
- Loosen screws 5 and 6.
- Approximately aim the source horizontally toward the detector.
- Tighten screw 6.
- Loosen screws 3 and 4.
- Approximately aim the source vertically toward the detector.
- Tighten screw 3.

4 Repeat step 3 for the detector towards the source.

5 Fine Alignment:

- Aim the source to the detector within horizontal axis using screw 7. Aim the telescope cross toward the front level of the telescope site or the detector.

6 Tighten screw 5.

7 Aim within the vertical axis using screw 8.

8 Tighten screw 4.

9 Make sure the telescope cross is pointing to the center of the detector and source window.

10 Repeat step 5 for the detector alignment.

6.3 Powering Up the System

Caution: Prior to any operation or maintenance, follow the instructions in *Safety Precautions,* page 57.

➢ **To power up the system:**

1. Connect the source and detector to the power source.
2. Connect the 0–20mA meter to the detector.
3. Power up the system using 18–32VDC.
4. After 60 seconds, the current meter indicates 4mA.

Note: Zero calibration should be performed after powering up the system (see *Zero Calibration*, page 58).

6.4 Safety Precautions

After powering up, the detector requires minimal attention for proper functioning, but the following should be noted:

- Follow the manual instructions, and refer to the drawings and specifications issued by the manufacturer.
- Do not open the detector/source housing while power is connected.
- External devices such as automatic extinguishing systems must be disconnected before performing maintenance tasks required by the warranty.

6.5 Signal Verification

Perform signal verification through the host software supplied by SPECTREX (see *Detection Function Programming*, page 33).

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 Gain 4
Signal 1	1V Gain1	1V Gain2	1V Gain3	The minimum signal allowed is 2.5V at Gain 4
Signal 2	1V Gain1	1V Gain2	1V Gain3	The minimum signal allowed is 2.5V at Gain 4
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 for that model
- **Med**: Half of the maximum distance as defined for that model
- **Max**: The maximum distance as defined for that model

6.6 Zero Calibration

Zero calibration must be performed after:

- Installation
- Realignment
- Window cleaning
- Any change in detector or source position

Precise alignment must be performed prior to the zero calibration procedure. Perform zero calibration 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 the mode switches to normal. The detector reading is now set to normal and the 0–20mA output indicates 4mA.

  Use the Host HART (refer to *Manual TM888030*), RS-485 (refer to *Manuals TM888050* or *TM799060*), or move the magnetic mode selector above the magnetic switch (see Figure 8) to switch between each mode.

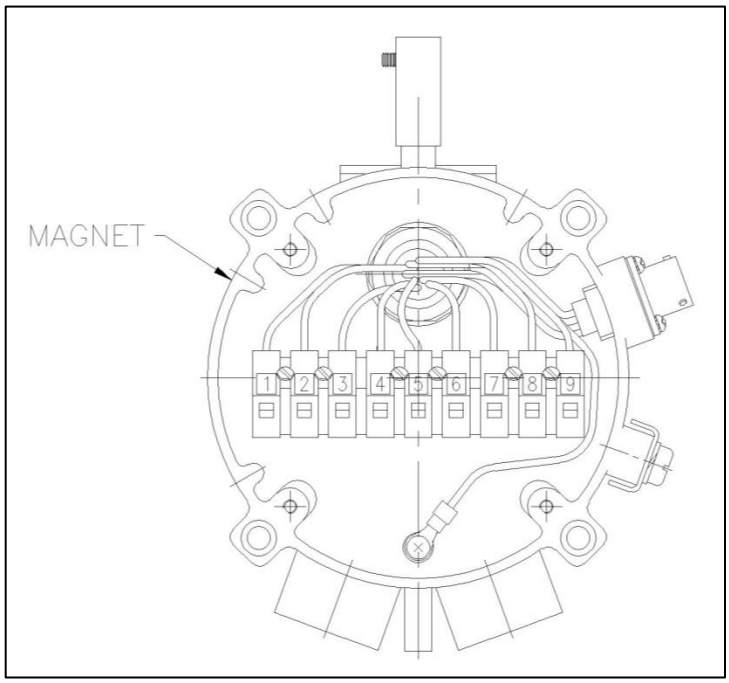

Figure 8: Magnetic Mode Selector

6.7 Functional Check

The SafEye system has been calibrated at the factory for the user's specific gas or vapor detection requirements. The functional check procedure validates the system's functional operation. 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, since it is unnecessary in the procedure, nor does it equate to a particular quantity of gas.

