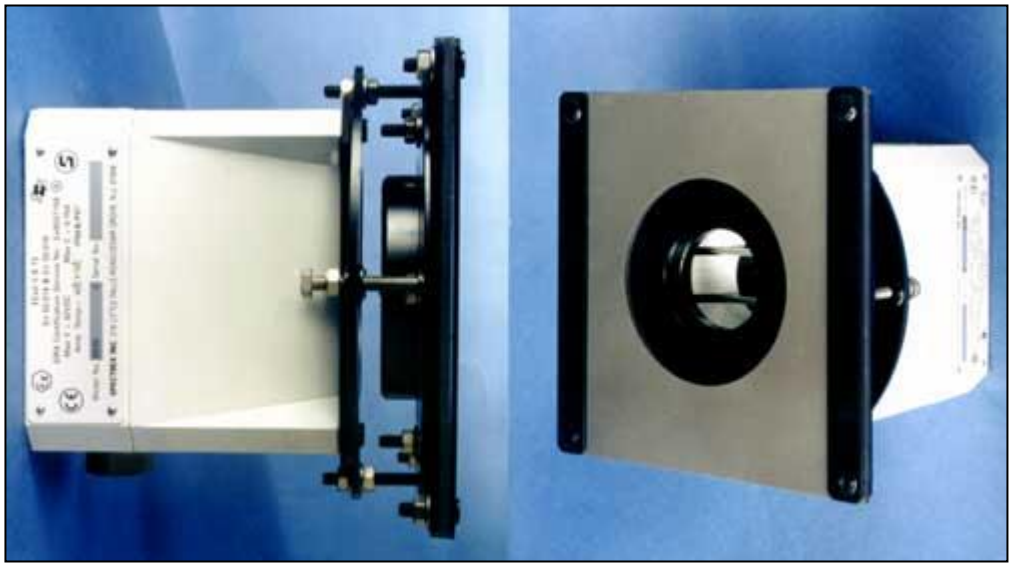
SafEye™

Series 300

Open-Path Gas Detection System

User Guide



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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.

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SPECTREX agrees to extend to Purchaser/Distributor a warranty on the SPECTREX supplied components of the SharpEye products. SPECTREX warrants to Purchaser/Distributor that the products are free from defects in materials and workmanship for a period of five (5) years, commencing with the date of delivery to Purchaser/Distributor. SPECTREX expressly excludes damage incurred in transit from the factory or other damage due to abuse, misuse, improper installation, or lack of maintenance or "Act of God" which are above and beyond its control. SPECTREX will, upon receipt of any defective product, transportation prepaid, repair or replace it at its sole discretion if found to have been defective when shipped. Said repair or replacement is SPECTREX's sole liability under this warranty and SPECTREX's liability shall be limited to repair or replacement of the component found defective and shall not include any liability for consequential or other damages. The customer is responsible for all freight charges and taxes due on shipments both ways. This warranty is exclusive of all other warranties express or implied.

Release History

Rev	Date	Revision History	Prepared by	Approved by
0	December 2010	First Release	Ian Buchanan	Eric Zinn
1	June 2017	Second Release	Jay Cooley	Shaul Serero

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1 Scope

1.1 Product Overview

The SafEye 300 Series is an IR open-path gas detector that detects ambient combustible gases at LEL.m concentrations over a path length from 2ft/0.6m up to 49ft/15m, even in harsh environments where dust, fog, rain, snow, or vibration can cause a high reduction of signal. The shorter path lengths are usually associated with applications in ducts/air intakes to provide a fast response to ingress of flammable gases.

Due to its unique combination of triple optics and dual-spectrum reference sensor, the SafEye can maintain operation in up to 90% signal obscuration and ±2 degree of misalignment.

SafEye has a fast response detection time of no more than 2–10 seconds. This feature enables an adequate time to take appropriate safety measures.

This manual consists of a full description of the detector and its features. It contains instructions on the installation, operation and maintenance of the product. The system is intended to be operated by qualified personnel only.

- To use the host software to change the required functions and for maintenance, refer to *Manual TM899050* for instructions.
- To use the Mini Laptop (P/N 777820) to change the required functions and for maintenance, refer to *Manual TM777070* for instructions.
- To use HART protocol to change the required functions and for maintenance, refer to *Manual TM899030*.

1.2 Document Overview

This manual describes the detector and its features and provides instructions on the installation, operation, and maintenance of the detector.

This manual is divided into separate chapters as follows:

Chapter 1	**Scope** - a general introduction and overview of the product and the manual, with a brief description of its content.
Chapter 2	**Technical Description** - the detector's theory of operation.
Chapter 3	**Operation Mode** - the detector's operation modes, user interface, and indications.
Chapter 4	**Technical Specifications** - the detector's electrical, mechanical, and environmental specifications.
Chapter 5	**Installation Instructions**, including wiring and mode setting.
Chapter 6	**Operating Instructions** and power-up procedures.
Chapter 7	**Maintenance Instructions** and support procedures.
Chapter 8	**Troubleshooting**
Appendix A	**Wire Selection Tables** for electrical wire selection according to installation configuration.
Appendix B	**Wiring Option Configurations** - wiring diagrams for installation.
Appendix C	**Outline Drawings**
Appendix D	**Special Conditions to Comply with SIL-2 Requirements**

2 Technical Description

2.1 Features

- Operating distance from 2ft/0.6m up to 49ft/15m
- Simultaneous detection of C_1–C_8 flammable gases
- High sensitivity and fast response to hydrocarbon gases
- Continuous operation in extreme and harsh environmental conditions
- Withstands extreme vibration conditions
- Interfaces with most commonly used control panels
- Standard 4–20mA and dry contact relay outputs
- RS-485 output for PC communications network for a maximum of 64 systems
- Simple 1-person installation, alignment, and calibration
- SIL-2 approved by TÜV
- Programmable configuration

2.2 Applications

The SafEye system may be used to monitor flammable gas concentration in various applications, such as fence-line monitoring and area monitoring in processing facilities, air-intakes, and duct installations found in various industries, including:

- 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
- Hazardous enclosures and 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

The following list defines gas concentrations measurement terms that are used in this manual:

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, or path length, 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 "fingerprint." There are 3 IR sensors: 2 signals and 1 reference. The detection process involves 2 separate filters: 1 transmitting radiation that is absorbed by a particular gas and 1 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 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 regular sensitivity of 0–5 LEL.m or high sensitivity of 0–2 LEL.m according to functions setup.

In the short-range duct Model 301, the standard full scale is 2.5 LEL.m or 1 LEL.m by DIP-Switch.

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 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 3.4µ 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 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:

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% and 95%. It is also good for protecting areas where a leak can be either pure methane or pure propane.

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 local agents, can advise on how to calibrate a SafEye detector to any specific gas.

2.3.7 HART Protocol

The SafEye 300 uses the HART Protocol.

HART communications is a bi-directional industrial field communications 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 TM899030*.

2.3.8 Handheld Unit

The P.C. diagnostics unit (P/N 777820) is available to make installation and maintenance easier. This is an all-in-one diagnostic/calibration/interrogation plug-in unit that allows for 1-person installation and maintenance.

The handheld unit can be used for onsite function programming and setup 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 troubleshooting, the handheld unit will provide recommendation of maintenance action to overcome and optimize the detector's performance.

For more details, refer to *Manual TM777070*.

2.3.9 Modbus RS-485

For more advanced communications, the SafEye Xenon 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 of local and remote diagnostic tools.

2.4 Product Marking

The SafEye 300 Series open path gas detector and source unit are certified to:
FM per Class I, Div. I, Groups B, C, and D

Class II, Div. I, Groups E, F, and G

Type 6P, IP66/IP67

2.5 Models and Types

This manual includes information for SafEye Series 300 models. Table 1: Model Selection Guideline for SafEye Series 300 IR Type identifies the detector model options in reference to the required gas type and detection range.

Table 1: Model Selection Guideline for SafEye Series 300 IR Type

Model	Distance		Detector*	Light Source*	Option for Duct Mount	Option for St.St Enclosure
	Ft	m				
301S	2–11.5	0.6–3.5	OP-IL000XFX	OPS-LI0XFX	Yes	Yes
302S	9.8–49	3–15	OP-IL100XFX	OPS-LI0XFX	Yes	Yes

Note: For standard installation add "S" suffix. For duct installation add "D" suffix. For St.St. version add "St" suffix after the "D" or the "S" suffix.

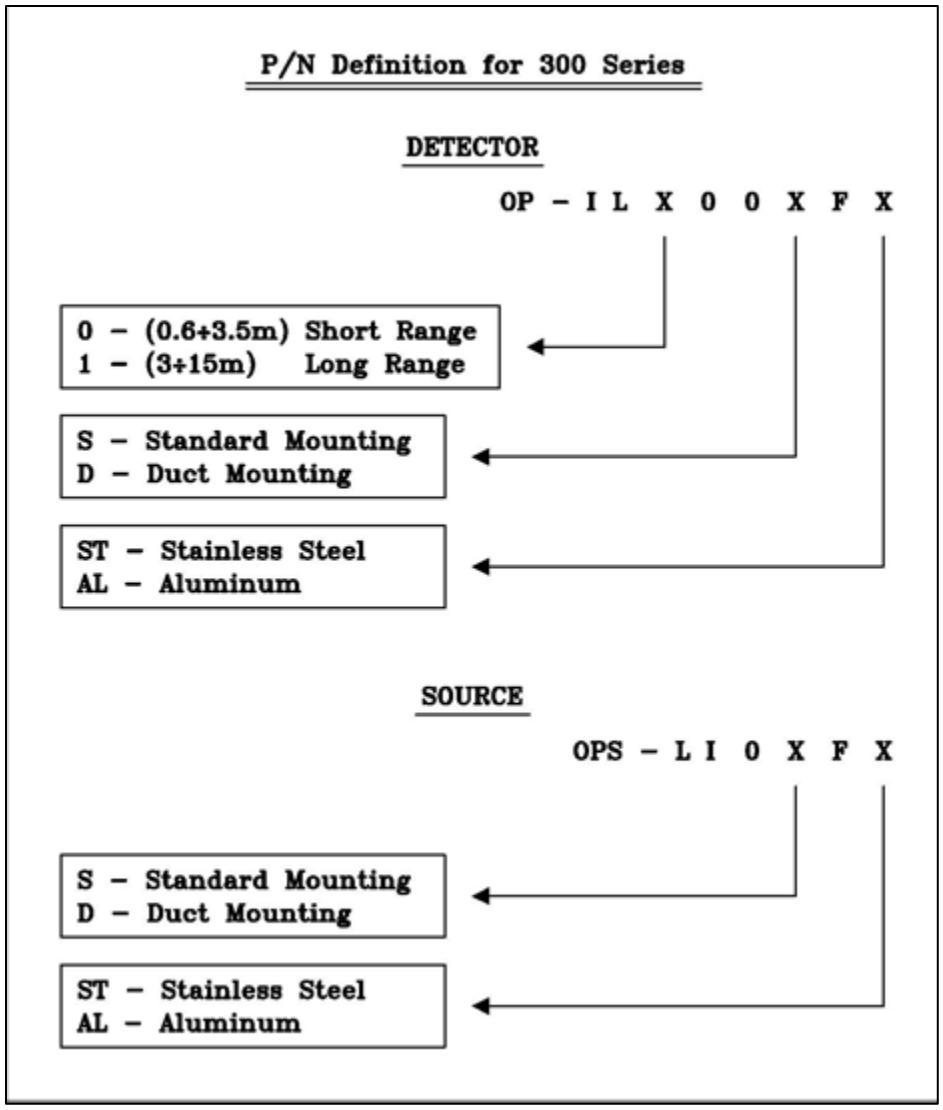


Figure 1: P/N Definition for the 300 Series

2.6 Description

The system comprises 2 main units: the light source and the detector. The SafEye system detects gases over an open path transmitted from the light source to the detector.

2.6.1 Light Source Unit

The light source unit emits IR radiation pulses in a collimated beam (for maximum intensity) to the detector unit. The model number is OPS-LI0XFX (Figure 2).

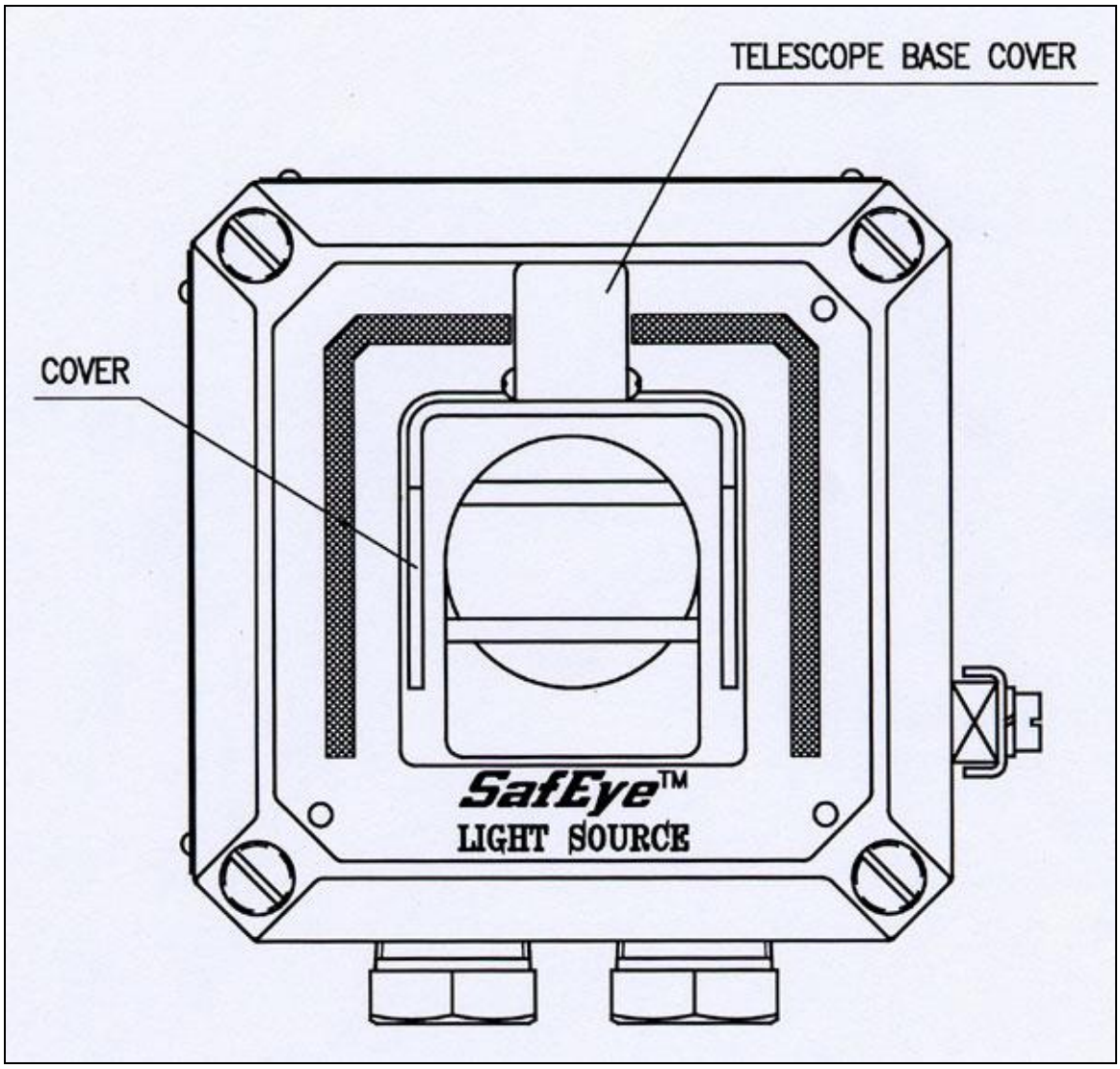


Figure 2: Light Source – Reflector Type

2.6.2 Detector Unit

The detector's sensors receive the transmitted pulsed radiation signals from the light source (see Figure 3). 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 Series 300 detector is available in 2 basic types:

- Model OP-IL000XFX, for short-range installation.
- Model OP-IL100XFX, for medium-range installation.