Caution: Disable automatic activation and disconnect any external device that should not be activated during the calibration check.

Notes:

- This functional verification procedure is for a standard 0–20mA output.
- 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. Center the functional check filter's window over the detector's viewing window.
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…

General Maintenance *page 61*

Periodic Maintenance *page 61*

7.1 General Maintenance

Only basic periodic maintenance is required to keep the SafEye Xenon 700 at maximum performance and reliability levels. The detector and source units can be maintained with the use of common tools and equipment. The test results should be recorded in a maintenance logbook, together with a copy of the delivery form.

7.2 Periodic Maintenance

The optical surfaces of the source and detector viewing windows should be kept as clean as possible, as they are active devices. Perform proper maintenance procedures periodically to allow the SafEye system to retain maximum performance and reliability.

Note: The frequency of cleaning operations depends on the existing environmental conditions and the applications used.

➢ **To perform periodic maintenance:**

- Alignment procedures must be performed each time that the source or the detector unit are opened or moved for any reason.
- The signal verification check corroborates the current signals from the flash source compared to that of previous alignments. This check should be performed every 6–12 months. The signal should be checked according to threshold levels (see *Signal Verification*, page 57).
- Perform a functional check every 6 months (see *Functional Check*, page 60).
- The alignment procedure should be performed only if the signals are below threshold value (see *Signal Verification,* page 57).
- Zero calibration (see *Zero Calibration*, page 58) must be done every time the detector or source is realigned, or the windows are 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 involved are the source and detector viewing windows.

➢ **To clean the optical windows:**

1. Disconnect 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. Wash the surfaces 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 the date, name of company, and person who performed the maintenance service into in the maintenance logbook.
7. Reconnect the power to the SafEye detector and source.
8. Perform signal verification (see *Signal Verification*, page 57).
9. Perform zero calibration (see *Zero Calibration,* page 58).
10. Perform a functional check (see *Functional Check*, page 60).

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 the source or detector. Use the PC host software to measure the signal verification.

Refer to *Manual TM 799060* or use the I.S. handheld unit. Refer to *Manual TM 777070* for Non I.S. Mini Laptop Unit.

7.2.3 Functional Check of Unit

The SafEye Xenon 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*, page 60 for instructions.

Caution: Disable automatic activation and disconnect any external device that should not be activated during the calibration check.

8 Troubleshooting

In this chapter…

Troubleshooting Problems *page 63*

8.1 Troubleshooting Problems

Table 21: Troubleshooting Problems

Problem	Cause	Solution
"Maintenance call" status or R, S1, and S2 are below 2.5VDC 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 16VDC. The detector at "V" fault	Low input voltage	Check the power supply and installation

Appendix A: Wire Selection Tables

In this appendix...

General Instructions for Electrical Wiring *page 65*

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 the detector's supply inputs.

Table 22: Maximum DC Resistance at 68˚F/20˚C for Copper Wire

AWG #	mm^2	Ohm per 100ft	Ohm per 100m
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

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

Table 23: Wiring Length in Feet/Meters

No. of Detectors	Recommended Wire Diameter					Power Supply Range (VDC)
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
ft	164	328	492	656	820	
meters	50	100	150	200	250	
	Max. Length from power supply to last detector					

Appendix B: Wiring Option Configurations

In this appendix...