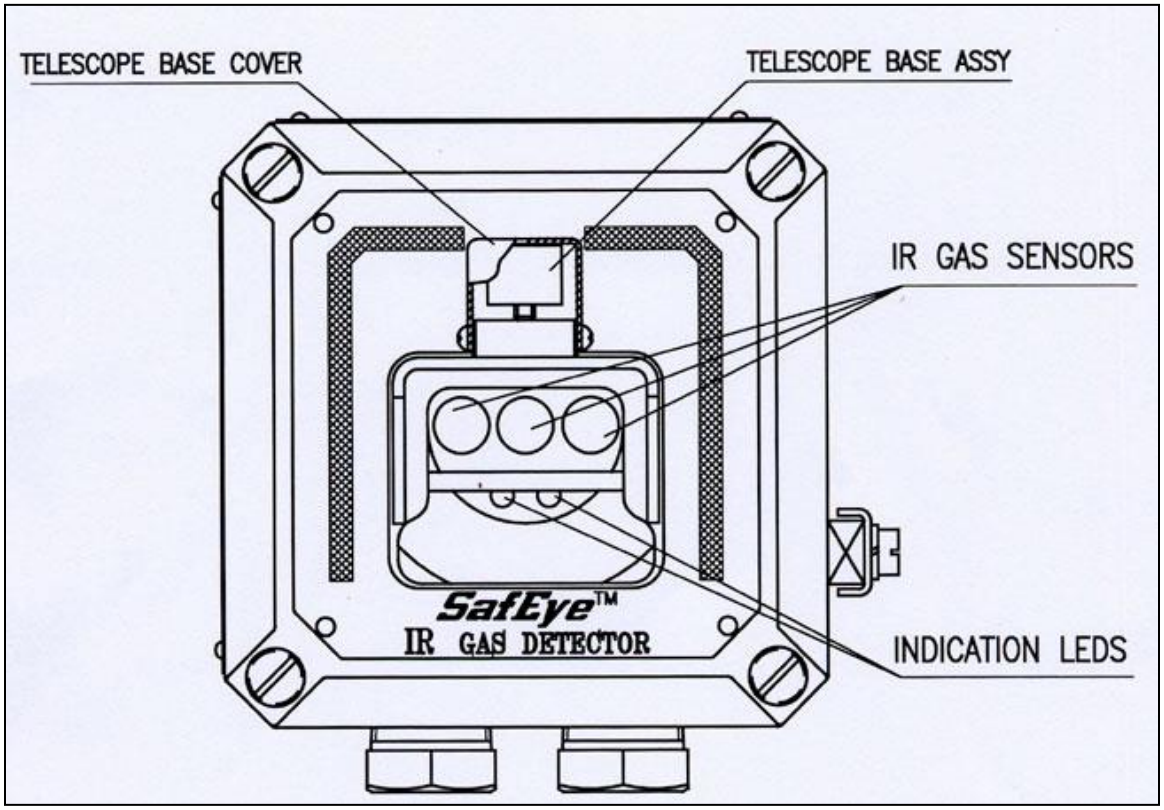


Figure 3: Detector

3 Operation Mode

The SafEye system has 3 operation modes: Normal, Alignment, and Zero Calibration.

3.1 Normal Mode

This mode is used for gas detection. The following status signals are possible (see Table 2 for visual indications):

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.

3.2 Fault Mode

There are 3 fault types:

- **Fault 1 (2mA Output)**
  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 will 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 objects/people 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 is restored.
- **Fault 2 (0mA Output)**
  In this case, the **detection is disabled** due to an electrical/software operational failure or a central device (memory/processor) fault. Such faults cause the detector to cease operation.

3.3 Alignment Mode

This mode is used when the received signal needs to be measured (i.e. installation and periodic maintenance). LED indications represent the received signal strength for precise alignment. There is a temporary standby mode to enable the option of switching from alignment mode to calibration mode.

3.4 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 paths between the light source and detector
- Clear weather conditions

Zero calibration must be performed after installation, re-alignment, and window cleaning, using magnetic mode selection.

3.5 Mode Selection

A magnetic mode selector is used to change to alignment and calibration modes by placing the magnet on the side of the detector (Figure 16).

3.6 Visual Indicator LEDs

There are 2 indicators (LEDs) located in the detector's front window, referred to as the right and left LEDs. They display red, orange, and green lights that can be either "On" steady, flashing, or "Off."

Table 2: LED Status Indication

Status	Remarks	Left LED	Right LED	LED Status	4–20mA Output
Normal		Green	Off	On	4mA
Warning	See Note 4	Red	Off	On	14mA
Alarm	See Note 4	Red	Red	On	19mA
Fault 1		Orange	Off	On	2mA
Fault 2		Orange	Orange	On	0mA
Low Voltage		Orange	Orange	Both LEDs flash at rate of 2Hz	0mA
Alignment Mode	First receives the intensity compared to the last calibration: The intensity is min. 80% of the last calibration intensity	Green	Green		0mA
	80%–60%	Orange	Green		0mA
	60% or less	Red	Orange		0mA
	After 20 seconds the color represents the signal intensity (See Note 2)	See Note 1	See Note 1		0mA
Standby mode		Green	Green	Both LEDs flash alternately at a rate of 2Hz.	0mA
Calibration mode	See Note 3	Off	Off		0mA

Notes:

1 The number of flashes shows the intensity of the received signals while the color represents the gain (see Table 3). The left LED shows the "tens" unit of the number while the right LED displays the "one" unit of the number of the signal intensity. Each LED will flash 0 to 9 times (9 being the maximum possible signal intensity). When the left LED has reached its highest signal, look at the right LED for fine adjustment.

Table 3: Alignment Indication LED Color

Left LED	Right LED	Gain
Red	Red	3
Orange	Orange	2
Green	Orange	1
Green	Green	0

2 After 20 minutes at alignment mode the detector will return to normal mode.

3 After zero calibration is finished, the detector will return to normal mode and the signal intensity will be saved for next alignment comparison.

4 The 4–20mA level in this table refers to discrete indication option. A different (continuous reading) option is described later in *4–20mA Current Output* on page 24.

3.7 Output Signals

The SafEye system provides the following outputs:

- Standard 4–20mA port
- Three dry contact relays
- Optional RS-485 output for PC communications

3.7.1 4–20mA Current Output

The 4–20mA output can provide the detector status measurement in 1 of the 2 following methods:

- It can be measured proportionally (default) showing a continuous reading of the exact gas concentration (see Table 4).
- It can be a discrete indication according to the detector mode or the warning or alarm signal at a defined gas concentration. Setting of this method can be done by a maintenance host or PC unit.

The 4–20mA functions as the current source. The maximum permitted load resistance for the 4–20mA output is 600ohms. The minimum permitted load resistance is 100ohms.

Table 4: Standard (Default) 4–20mA Current for the Gas Channel

Current	Status and Description
0mA + 0.5mA	Fault 2 or low voltage
2mA ± 0.5mA	Fault 1
4mA ± 0.5mA	Zero reading - no gas detected
4–20mA	Continuous measuring of gas concentration at a range between 0 and 5 LEL.m or full scale
21mA	Concentration is over the range limit (more than full scale concentration).

Table 5: Discrete Reading of 4–20mA at Different Detector Modes

Current Reading	Mode	LEL.m Setting	
		301	302
0 + 0.5mA	Fault 2 or low voltage	-	-
2 ± 0.5mA	Fault 1	-	-
4 ± 0.5mA	Standby	0	0
14 ± 0.5mA	Warning	1	1
19 ± 0.5mA	Alarm	1.5	3

3.7.2 Relays

The detector includes 3 relays:

- Fault relay
- Alarm relay
- Accessory relay

Fault relay contacts are normally energized closed and opened when in fault condition.

3.7.3 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. Communication with the PC is operated through this interface is executed only when used with appropriate host software.

3.8 Terminals

Terminal outputs are described for the detector and the light source.

3.8.1 Detector Terminal

Terminal wiring: Figure 4 displays a schematic diagram of the terminals and Figure 5 shows their location.

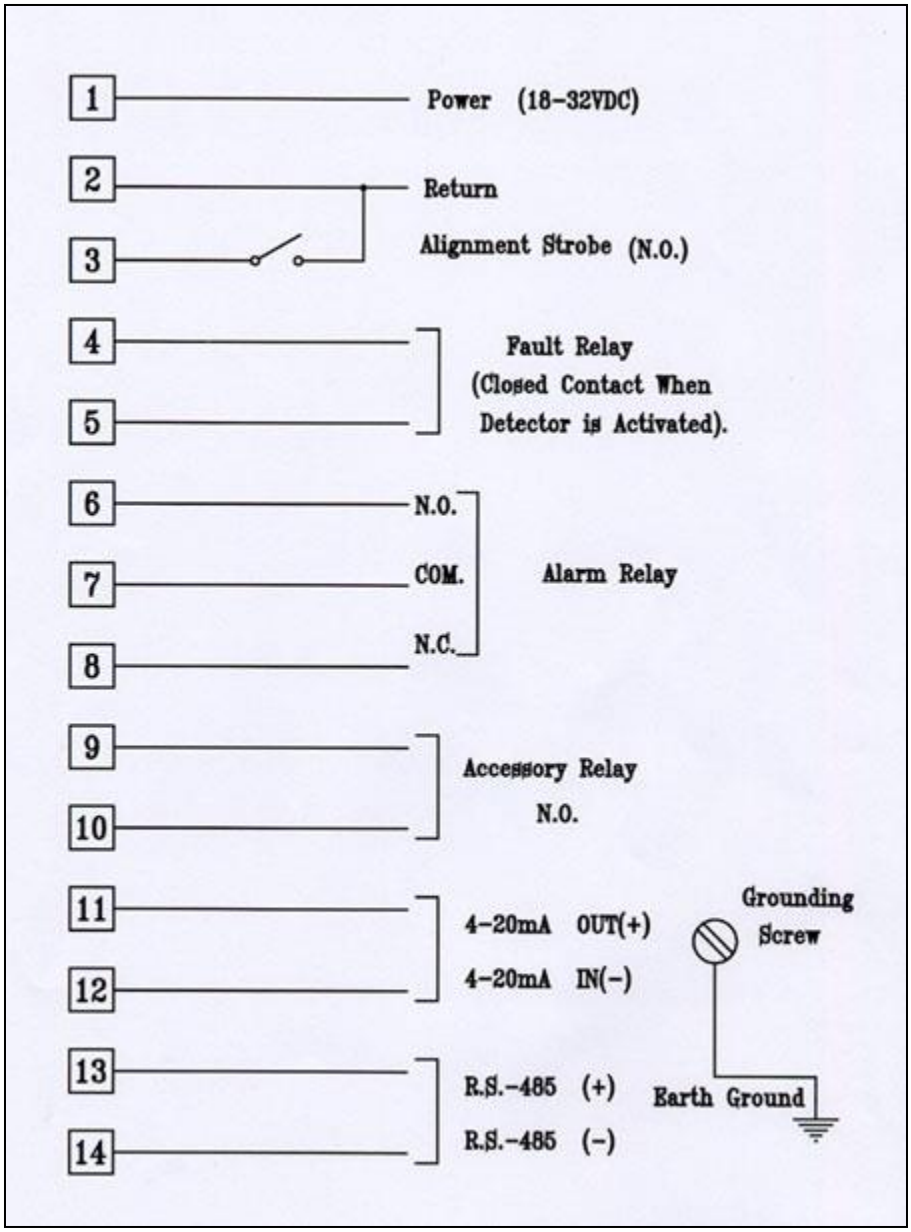
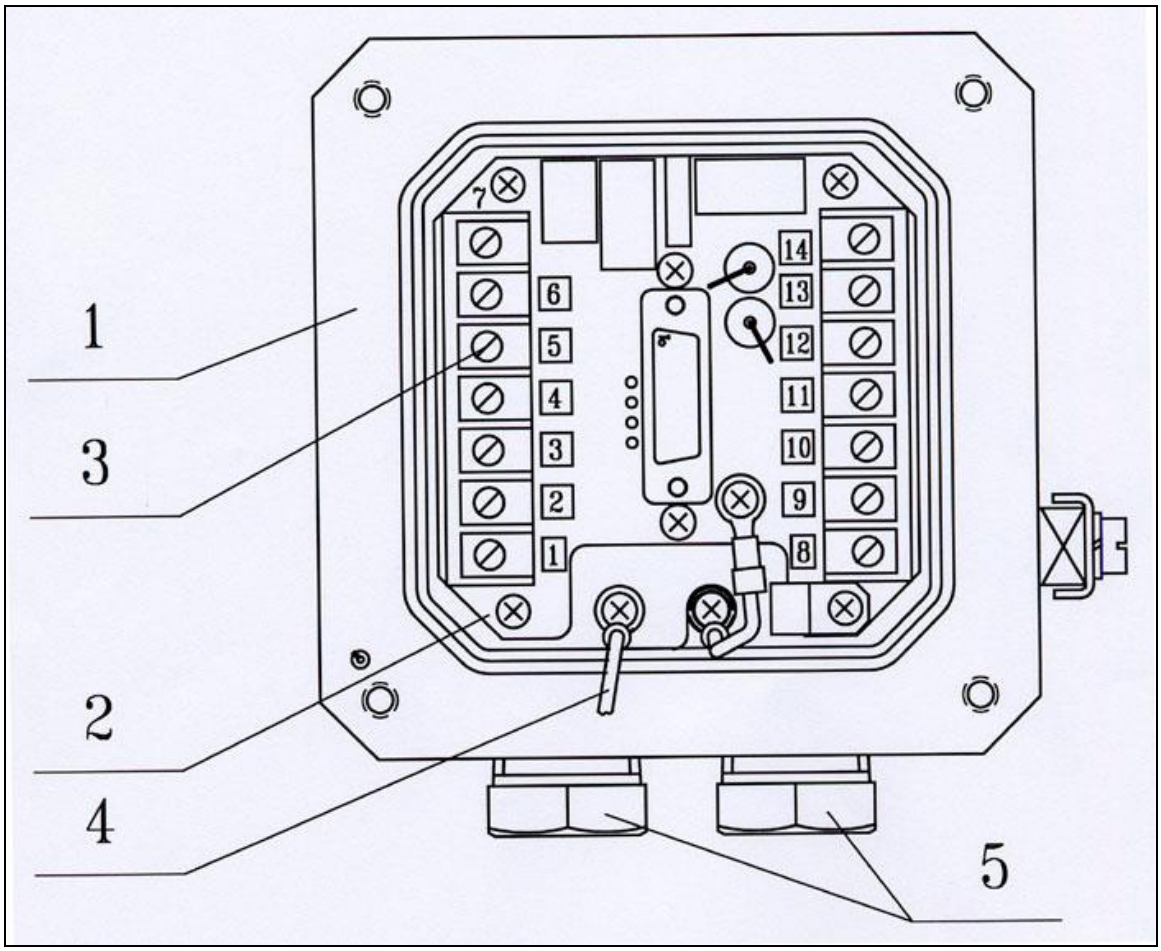


Figure 4: Detector Wiring Diagram



Description	
1	Detector Cover
2	Terminal Board
3	Terminal Screw
4	Securing Cable

Figure 5: Detector Terminal Board

3.8.2 Light Source Terminals

Figure 6 shows the terminals board and Table 6 describes their use.

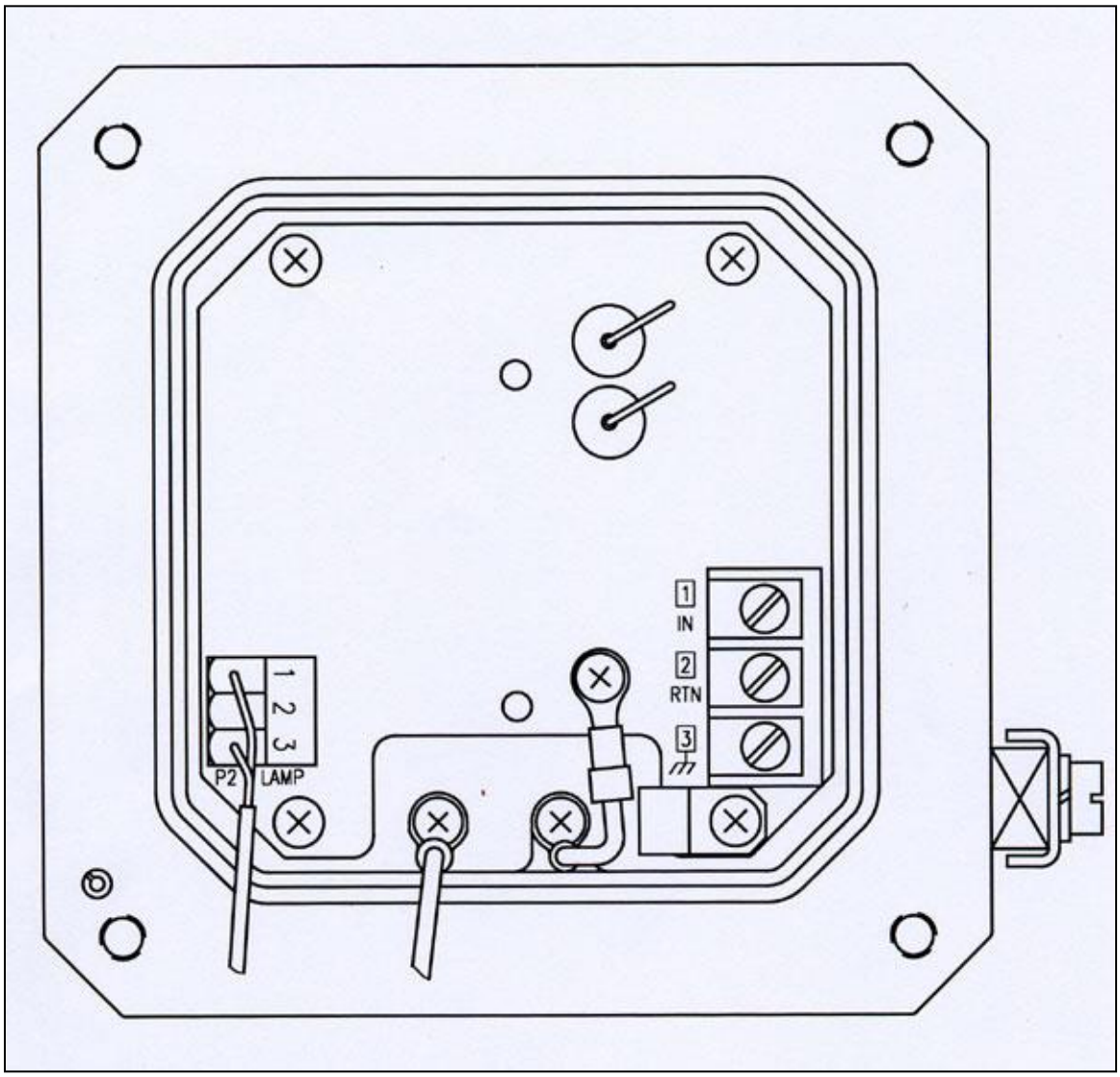


Figure 6: Light Source Terminal Board

Table 6: Light Source Terminals

Light Source Terminal Number	Description
1	VIN
2	RTN

3.9 System Setup

3.9.1 Detection Function Programming

The SafEye 300 series incorporates several functions that can be set by the customer using:

- **Host software**: Refer to *Manual TM799050* for programming instructions.
- **Handheld unit (P/N 777820):** Refer to *Manual TM777060* for programming instructions. The connection of the handheld unit to the detector is fast and intrinsically safe and allows function change with no need to open the detector.

3.9.2 Detection Setup Function

See *Detector Default Setup* on page 31 for default settings.

3.9.2.1 Gas Calibration

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

Gas Type for Models 301, 302:

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

Gas Type for Models 321, 322:

- Ethylene 100%

These 4 calibrations are standard calibrations. The detector can be calibrated up to 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 setup, full-scale, alarm, and warning level.

3.9.2.2 Full Scale

Two full scales are available:

Table 7: Sensitivity Levels Options 302 SIL

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

Table 8: Sensitivity Levels Options 301 SIL

Sensitivity	Full Scale	Warning Level	Alarm Level
Normal	2.5 LEL.m	1 LEL.m	1.5 LEL.m
High	1 LEL.m	0.4 LEL.m	0.6 LEL.m

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

3.9.2.3 Zero Calibration

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

3.9.2.4 Other Functions

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	Continued reading of the 4–20mA per the gas concentration level (see Table 1: Model Selection Guideline for SafEye Series 300 IR Type).	Discrete reading of the 4–20mA 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 switches to blocking mode from alarm position. Latching reset can be provided only if the detector returns to normal mode.

3.9.2.5 Address Setup

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

3.9.3 Detector Default Setup

The detector has 8 functions that can be programmed according to the customer requirement, at the factory or at the customer facility, using a software host or a handheld unit.

The standard setup is as follows:

Detector Default Setup		
	302	**301**
Gas type	2	2
Full scale sensitivity	5 LEL.m	2.5 LEL.m
BG zero calibration	Enabled	Enabled
Accessory relay	Warning	Warning
Alarm latching	No	No
4–20mA	Continuous	Continuous
Beam block during alarm	No latch	No latch

4 Technical Specifications

4.1 General Specifications

Detected Gases: Simultaneous detection of C_1–C_8 flammable gases

Detection Distance Range:

Table 9: Detection Distance Range

Model No.	**301**	**302**
Distance (ft)	2–11.5	9.8–49
Distance (m)	0.6–3.5	3–15
Response Time	2 sec	10 sec

Spectral Response: 3.0–4.0µm

Sensitivity Range:

Table 10: Sensitivity Range

	301	**302**
Standard	0–2.5 LEL.m	0–5 LEL.m
DIP switch	0–1 LEL.m	0–2 LEL.m

Field of view: Line of Sight

Alignment tolerance: ± 2°

Drift: Long term ± 5% of full scale

Temperature range: -40°F/-40°C – 158°F/70°C

Immunity to false alarms: Does not produce false alarms due to hydrocarbon flames and IR radiation sources

4.2 Electrical Specifications

- **Operating Voltage**: 18–32 VDC

  Power Consumption
  Detector 150 mA at 24 VDC (200 mA peak)

  Source 100 mA at 24 VDC (220 mA peak)

- **Electrical input protection**:
  The input circuit is protected against voltage-reversed polarity, voltage transients, surges, and spikes according to MIL-STD-1275A.
- **Electrical Interface** (see Figure 5).
- **Electrical outputs.**

4.2.1 4–20mA Current Output

The 4–20mA is a source configuration. The maximum permitted load resistance is 600ohm.

There are 2 options for 4–20mA:

- Continuous reading - **default** (see Table 4)
- Discrete reading (see Table 5)

4.2.2 Communications 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 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.

4.2.3 Relay Output:

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

Table 11: Dry Contact Relays

Relay	Type	Normal	Maximum Ratings
Alarm*	SPST	N.O.	2A at 30VDC
Accessory*	SPST	N.O.	5A at 30VDC
Fault**	SPST	N.C.	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 and the contact will be closed. When it is in Fault status, the relay is opened.

4.2.4 HART Protocol

The HART protocol is a digital communications 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 setup
- Reconfigure setup
- Display detector status and definition
- Perform detector diagnostics
- Troubleshoot

4.3 Mechanical Specifications

Enclosure:	The source and detector housings are made of either anodized aluminum with less than 1%mg with an epoxy enamel finish, or St.St. 316L enclosure with an electro-polish finish. The back covers are all sealed with special "O" rings to prevent intrusions such as dust, salt, and sprays. The circuit boards are conformal, coated, and protected from mechanical vibrations and a slight impact. Alignment base is stainless steel 316L for all models.	
Approvals:	FM	Class I Div. 1 Groups B, C, and D Class II Div. 1 Groups E, F, and G
Electrical Modules:	Conformal coated	
Electrical Connection:	(Two options - specified at time of order) 2xM25 (ISO) Or 2x3/4" - 14NPT conduits	
Water and Dust-Tight:	IP66 and IP67 NEMA 250 Type 6p	
Weight and Dimensions	See Table 12	

Table 12: Detector/Source Weight and Dimensions

Detector/source type and application	Al. enclosure		St.St. enclosure		Dimensions	
	Lb	Kg	Lb	Kg	Inch	mm
Detector for duct mount	8.1	3.7	13.4	6.1	5.2x5.2x4.7	132x132x120
Detector for standard mount	8.8	4.0	14.4	6.55	5.2x5.2x9	132x132x230
Source for duct mount	8.5	3.9	13.8	6.3	5.2x5.2x4.7	132x132x120
Source (reflector)	9.5	4.3	14.9	6.8	5.2x5.2x9	132x132x230

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:

- **High Temperature:**
  Designed to meet MIL-STD-810C, Method 501.1, Procedure II.

  Operating temperature: +158ºF/+70ºC

  Storage temperature: +158ºF/+70ºC

- **Low Temperature:**
  Designed to meet MIL-STD-810C, Method 502.1, Procedure I.

  Operating temperature: -4ºF/-20ºC

  Storage temperature: -40ºF/-40ºC

- **Humidity:**
  Designed to meet MIL-STD-810C, Method 507.1, Procedure IV.
  Relative humidity of up to 95% for the operational temperature range.
- **Salt and Fog:**
  Designed to meet MIL-STD-810C, Method 509.1, Procedure I.
  Exposure to a 5% salt solution for 48 hours.
- **Water and Dust**:
  IP66 and IP67 per EN60529

  Dust: Totally protected against dust.

  Liquids: Protected against immersion between 15cm and 1m in depth.

Protected against all water jets from all directions.

- **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.

- **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

The detector and light 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.

5.1 Introduction

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, and in particular, knowledge of 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, the prevailing wind directions, 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 areas with expected heavy fog, rain, or snow, consider the effect of long-range installation and install the detector at shorter ranges with the maximum intensity model available.

5.3 Preparations for Installation

Upon receipt, verify the appropriate purchase order and record the P/N and serial number of the source and detector units in the appropriate logbook.

Carefully unpack the following equipment, observing any instructions printed on or contained in the packaging list. Check the contents for any possible damage caused from shipping and handling.
In the event of damage or loss in transit, notify the carrier and your supplier immediately.

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

- Detector unit
- Source unit
- Two tilt or swivel mounting bases – 1 for the detector and 1 for the light source.
- Telescope kit
- Functional filter
- Magnetic mode selector

Notes:

- The magnetic mode selector, the calibration filter, and the telescope kit are 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.
- There are 2 different telescope kits:

  For standard installation: P/N 794110

  For duct installation: P/N 794245

- There are 2 different types of functional filters. One for the standard mount and the other for the duct mount. Each type has 5 different models for different gas reading.

  For standard installation: P/N 794260 - 1 to 5

  For duct installation: P/N 794220 - 1 to 5

5.4 Mounting for Standard Open-Path Installation

The following instructions are applicable for both the light source unit and the detector unit.