RS-485 *page 71*

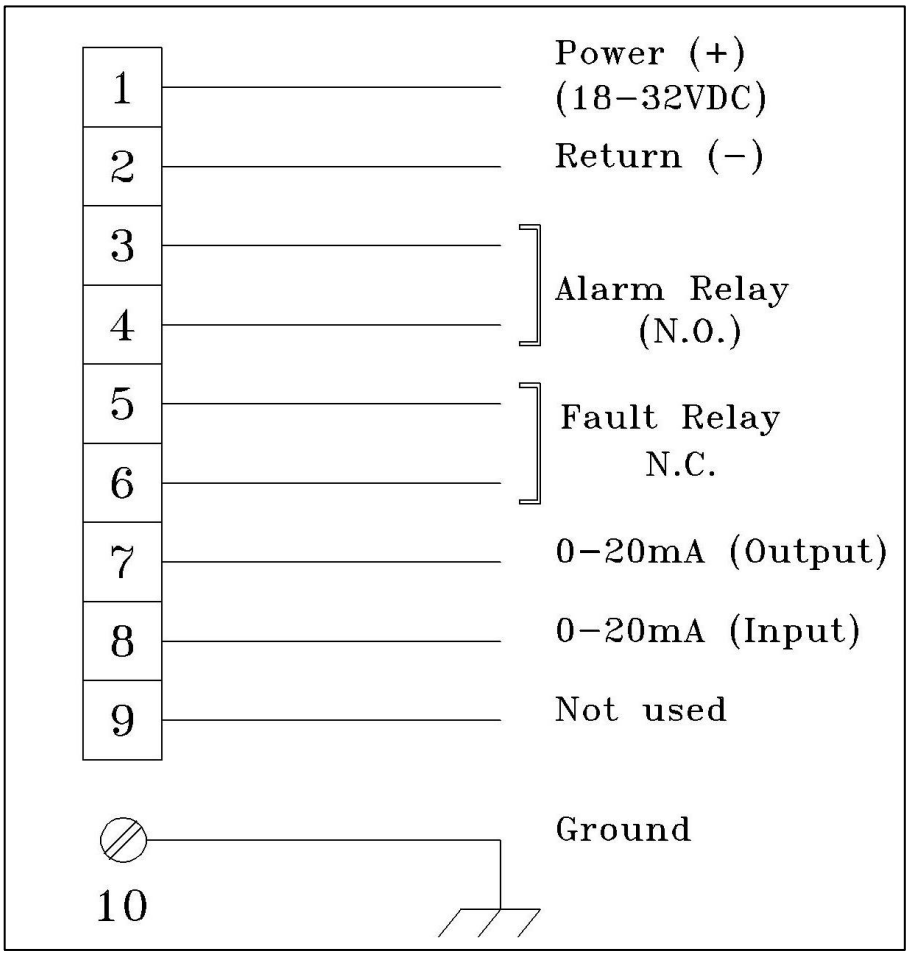

Figure 9: Wiring Option 1

Note: Only 0–20mA is SIL2 approved.