The detector may be mounted on:

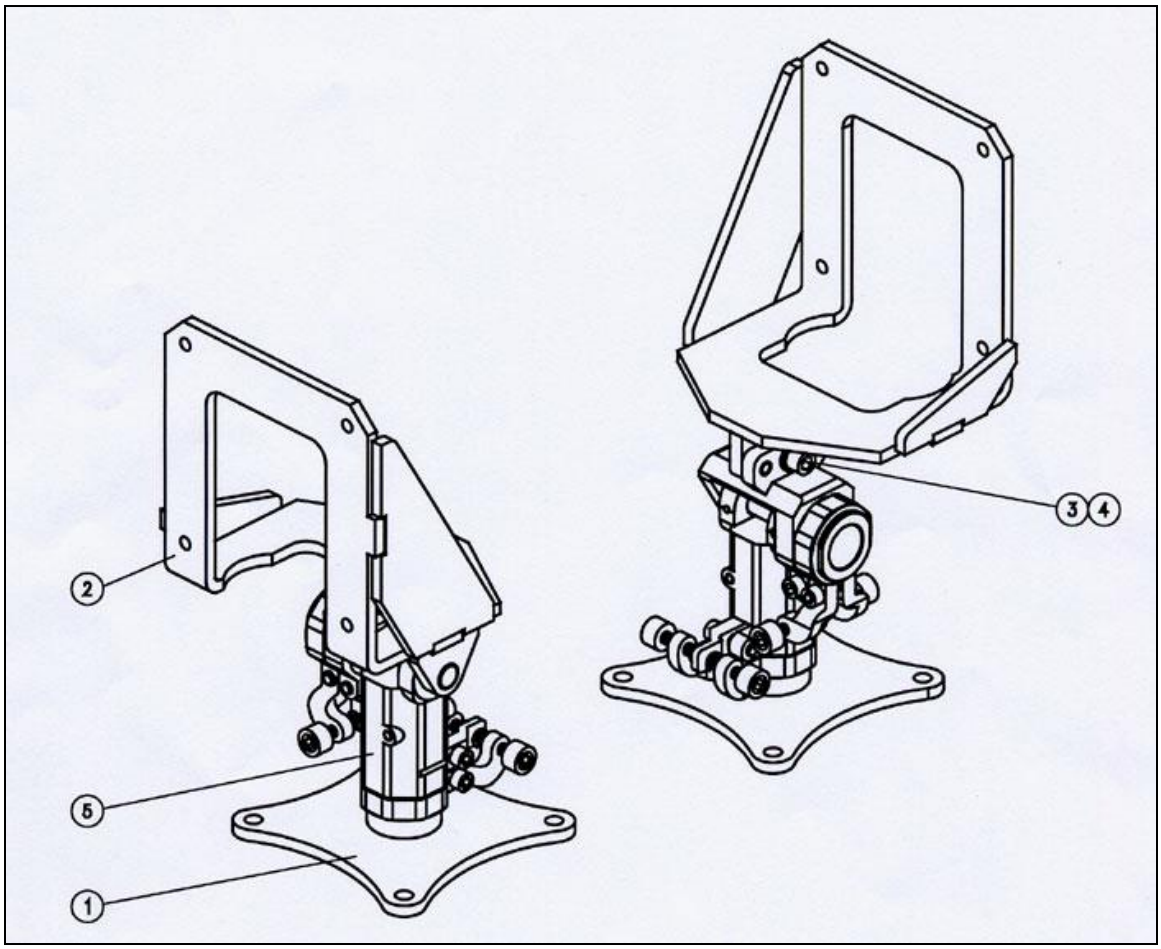
- Special swivel mounts
- Tilt mounts (see *Tilt Mount Kit* on page 41)
- Duct mounts – (see *Mounting for Duct Installation* on page 44)

5.4.1 Tilt Mount Kit

The tilt mount kit includes the items listed in Table 13, as follows:

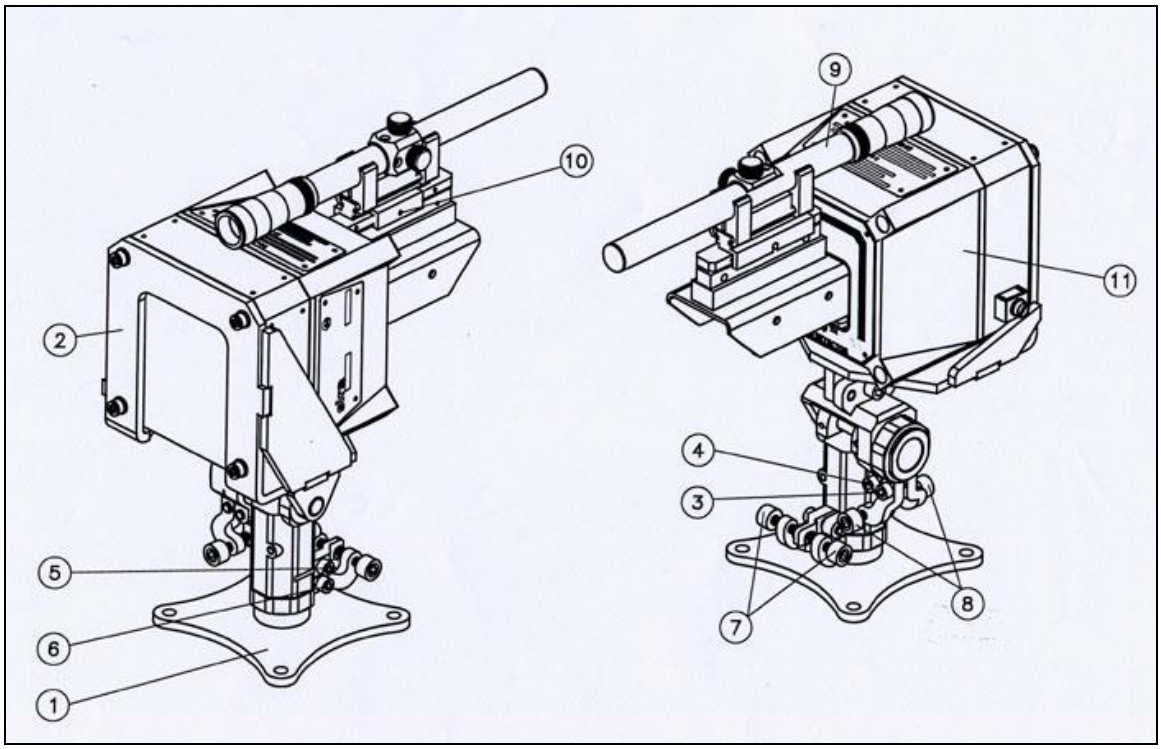
Table 13: Tilt Mount Kit

Item	Qty	DWG
Tilt mount	1	799220
Cap socket	1	Screw 5/16 - 18 UNC - 2H 3/4” St.St.
Spring washer	1	Spring washer 5/16” St.St.
Detector base assembly	1	799110
Cap socket screw	4	Screw 1/4” - 20 UNC - 3A x 1/22
Spring washer	4	1/4” St.St



Description			
1	Tilt mount	4	Spring washer
2	Detector base	5	Holding plate
3	Cap socket		

Figure 7: Tilt Mount Assembly



Description			
1	Tilt mount holding plate	7	Vertical fine alignment screw
2	Detector base	8	Horizontal fine alignment tighten screw
3	Horizontal crude alignment tighten screw	9	Telescope
4	Horizontal fine alignment tighten screw	10	Telescope tightening bolt
5	Vertical fine alignment tighten screw	11	Detector/source
6	Vertical crude alignment tighten screw		

Figure 8: Detector/Source and Tilt Mount Assembly

5.4.2 Detector/Source Installation

➢ **To install the detector/source (see Figure 7 and Figure 8):**

1. Place the tilt mount holding plate (Item 1) in its designated location and secure it with 4 fasteners through 4 holes dia. 8.5mm.
2. Install the detector base assy. (Item 2) on the tilt mount using a cap socket screw (Item 3) and a spring washer (Item 4).

Notes:

- Skip steps 1 and 2 if the tilt mount is already installed.
- Detector removal for maintenance purposes does not require tilt mount removal.

3. Place the detector, with its conduit/cable inlets pointing downwards, on the detector base assy. of the tilt mount (Item 2). Secure the detector with 4 1/4"- 20 UNC - 3A x 1/2" screw with no. 1/4" spring washers to the tilt mount. Use a 1/4" hex key for the 3/16" screw.
4. Repeat 1–2 to install the source.

5.5 Mounting for Duct Installation

The following instructions are applicable for both the source unit and the detector unit.

The detector may be mounted on a special duct mount. The duct mount enables the detector to be rotated up to ±3 degrees in the X–Y directions in order to provide fine alignment.

For duct installation, use duct mount P/N 794716.

The duct mount kit is supplied with the items listed in Table 14 as follows:

Table 14: Duct Mount Kit

Item	Qty
Duct mount set	1
Open and closed wrench no. 10 key	1 per installation
Closed no. 10 key	1 per installation

5.5.1 Duct Mount Set

The duct mount set consists of fitting plates, sealing rings, a windowed plate, and securing elements combined with appropriate screws and nuts. It provides a reliable attachment of the detector to the air intake, as well as good sealing and accurate alignment capability (see Figure 10 and Figure 11).

5.5.2 Duct Alignment Set and Accessories

Air duct installation has a limitation, which is the disability of viewing the detector front and performing fine alignment through detector aiming such as performed in a standard installation. As a result, fine alignment of the detector mount should be performed before the detector assembly is mounted to it (see Figure 11).

The alignment set solves this problem by enabling the installer to align the detector mount first, and then to install the detector. The alignment set includes a mount that is identical to the detector mount surface and a telescope that is installed in the middle of the mount surface. The telescope is centered in the duct mount in a way that it is located in the same optical axis as the detector that will be mounted later in the same location.

The accessories supplied with the kit includes 1 no.10 key for installation and for alignment. One accessory set is supplied for each installation.

5.5.3 Duct Installation: Surface Preparation

The following instructions are applicable for both the light source unit and the detector unit (see Figure 10):

- **To prepare the surface:**

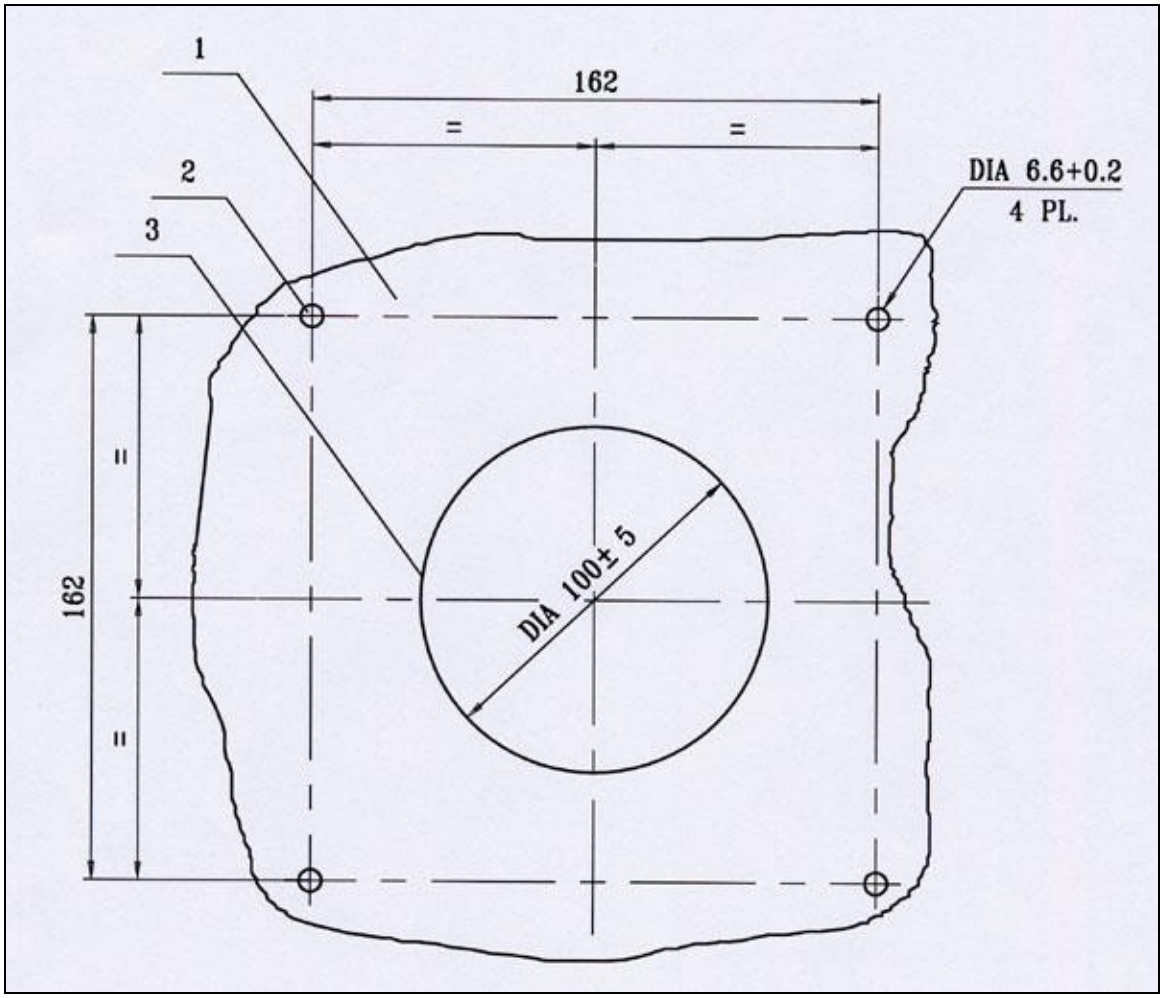
1 Check the air duct installation surface (1) stability. It should be as near as possible to a rigid girder connection in order to assure proper support to the mounting and the unit. Also the surface must be stable and free of vibrations.

2 Locate the best installation surface for the detector/light source. The location of the central point of each duct hole (3) should be at the same distance from the surface edge. This will provide that both detector and optical axis will be parallel to the air duct wall lines such that any blocking in the interior area will be prevented.

3 Preparation of the surface: Prior to hole drilling, you should verify that the installation surface is straight, clean, and free of corrosion.

4 Drilling and cutting: Mark the location and dimensions of the installation.
Figure 9 shows surface drilling dimensions. Drill the duct hole (3) and the screw holes (2) carefully.

Caution: Since the installation is done in a potentially explosive atmosphere, any workmanship in the installation area should be performed under the appropriate rules and regulations.



Description	
1	Air duct installation surface
2	Duct mount screw securing hole
3	Hole for detector/light source

Figure 9: Drilling Layout Dimensions for Duct Installation

5.5.4 Duct Mount Installation

The following instructions are applicable for both the light source unit and the detector unit.

- **To install the duct mount (see Figure 10 and Figure 11):**

1 Insert the first internal plate (1) through the air duct hole. Hold it by the hand and press the base plate gasket (2) to the installation surface, against the internal plate. The internal plate screws should be inserted into the gasket holes and hold it from falling. Then remove your hand and repeat the process for the second internal plate.

2 Attach the base plate (3) to the gasket (2) carefully. The internal plate screws should be inserted slightly into the base plate holes.

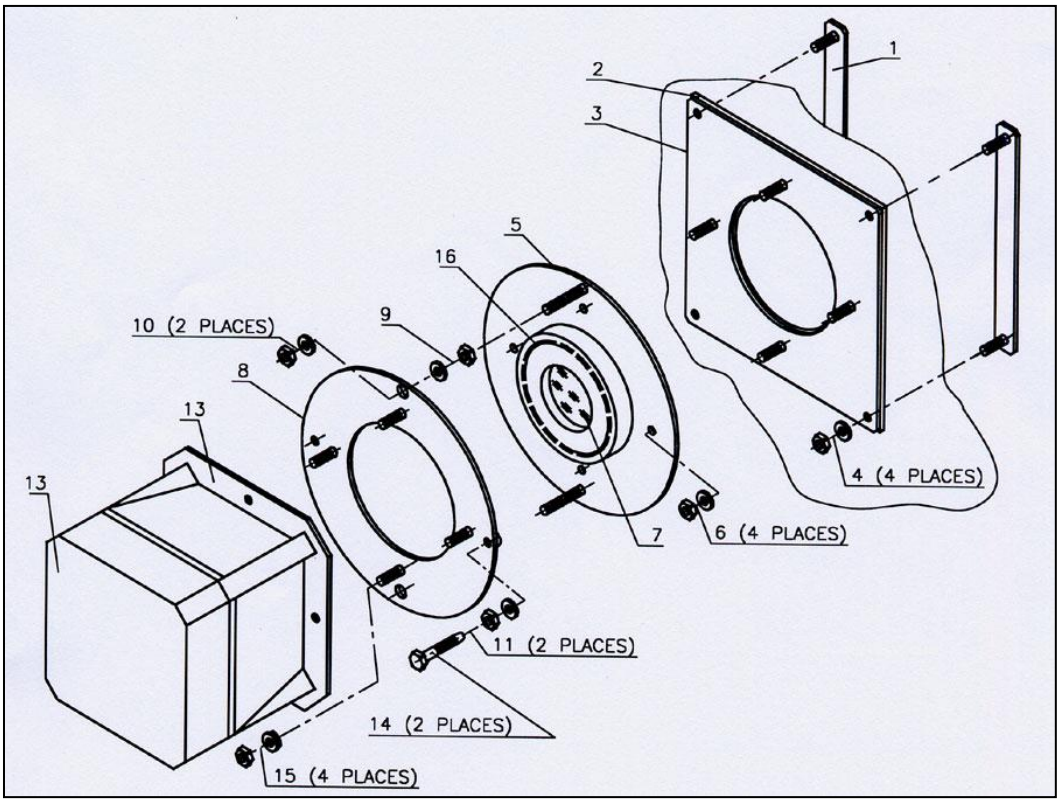
3 Secure the base plate to the installation surface using 4 nuts and flat washers (4).

4 Attach the window plate (5) by threading its holes on the base plate screws. The window (7) protection ring of the plate should be facing outside. Secure it with 4 nuts and flat washers (6).

5 Alignment plate installation: Screw together the internal vertical alignment nut and the washer (9) to the base plate screws. Then thread the alignment plate (8) on the screws. Connect the 2 external alignment nuts and flat washers (10) without fastening. The plate is now connected.

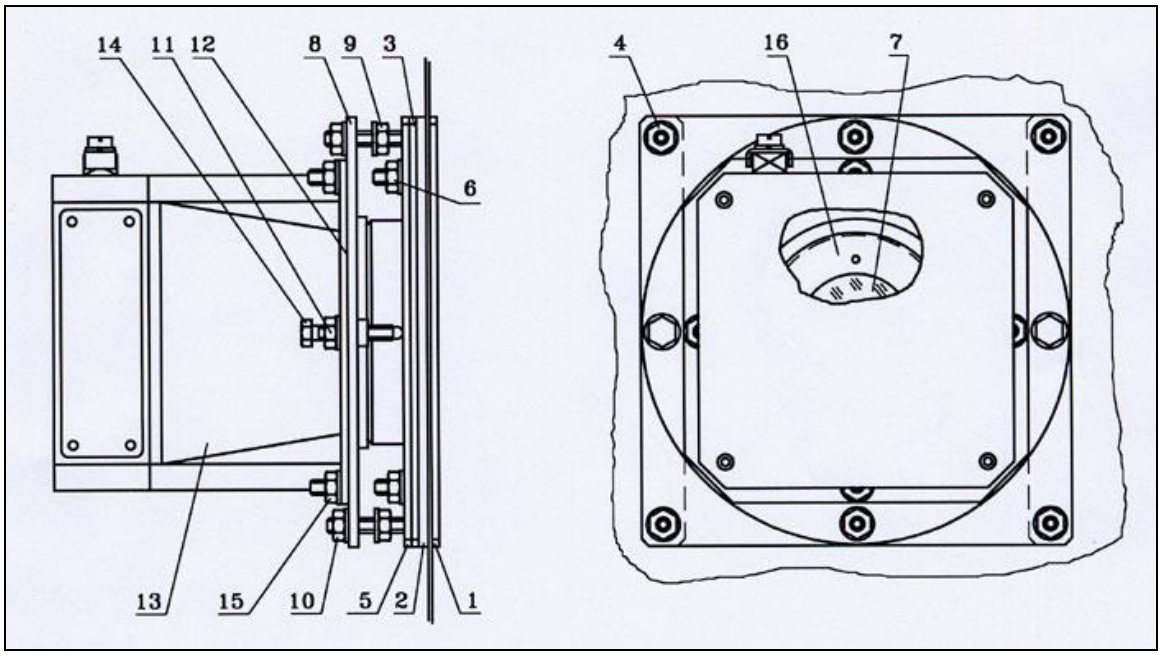
6 Connect the horizontal alignment screw with the nut and flat washer (11) according the illustration. The alignment plate should be held but be available for alignment.

At this point, the duct mount is ready for alignment.



Description			
1	Internal plate	9	Internal vertical alignment nut and flat washer
2	Base plate gasket	10	External alignment nut and flat washer
3	Base plate	11	Horizontal alignment nut and flat washer
4	Base plate securing nut and flat washer	12	Detector/light source plate
5	Window plate	13	Detector/light source
6	Window plate nut and flat washer	14	Horizontal adjustment locking screw
7	Window	15	Detector/light source securing nut and flat washer
8	Alignment plate	16	Window nut

Figure 10: Detector/Light Source and Duct Mount Installation Scheme



Description			
1	Internal plate	9	Internal vertical alignment nut and flat washer
2	Base plate gasket	10	External alignment nut and flat washer
3	Base plate	11	Horizontal alignment nut and flat washer
4	Base plate securing nut and flat washer	12	Detector/light source plate
5	Window plate	13	Detector/light source
6	Window plate nut and flat washer	14	Horizontal adjustment locking screw
7	Window	15	Detector/light source securing nut and flat washer
8	Alignment plate	16	Window nut

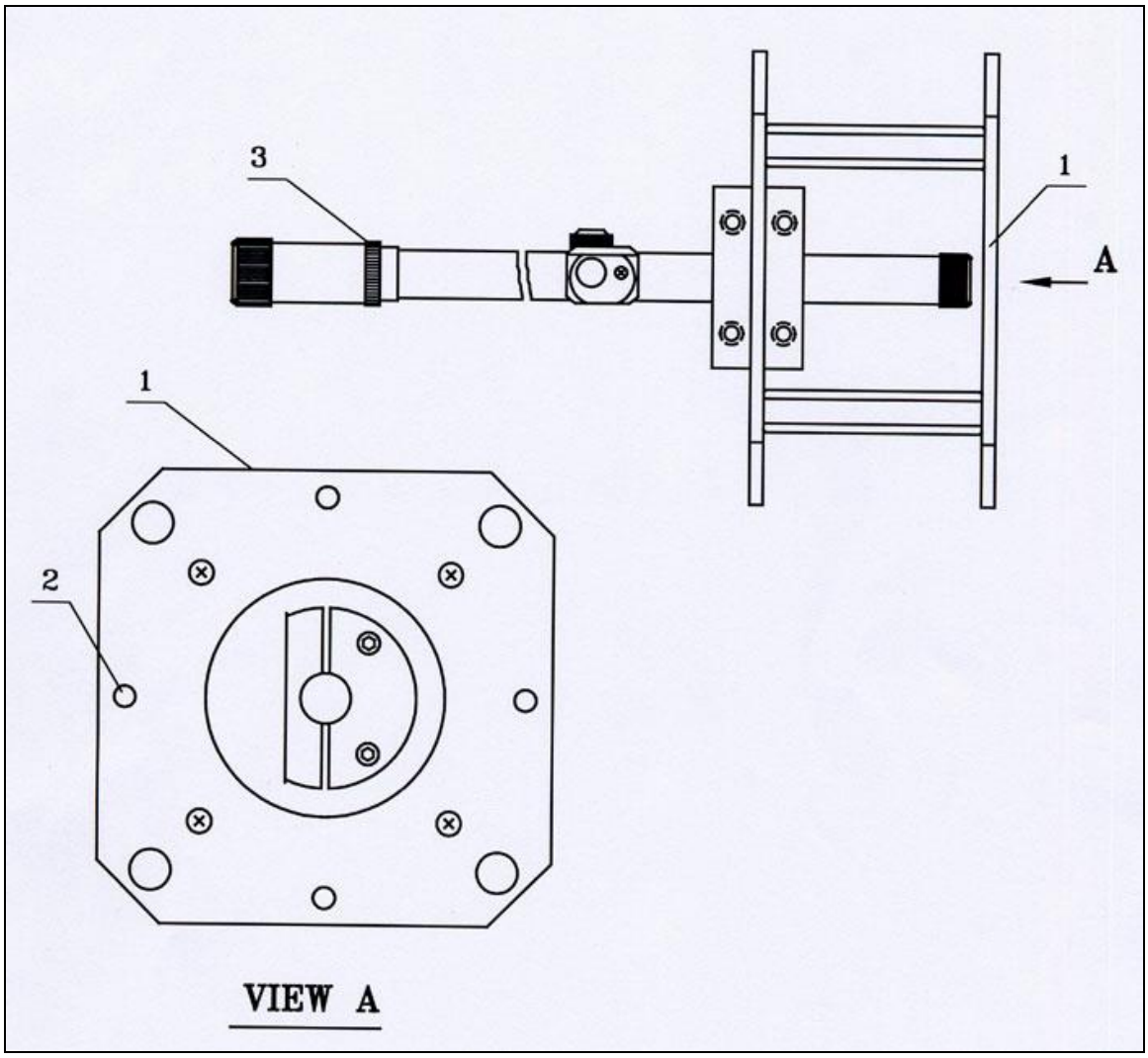
Figure 11: Duct Mount Installation - Outline Drawing

5.5.5 Duct Mount Alignment

The following instructions are applicable for both the light source unit and the detector unit.

- **To align the unit (see Figure 11 and Figure 12):**

1. Connect the telescope plate (Figure 12, Item 1) to the duct mount alignment plate (Figure 11, Item 8).
   Insert each 1 of 4 screws (Figure 11, Item 15) from the duct mount side through the hole (Figure 12, Item 2), and secure it with nut and flat washer (Figure 11, Item 15).
2. Locate the telescope aim (Figure 12, Item 3) to be vertical to the installation surface.
3. Look at the aim view and locate the "aim cross" in the middle of installation surface hole on the opposite side. Rotate the vertical and horizontal nuts (Figure 11, Items 10, 14) to achieve best results.
   Provide stability for the plate by securing and releasing the opposite nuts or screws gently.
4. Repeat step 3 until best results are achieved.
5. Secure the screws and nuts tightly (Figure 11, Items 9, 11).
6. Remove the alignment set carefully by unscrewing the nuts and screws from the hole (Figure 12, Item 2).
7. Perform detector wiring according to *Light Source Wiring* on page 54.
   Note that in case of air duct installation, the detector is mounted at the front side. Therefore, it must be removed from its mounting before removing any detector cover opening.
8. Install the detector/light source on the alignment plate (Figure 11, Item 8).
9. Secure the detector/light source with nuts and flat washers (Figure 11, Item 15).



Description	
1	Telescope plate
2	Detector/light source securing screw hole
3	Telescope aim

Figure 12: Telescope Alignment Set

5.5.6 Conduit/Cable Installation

- To avoid water condensation in the detector, it should be installed with the conduits/electrical entries facing downward.
- When using the swivel mount or duct mount, use flexible conduits for the last portion connecting 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.

5.5.7 Harness Connection

➢ **To prepare the harness connection (see Figure 13):**

1 Remove the 4 threaded plugs (13) from detector front.

2 Release the 4 socket-head screws (14) that secure the detector housing (1) to its back cover (2) using no. 5 hex key for M6 screw.

3 Hold the housing during the removal of the screws.

4 Pull the detector housing from its cover.
The cover remains attached to the detector swivel mount. The housing slides under the cover and remains attached to it by a securing cable (8). Do not let the cover simply drop but rather support it until it hangs.
The terminal board (12) inside the detector cover is now revealed.

5 Remove the protective plug (6) mounted on the detector conduit inlet.

6 Pull the wires through the detector cover (2) and secure them firmly to the cover using the cable-tie (16) attached to it.
Use a 3/4”-14NPT or M25x1.5P explosion-proof conduit/electrical entry connection to assemble the conduit/cable to the detector.

7 Connect the wires to the required terminals (12) according to the wiring diagram (see Appendix B).

8 Connect a grounding cable to the ground terminal (7) outside the detector cover (2). The detector must be well grounded to earth ground for proper operation.

9 Verify the wiring. Improper wiring may damage the detector.

10 Check the wires for secure mechanical connections and press them neatly against the terminal board (12) to prevent them from interfering while closing the detector housing.

11 Dress all wires so they will not interfere with the closure of the unit.

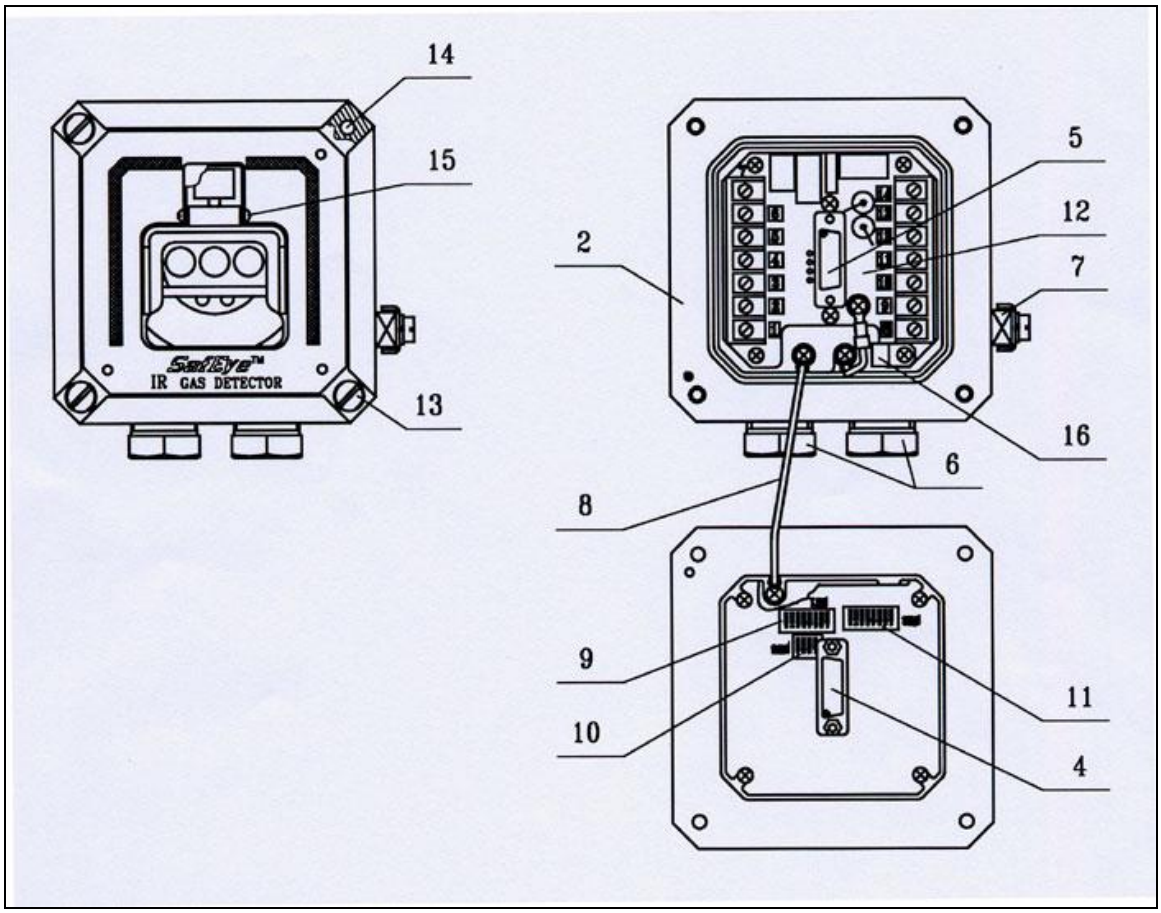
12 Seal the conduit inlet and outlet.