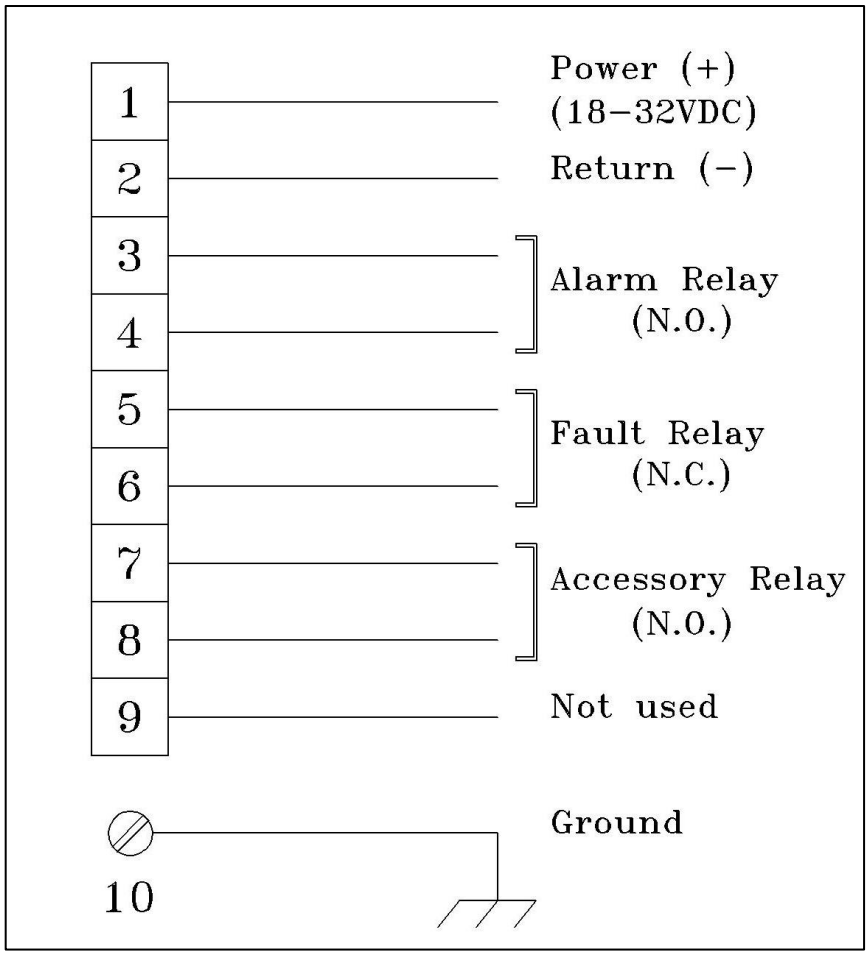

Figure 10: Wiring Option 2

Note: This option does not comply with SIL2 requirements.

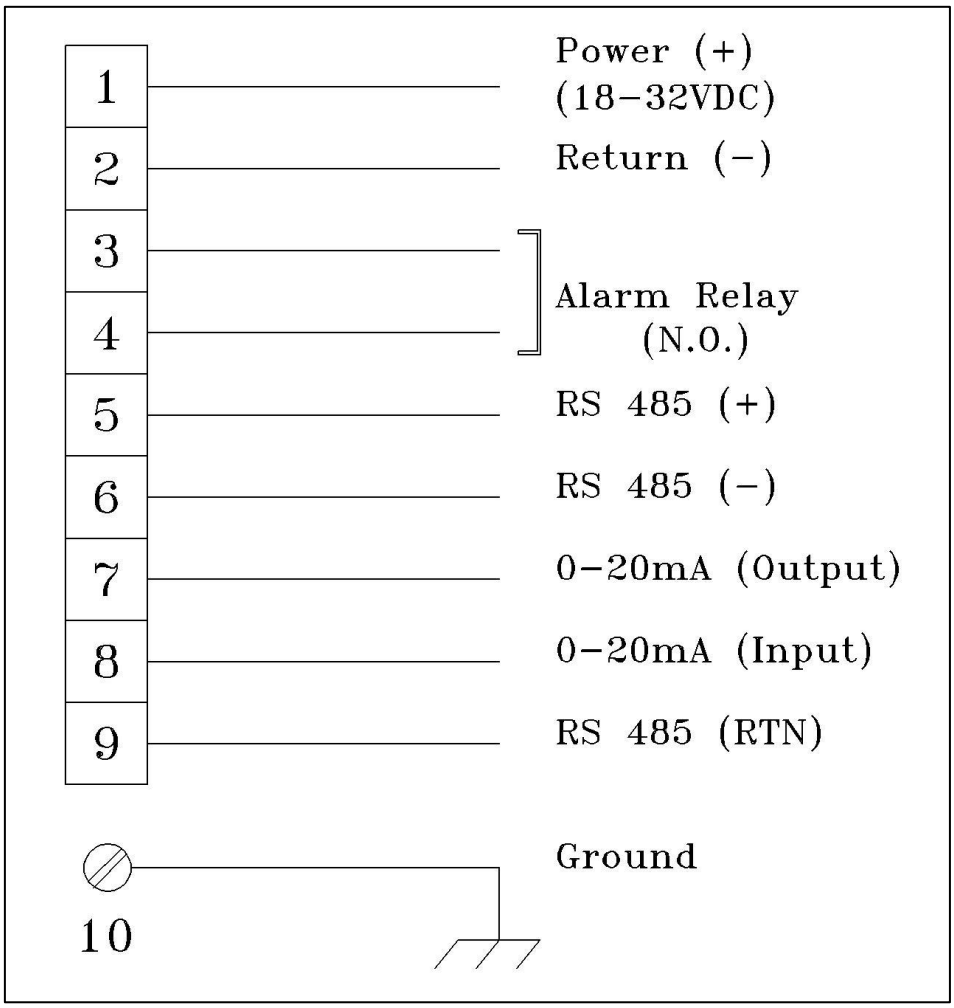

Figure 11: Wiring Option 3 (Default)

Note: Only 0–20mA is SIL2 approved.