13 Align the 2 connector guide pins in the housing section with the correct openings in the housing section.

14 Carefully slide the housing section onto the floating holes in the female D connector.

15 Using the long handled hex key, tighten the 4M6 1.0Px50 screws (14).

16 Insert the 4 threaded plugs (13).



Description			
1	Housing	9	SW1
2	Cover	10	SW3
3	Screw hole	11	SW2
4	Female D connector	12	Terminal board
5	Male D connector	13	Threaded plug
6	Conduit inlet plug	14	Socket head screw (M6x1.0Px50)
7	Ground terminal screw	15	Screw pan head (No. 4-40UNC-2Ax3/8”)
8	Securing cable	16	Cable tie

Figure 13: Detector with Cover (removed)

5.5.8 Detector Terminal Wiring

The detector contains a terminal board consisting of 2 terminal blocks.

5.5.8.1 Power Supply:

The input power is supplied to Terminal 1. The return is connected to Terminal 2.

Note: Ensure that the detector unit receives a minimum of 18VDC and does not exceed 32VDC.

5.5.8.2 Fault Relay:

The fault relay is normally open. The SPST relay is at Terminals 4 and 5. The contacts are normally energized closed when the detector is in normal operation.

5.5.8.3 Alarm Relay:

The Alarm Relay is SPDT relay. Terminals 6 and 7 are normally open and the contacts are closed when the detector is in the alarm status. Terminals 7 and 8 are normally closed and the contacts are open when the detector is in the alarm status.

5.5.8.4 Accessory Relay:

The Accessory output is normally open SPST relay. Its contacts are at Terminals 9 and 10. It can be defined per user requirements (see Appendix B).

Note: To protect the dry contacts from voltage surges when connected to reactive loads (electric motors, sirens, etc.), connect an appropriate varistor over these contacts.

5.5.8.5 4–20mA Output

Terminals 11 and 12 are used for 4–20mA current output as specified in *4–20mA Current Output* on page 24 (see Appendix B).

5.5.8.6 RS-485 Output

Terminal 13 and 14 are used for the communications network (see Appendix B).

5.6 Light Source Wiring

5.6.1 Power Supply

Input power is supplied to Terminal 1.

The return is connected to Terminal 2 (see Figure 14).

Note: Ensure that the light source unit will receive a minimum of 18VDC and does not exceed 32VDC.

Pre-wiring requirements and wiring requirements are identical to the appropriate requirements for the detector, as described in Appendix A.

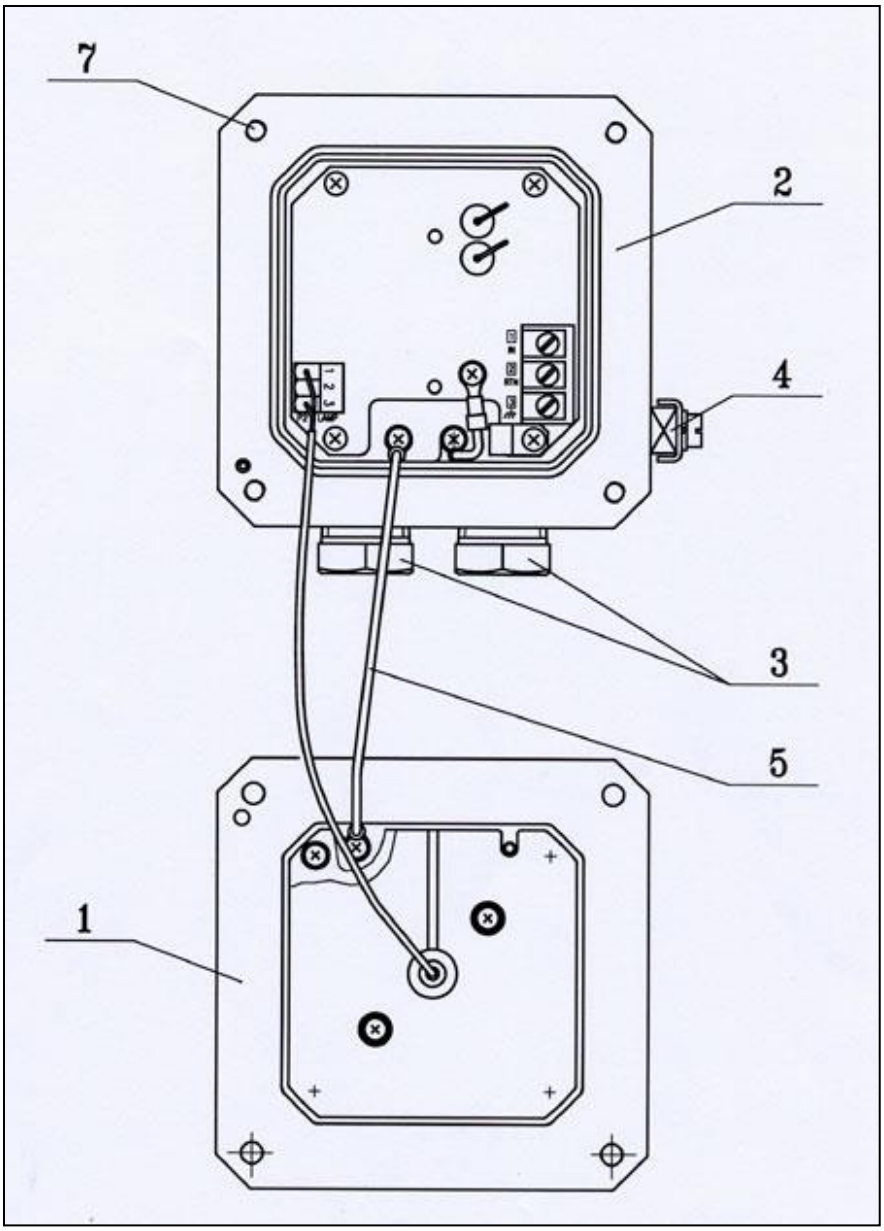
5.6.2 Harness Connection

The instructions for this are identical to the detector (see Figure 13). Refer to *Harness Connection* on page 52.

5.6.3 Terminal Wiring

The light source contains a terminal board (see Table 6). Terminal wiring instructions are identical to the detector wiring instructions. The light source consists of 2 wires only. The positive supply power is connected to Terminal 1 and the common return is connected to Terminal 2.

Connect the grounding cable to the ground terminal (Figure 14, Item 4) outside the light source cover (Figure 14, Item 2). The detector must be well grounded to earth ground for proper operation.



Description			
1	Housing	5	Grounding wire
2	Cover	6	Securing cable
3	Conduit/cable inlet plugs	7	Screw hole
4	Ground terminal screw	8	DIP switches

Figure 14: Light Source - Open View

6 Operating Instructions

6.1 SafEye Operation

Once the system is positioned, it will monitor for possible specified gases, automatically sending signals to a standard control panel or a PC.

This chapter describes the alignment, calibration, and operation of the detector.

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

6.2 Alignment of Unit Using Swivel Mount

(See also *Alignment of Unit Using Tilt Mount* on page 60.)

This section applies to open-path installation only (see Figure 15 and Figure 16). For duct mount applications, the alignment is performed according to *Duct Mount Alignment* on page 50. Therefore, skip steps 1–10 when duct mount installation is performed.

The telescope is used for full alignment. The 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 located vertical to the telescope assembly. This allows the user to observe the opposite unit perpendicular to the alignment when access from the rear of the unit is difficult/impossible. In installations where rear access is possible, the periscope is not necessary. In this case it can be removed by releasing the periscope fastening screw (Item 5, Figure 15).

Note: 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.

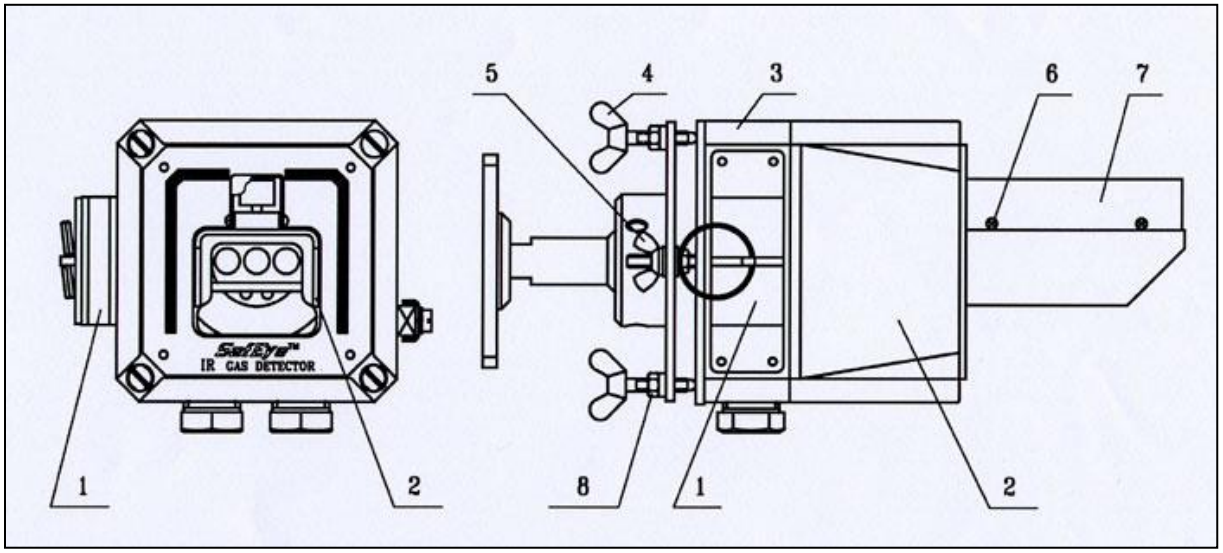
Caution: Do not attempt to change any factory calibration of the telescope or its mounting. This may prevent optimal alignment.

➢ **To align the unit using the swivel mount:**

1 Make sure that the detector and the light source are installed properly. Installation instructions are described in *Installation Instructions* on page 39.

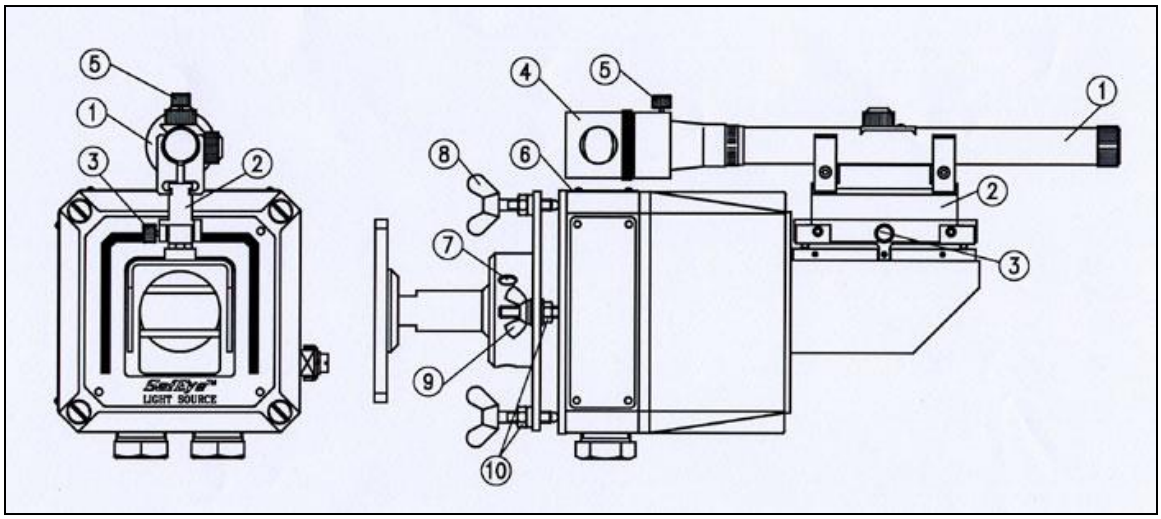
2 Refer to Figure 15. Slightly release 4 protective sight cover screws (Figure 15, Item 6) from the detector and the light source. Do not remove the screws from the covers. Remove the protective sight covers (Figure 15, Item 7) from the detector/light source assembly. Store the cover in a clean place for reinstallation after alignment is completed.

3 Refer to Figure 16. Install the telescope assembly (1) on the telescope sight mounting (2) of the detector according to the drawing. Fasten the telescope with fastening screw (3).



Description			
1	Magnetic mode selector	5	Horizontal adjustment screw
2	Detector housing	6	Sight cover screw
3	Detector cover	7	Protective sight cover
4	Vertical adjustment screw	8	Adjustment screw securing nut

Figure 15: Alignment and Mode Selection



Description			
1	Telescope assembly	6	Light source/detector housing
2	Sight mounting	7	Socket set screws (3)
3	Telescope fastening screw	8	Vertical adjustment screw (2)
4	Periscope	9	Horizontal adjustment screw (2)
5	Periscope fastening screw	10	Adjustment screw securing nut

Figure 16: SafEye Light Source/Detector Alignment

4 **Detector Crude Alignment:**
- **a** Refer to Figure 16 for all the following instructions:
- **b** Use a 3/16" Allen screwdriver to loosen up the 3 socket set screws (7).
- **c** Tilt the light source in the general direction of the detector.
- **d** Rotate the periscope (4) until its ocular is positioned in front of your eye for the most convenient observation.
- **e** Observe through the periscope (4) and locate the detector in the center of the view of the source unit.
- **f** Tighten 3 socket set screws (7) of the detector's swivel mount.
- **g** Release the fastening screw (3) and remove the telescope from the detector.

5 **Light Source Crude Alignment:**
Repeat steps 3 through 4 for the light source.

6 **Light Source Fine Adjustment**:
- **a** Release the adjustment screw securing nuts (10) from all adjustment screws (8,9) to enable fine alignment.
- **b** Watch through the periscope (4). The cross midpoint inside the telescope lens should be aimed to the opposite unit (light source) such that it is observed in the periscope.

c Rotate the vertical adjustment screws (8) and the horizontal adjustment screws (9). This should be performed until the cross midpoint is combined with the center of the top of the light source telescope sight mounting (Item 2).

d Carefully secure the 4 adjustment screw securing nuts (10).

e Release the fastening screw (3) and remove the telescope (1) from the unit.

7 **Detector Fine Adjustment:** Repeat steps 3 and 7 for the detector.

8 Repeat steps 3, 7, and 8 if additional adjustment is required.

9 Upon alignment completion perform the following:

10 Reinstall protective sight covers on the detector and the light source by screwing 4 sight cover screws (Figure 16, Item 6).

11 Return the telescope to its original case.

12 Power on the system according to *Powering on the System* on page 61.

13 Perform zero calibration according to *Zero Calibration* on page 62.

14 Perform Signal Intensity Check (SIC) according to *Signal Verification* on page 66.

15 Perform Functional Check (FC) according to *Functional Check of Unit* on page 62.

6.3 Alignment of Unit Using Tilt Mount

- See Figure 7 and Figure 8 for this procedure.
- Using the telescope performs full alignment.
- The alignment procedure should be performed in 2 stages: crude alignment then 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 the opposite unit perpendicular 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 that case, it can be removed by releasing the periscope fastening screw.

Caution:

- 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.
- 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 8):**

1. Make sure that the detector and the light source are installed properly. Installation instructions are described in *Installation Instructions* on page 39.
2. Install the telescope assembly (9) on the telescope site mounting of the source according to the drawing. Fasten the telescope with a fastening screw (10).
3. **Crude Alignment – Source**:
   - **a** Use a 1/4" Allen screwdriver for all alignment screws.
   - **b** Loosen screws 5 and 6.
   - **c** Approximately aim the source horizontally toward the detector.
   - **d** Tighten screw 5.
   - **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- Source**
   - **a** Aim the source at the detector within horizontal axis using screw 7. Aim the cross to the upper level of the telescope site of the detector.
   - **b** Tighten screw 6.
   - **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 fine alignment.

6.4 Powering on the System

Note: Prior to any operation or maintenance, follow the *Safety Precautions* on page 62.

➢ **To power up the system:**

1. Make sure that the source and detector are connected to the power.
2. Make sure that the 4–20mA meter is connected to the detector.
3. Power up the system 18–32VDC.
4. After 60 seconds, the left LED lights at green, the current meter will indicate 4mA.

If it is the first operation after installation, the LED may indicate any status. Zero calibration should be performed after powering the system (see *Safety Precautions* on page 62).

6.5 Safety Precautions

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

- Follow the instructions in the manual and refer to the drawings and specifications issued by the manufacturer.
- Do not open the detector housing while power is supplied.
- Do not touch internal parts other than the 2 functional switches. Interference with internal circuits may impair detector performance and will invalidate manufacturer's warranty.
- Disconnect external devices, such as automatic extinguishing systems, before carrying out any maintenance tasks.

6.6 Zero Calibration

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

Notes:

- To change modes, place the magnetic mode selector (see Figure 15, Item 1) on the detector for 2 seconds and wait for the LED indication.
- After mode change allow a time lapse of 5 seconds before changing mode again.
- Standby mode is a temporary mode lasting about 20 seconds used to facilitate Zero Calibration mode selection. If the mode selector is not placed during this 20 seconds period, the detector will be switched to Normal mode.
- Switch from Normal to Alignment mode: See Table 2 for LED status indication.
- Switch from Alignment to Standby mode: the LEDs will flash alternately with a green color.
- Switch from Standby to Calibration mode: the LEDs will turn off.
- Wait up to 60 seconds until it switches to Normal mode (right LED green). The detector reading is now set to Normal. The 4–20mA output should indicate 4mA.

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:

- This functional verification procedure is for a standard 4–20mA output.
- Prior to starting the functional check, verify that the power to the units is on and that the current of the 4–20mA channel is stable. Record the reading.

➢ **To perform a functional check of the unit:**

1 Position the functional check filter in front of the SafEye detector.

2 The functional check filter window must be centered over the viewing window of the detector.

3 Wait 20 seconds.

4 Read the 4–20mA current. Determine the difference between the reading taken with and without the functional check filter. This difference is the 4–20mA current variance.

5 Record the 4–20mA current variance in a 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

7.1 General Maintenance

The SafEye 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 a maintenance logbook with a copy of the delivery form inside.

Note: The maintenance can be performed through RS-485. For more details, refer to *Manual TM792050*.

7.2 Periodic Maintenance

It is recommended to perform periodic cleaning of optical surfaces.

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

- Proper maintenance will allow the SafEye system to retain maximum performance and reliability.
- The optical surfaces of the source and detector viewing windows should be kept as clean as possible as it is an active device.
- Alignment procedures must be performed each time that the source or the detector unit has been opened or moved for any reason.
- The Signal Verification Check corroborates the current signals from the light 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* on page 66).
- The functional check should be performed every 6 months (see *Functional Check of Unit* on page 62).
- Zero calibration (see *Zero Calibration* on page 62) 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:**

1 Turn off the power to the SafEye detector and source.

2 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, and soft cloth.

6 Enter into 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* on page 66).

9 Perform zero calibration (see *Zero Calibration* on page 62).

10 Perform functional check (see *Functional Check of Unit* on page 62).

7.2.2 Signal Verification

The Signal Intensity Check determines if there is a misalignment or if the light source signal is wearing over a period of time. Clean the optical surfaces prior to performing this check (see *Routine Optical Surface Cleaning* on page 66). This procedure should be performed in clear weather.

➢ **To check signal intensity:**

1 Enter alignment mode by placing the mode selector on the side of the detector for 2 seconds.

2 Within the first 20 seconds the detector indicates 3 different indication levels (see Table 2).

3 Wait 20 seconds, count the number of LED flashes, and note the colors. Then adjust the value (see Table 15).

4 Record the new results in the maintenance logbook.

5 Wait 20 seconds, count the number of LED flashes, and note the colors. Then adjust the value (see Table 15).

6 Record the new results in the maintenance logbook.

7 Determine the absolute variance compared with the previous alignment reading in the maintenance logbook.

8 If the variance is more than 30%, perform alignment (see *Operating Instructions* on page 57) and zero calibration (see *Zero Calibration* on page 62). Call a technician for service if the SIC is less than 66 and both LEDs flash red.

Table 15: LED Signal Adjustment

Color (left-right)	Number to be added
Red-Red	0
Orange-Orange	62
Green-Orange	124
Green-Green	186

Example:

At a hypothetical installation, the LEDs are green-orange with 3 green flashes (left LED) and 6 orange flashes (right LED).

The number is 36 + 124 = 160

The next periodic maintenance reading has orange-orange LEDs with 8 orange blinks (left LED) and 8 orange flashes (right LED).

The number is 88 + 62 = 150

The variance is 160 - 150 = 10 Units

The percentage of variance will be (10/160) x 100 = 6.25% less than the previous alignment.

7.2.3 Function Check of Unit

The SafEye 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* on page 62 for instructions.

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

7.2.4 Maintenance Records

Record every maintenance operation performed on the source and/or detector in a maintenance logbook. The logs should include but not be restricted to the following:

- The information identifying the measurement units.
- The date of installation and contractor.
- Entries for every maintenance operation performed to include at least the description of the operation, date, and personnel ID.
- Signal intensity records with SIC results.
- Calibration check (CC) results.

If the unit(s) is (are) sent to the authorized supplier, a copy of the maintenance records must accompany the unit concerned.

8 Troubleshooting

Problem	Cause	Solution
LEDs are off and fault is indicated at 0mA level	Power is not supplied to the detector	Supply power to the detector
Both LEDs are on at yellow and fault is indicated at 0mA level	Fault 2	Bring the detector unit for service
Both LEDs are flashing at yellow and fault is indicated at 0mA level	Low voltage is supplied to the detector	Check the voltage level supplied to the detector
One LED is on at yellow and 4–20mA indication level is 2mA	Dirt has accumulated on the detector window or on the light source window	Clean the optical windows (see *Routine Optical Surface Cleaning* on page 66)
	One unit at least has been moved or tilted	Perform realignment (see *Operating Instructions* on page 57)
	Power is not supplied to the light source	Supply power to the light source
	The optical open path beam is blocked	Remove the obstruction
	One unit at least has been moved or tilted	Perform realignment (see *Operating Instructions* on page 57)
	Electrical problem at the light source	Perform SIC in order to measure signal intensity Bring the light source to a technician for service if it is not flashing

Appendix A: Wire Selection Tables

A.1 General Instructions for Electrical Wiring

- **mA output or relay wiring**: Refer to Table 16 to determine the required wire gauge for general wiring and to calculate the permitted voltage fall with respect to loads current, wire gauge, and length of wires.
- **Power supply wires**: Refer to Table 17 to select wire gauge. DO NOT connect any circuit or load to detector supply inputs.

Table 16: Maximum DC Resistance at 68°F for Copper Wire

AWG #	mm^2	Ohm/100ft	Ohm/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 17: 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
Feet	164	328	492	656	820	
Meters	50	100	150	200	250	
	Max. length from power supply to last detector					

Appendix B: Wiring Option Configurations

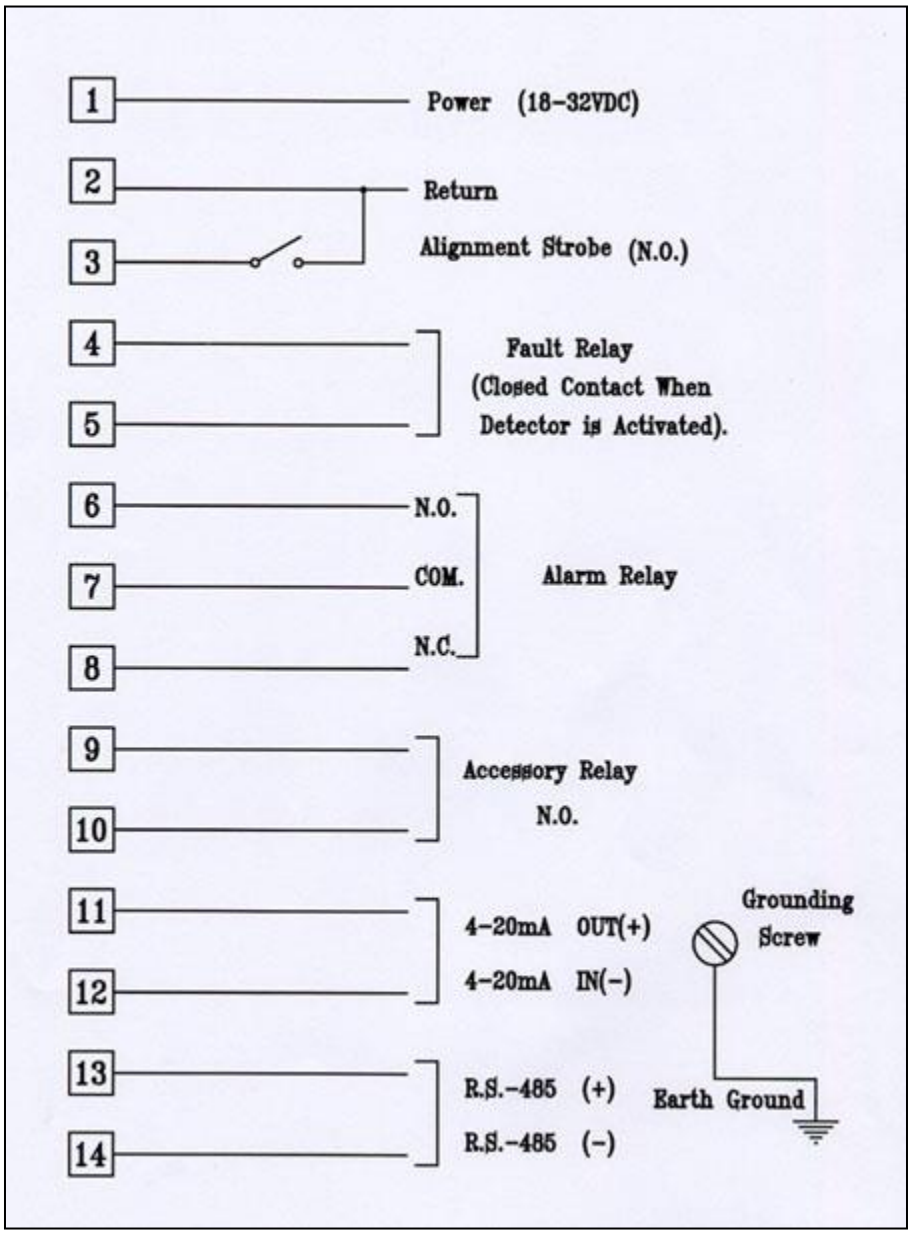


Figure 17: Detector Wiring Diagram

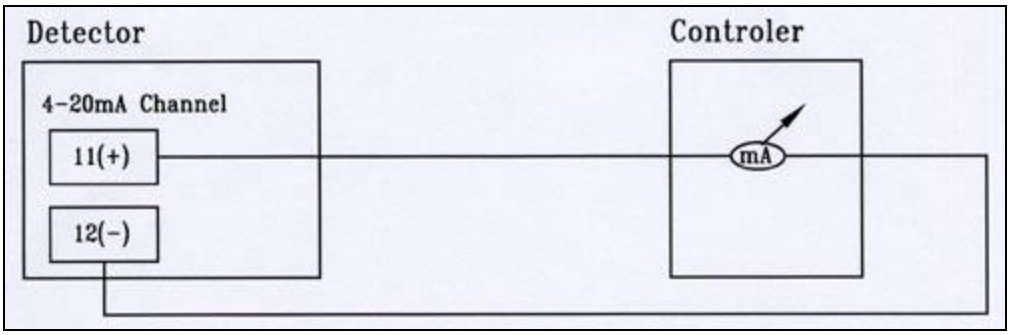


Figure 18: 4–20mA Source Output

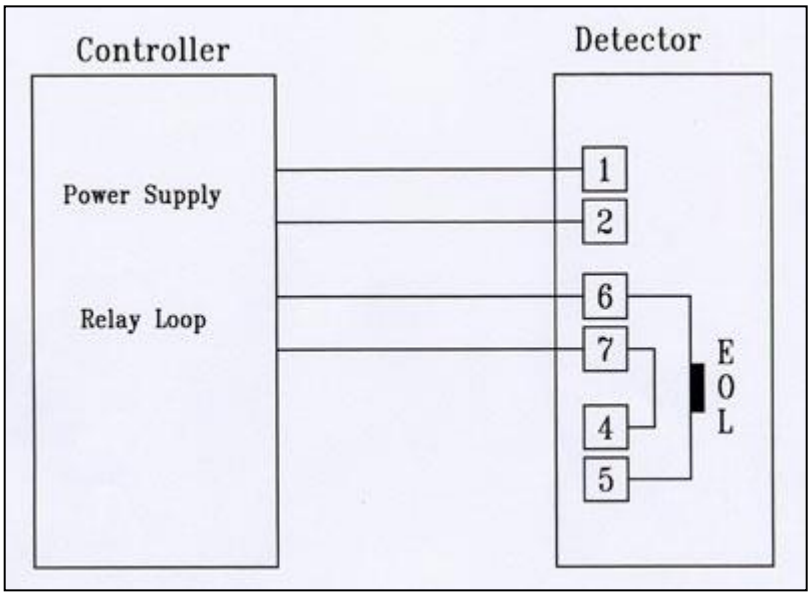


Figure 19: Typical 4 Wire Controller

A.2 RS-485 Communications Network

By using the RS-485 network capability of the SafEye 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 64 on the same 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.