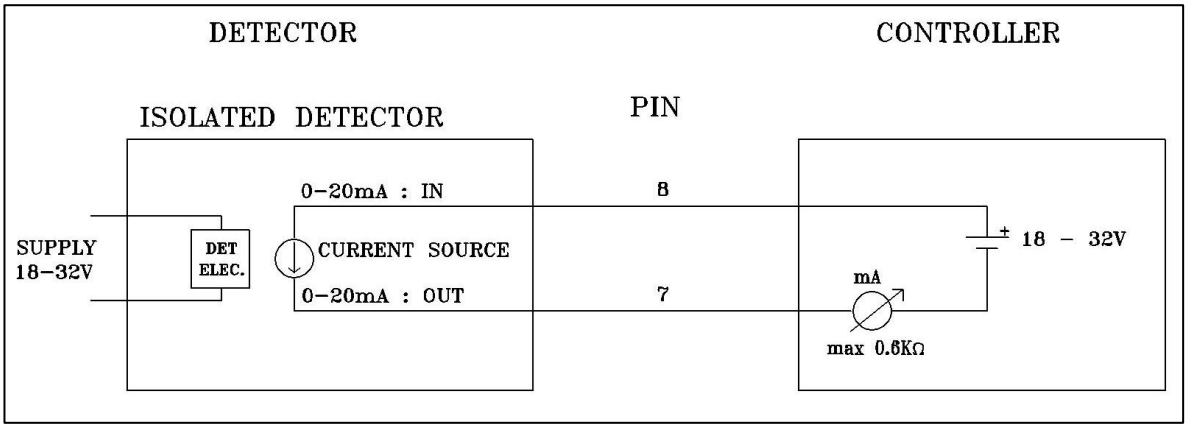

Figure 12: 0–20mA Wiring (Sink) For Wiring Options 1 and 3

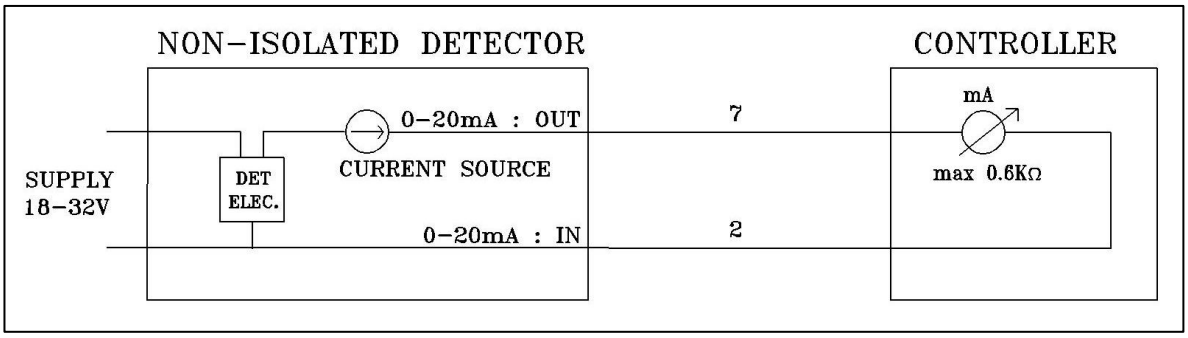

Figure 13: 0–20mA Wiring (Source) For Wiring Options 1 and 3

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.

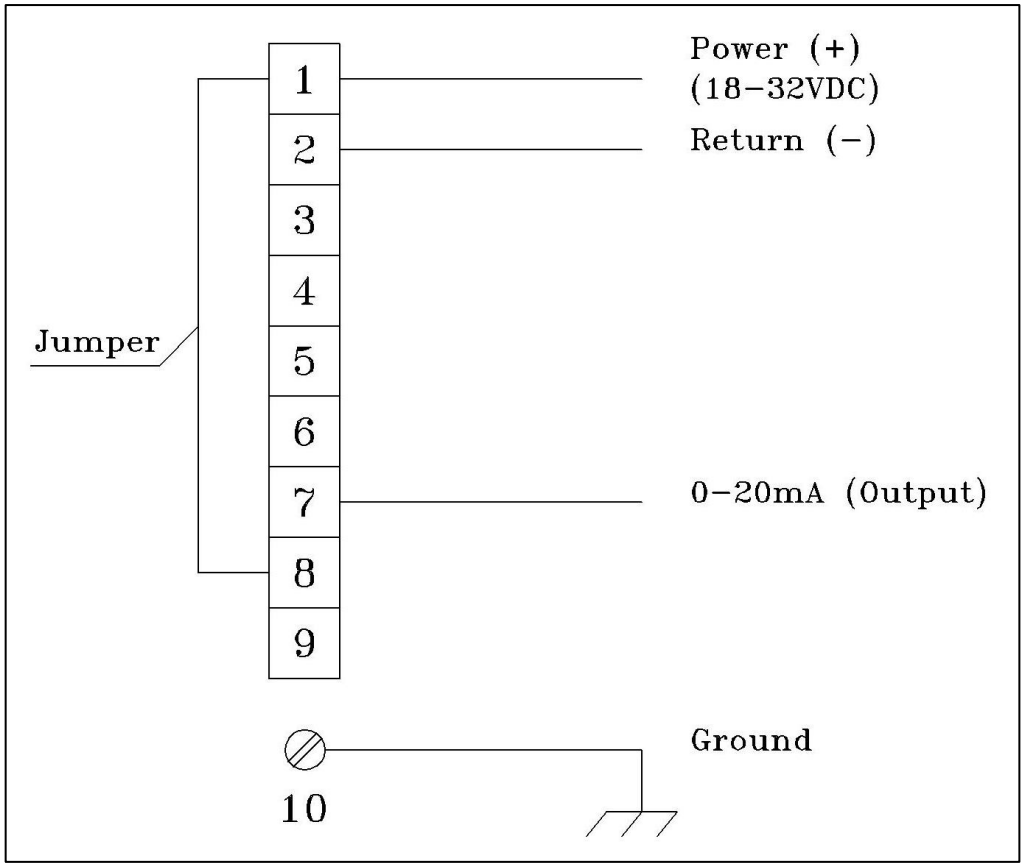

Figure 14: 0–20mA 3 Wire Connection for Options 1 and 3

B.1 RS-485 Communications 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 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 4 wires. When using the RS-485 network, it is possible to read each detector status (FAULT, WARNING, and ALARM) individually.

For more details, contact SPECTREX.

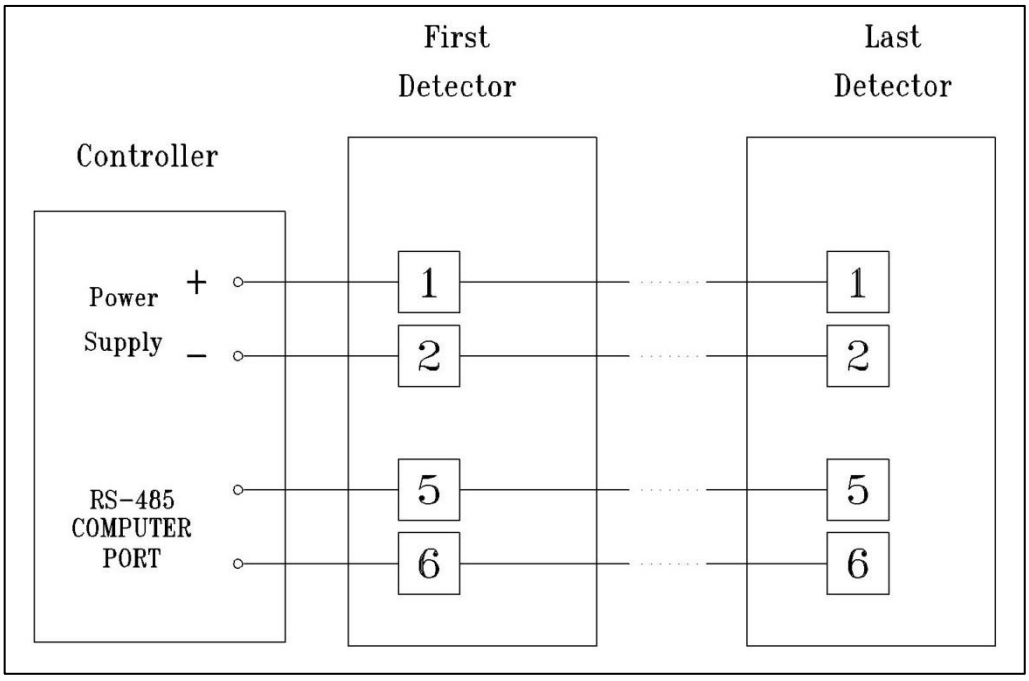

Figure 15: RS-485 Networking for Wiring Option 3

Appendix C: Accessories

In this appendix...

Tilt Mount	*page 73*
Pole Mount (U-Bolt 4–5")	*page 73*
Pole Mount (U-Bolt 2–3")	*page 73*
Wall Mount	*page 73*
HART Handheld Diagnostic Unit	*page 74*
USB/RS-485 Harness Converter Kit	*page 74*
Commissioning Kit	*page 74*
Weather Cover for the Source Unit	*page 74*
Weather Cover for the Detector Unit	*page 74*
Mini Laptop Kit	*page 75*

C.1 Tilt Mount

The tilt mounting brackets (P/N 799640) allow for accurate alignment of the detector/source for proper operation of the open path. The brackets give crude alignment of ±60°, and a fine alignment of ±10°.

C.2 Pole Mount (U-Bolt 4–5")

The U-bolt mount (P/N 799225) is available to facilitate 4–5" pipe mounting.

C.3 Pole Mount (U-Bolt 2–3")

The U-bolt mount (P/N 888140) is available to facilitate 2–3" pipe mounting.

C.4 Wall Mount

The Wall Mount (P/N 799255) is available to facilitate wall mounting.

C.5 HART Handheld Diagnostic Unit

The HART handheld diagnostic unit (P/N 888810) is fitted with a harness to the quick-plug connection, providing an easy, economical connection. The HART handheld unit provides verification, status, and instructions for correcting the detector's parameters. The unit is I.S.–approved, with a special harness to suit the detector, and a host for maintenance and commissioning.

C.6 USB/RS-485 Harness Converter Kit

The USB RS-485 Harness Kit with RS-485/USB converter (P/N 794079), together with SPECTREX host software, enables the user to connect to any available PC or laptop to reconfigure settings or perform diagnostics on the XENON 700 Gas Detector.

Refer to *Manual TM 799050* for programming instructions.

C.7 Commissioning Kit

The commissioning/alignment kit unit (P/N 799247) is required for commissioning and future maintenance checks. Only 1 kit is required per site.

The kit includes an alignment telescope (P/N 799210), a magnetic mode selector (P/N 790285), 2 functional check filters (P/N 792260-1÷5) for system installation and periodical functional testing, as well as socket keys for access to units.

C.8 Weather Cover for the Source Unit

This is designed to protect the source unit from extreme weather conditions (P/N 799267).

C.9 Weather Cover for the Detector Unit

This is designed to protect the detector unit from extreme weather conditions (P/N 799250).

C.10 Mini Laptop Kit

The mini laptop (P/N 777820), pre-loaded with SPECTREX software, enables setting reconfiguration or diagnostics performance on all flame and gas detectors in the series.

Refer to *Manual TM777070* for programming instructions when using the mini laptop kit. The kit includes a cable harness with an RS-485/USB converter. The device is programmed with maintenance WinHost for all types of SPECTREX detectors.

Appendix D: SIL-2 Features

In this appendix...

Safety Relevant Parameters	*page 77*
Guidelines for Configuration, Installation, Operation, and Maintenance	*page 77*
Miscellaneous	*page 78*

This appendix details the special conditions for compliance with the requirements of EN 61508 for SIL-2.

The SafEye 700S can be used in low and high demand mode applications, see *IEC 61508.4, Chapter 3.5.12*.

D.1 Safety Relevant Parameters

Perform the following functional check of the detector every 6 months:

Periodic *Maintenance*, page 61 and *Functional Check of Unit*, page 62)

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

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

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

D.2.1 Conditions for Safe Operation

- The SafEye 700S should consist only of the approved hardware and software modules.
- The 24C power supply must fulfill the requirements for "safe low voltage" according to EN 60950 (PELV/SELV).
- After installation and configuration the setup 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.

D.2.2 Alarm Operation Using the 0–20mA Signal Current

The connected controller monitors the 0–20mA signal current for valid values. (See *Output Signals*, page 31).

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

The connected controller monitors the 0–20mA signal current for values below 4mA and above 20mA.

D.2.3 Relay Outputs

Relay outputs don't comply with SIL-2 requirements.

D.3 Miscellaneous

The complete functional performance of the gas detector should be checked every 6 months (gas detection, fault detection, performance of the 0–20mA signal current and the relays, gas alarms on and off).

The HART and RS-485 interfaces are not meant for the transmission of safety related data.

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