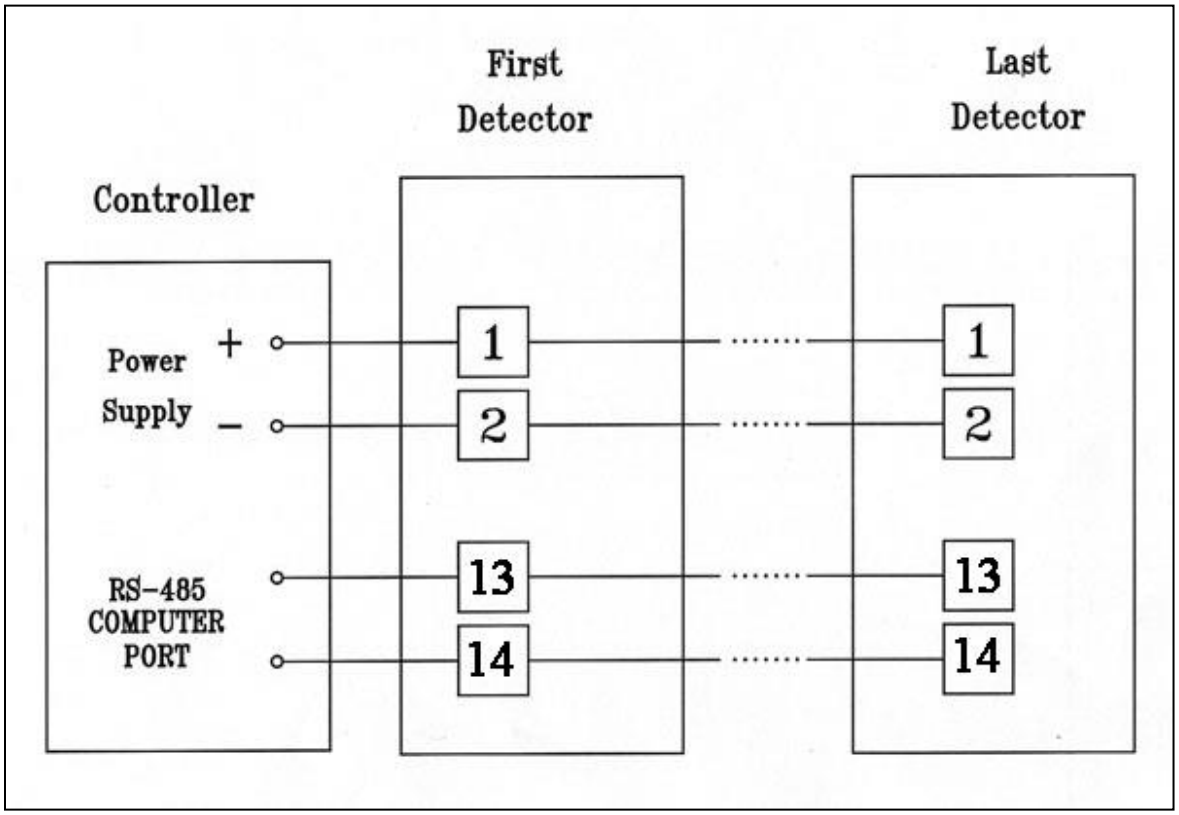


Figure 20: RS-485 Networking

Appendix C: Outline Drawings

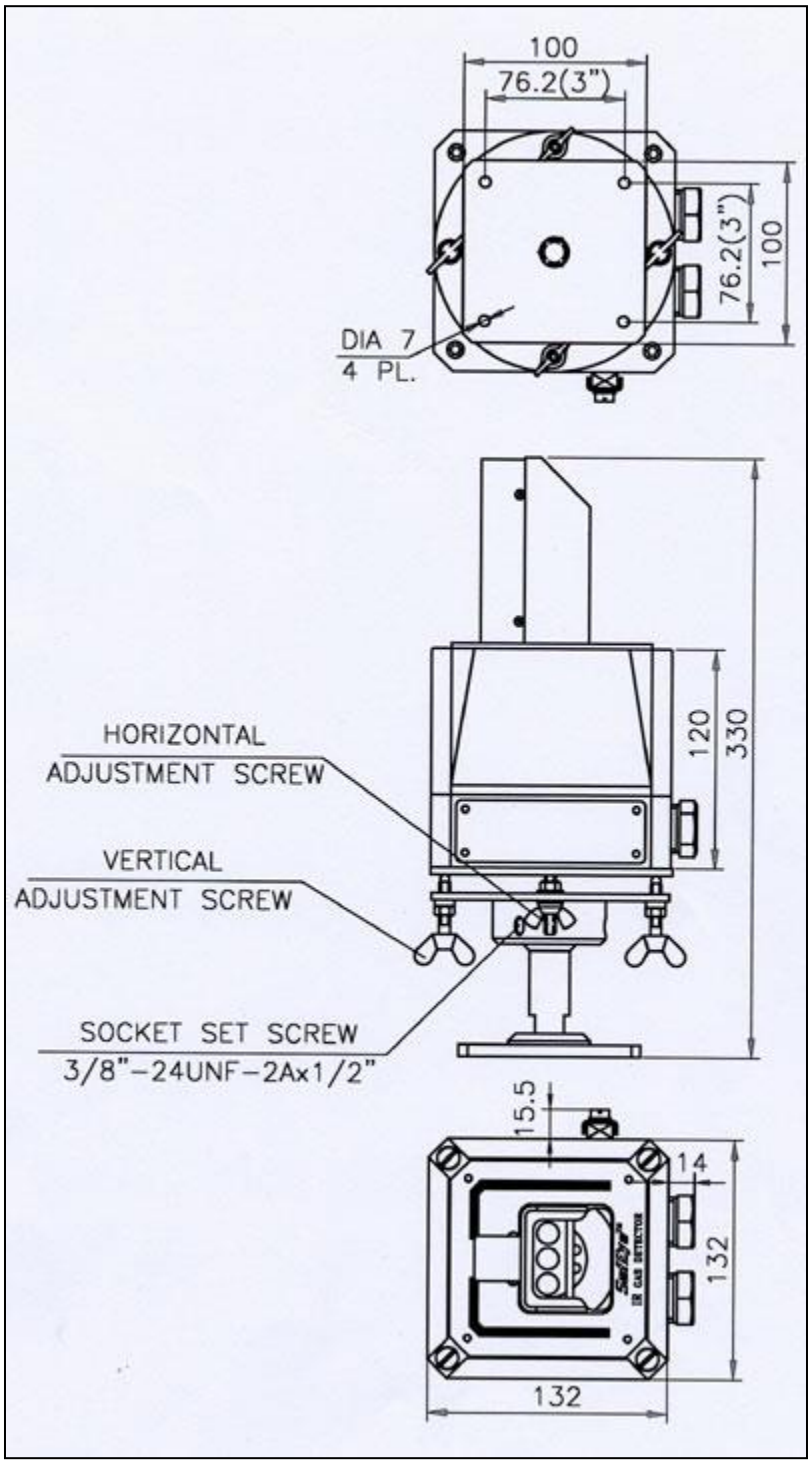


Figure 21: Detector Outline Drawing with Swivel Mount

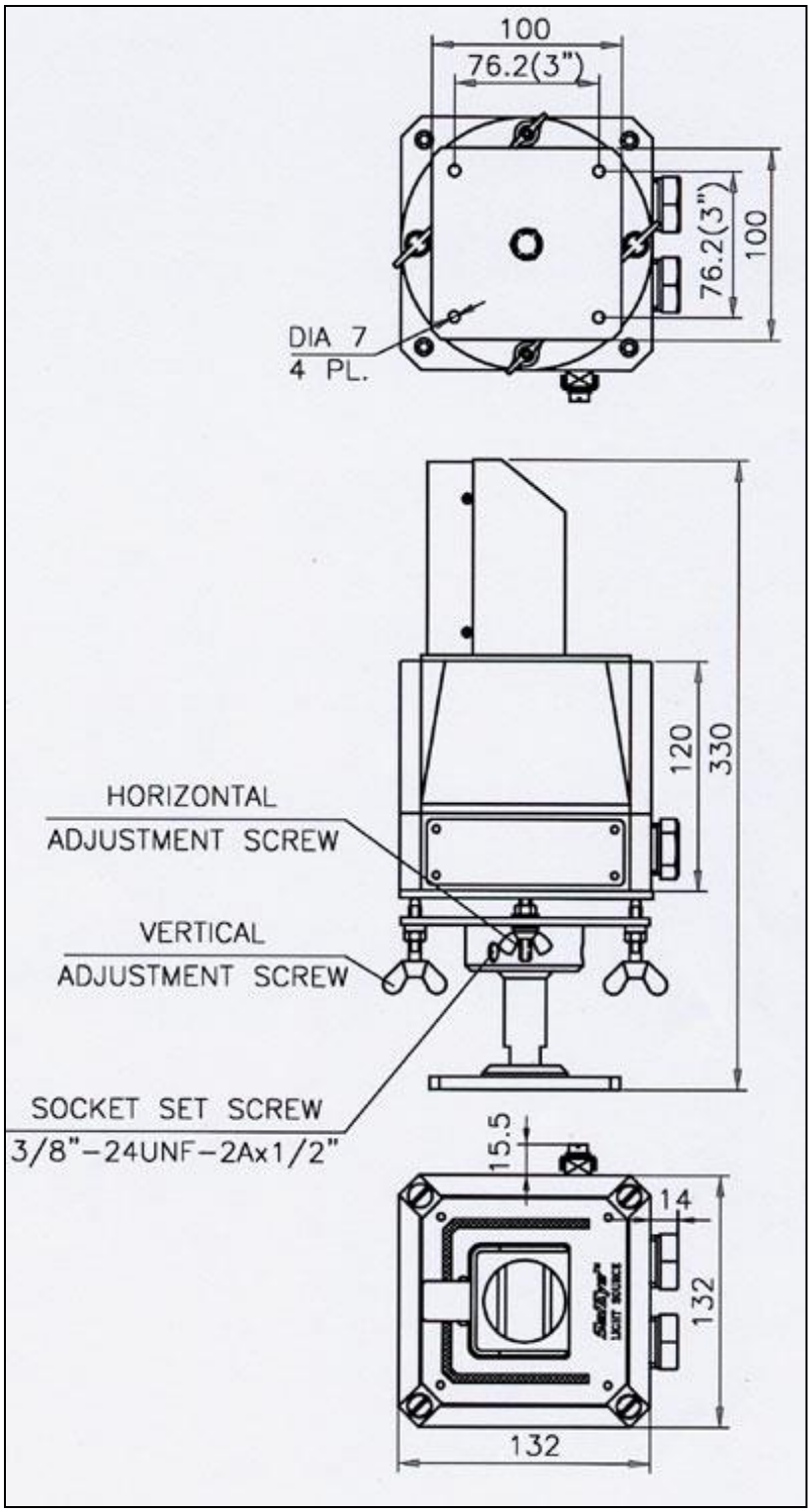


Figure 22: Source Outline Drawing (Reflector Type) with Swivel Mount

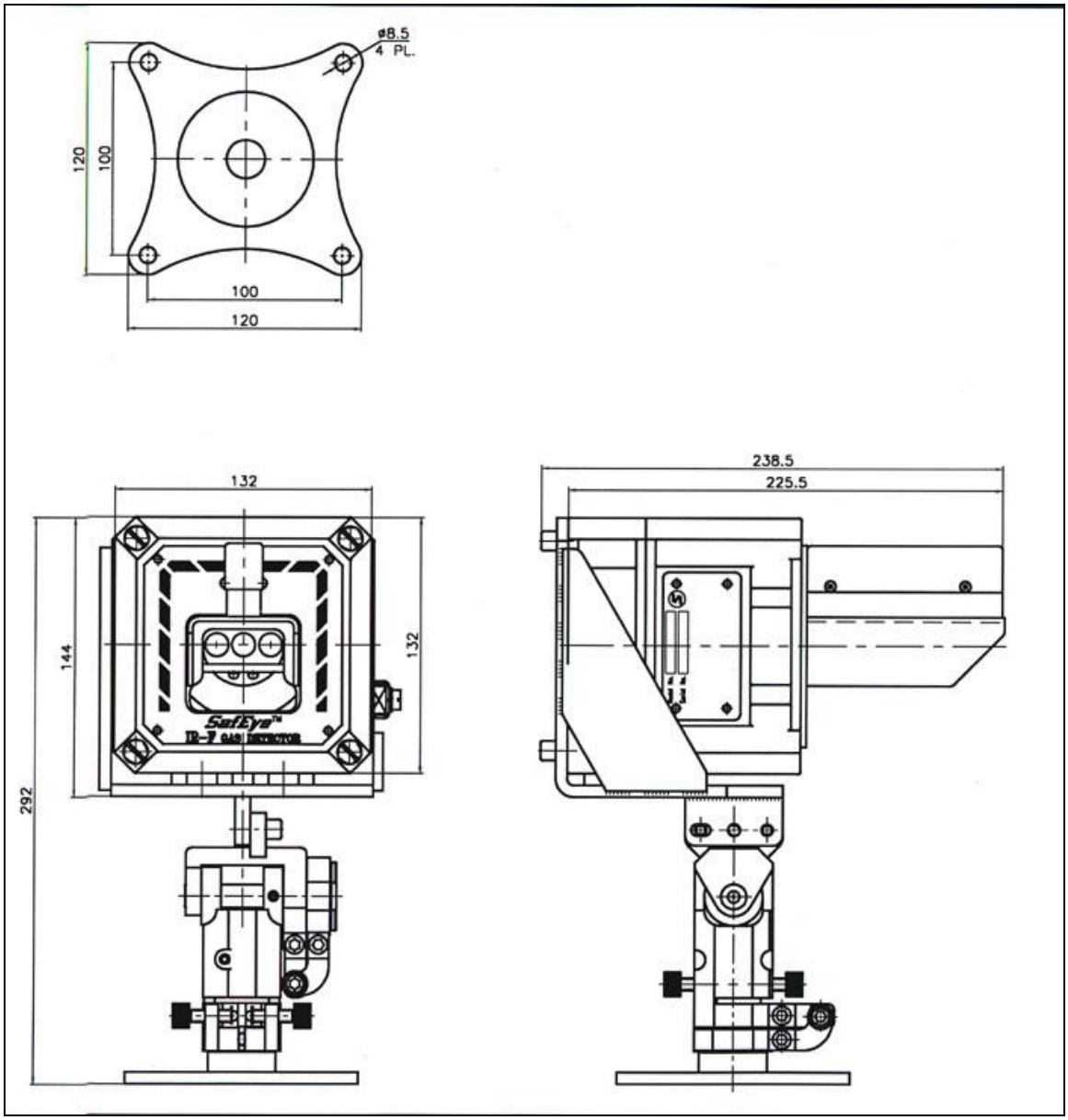


Figure 23: Detector and Tilt Mount Outline Drawing

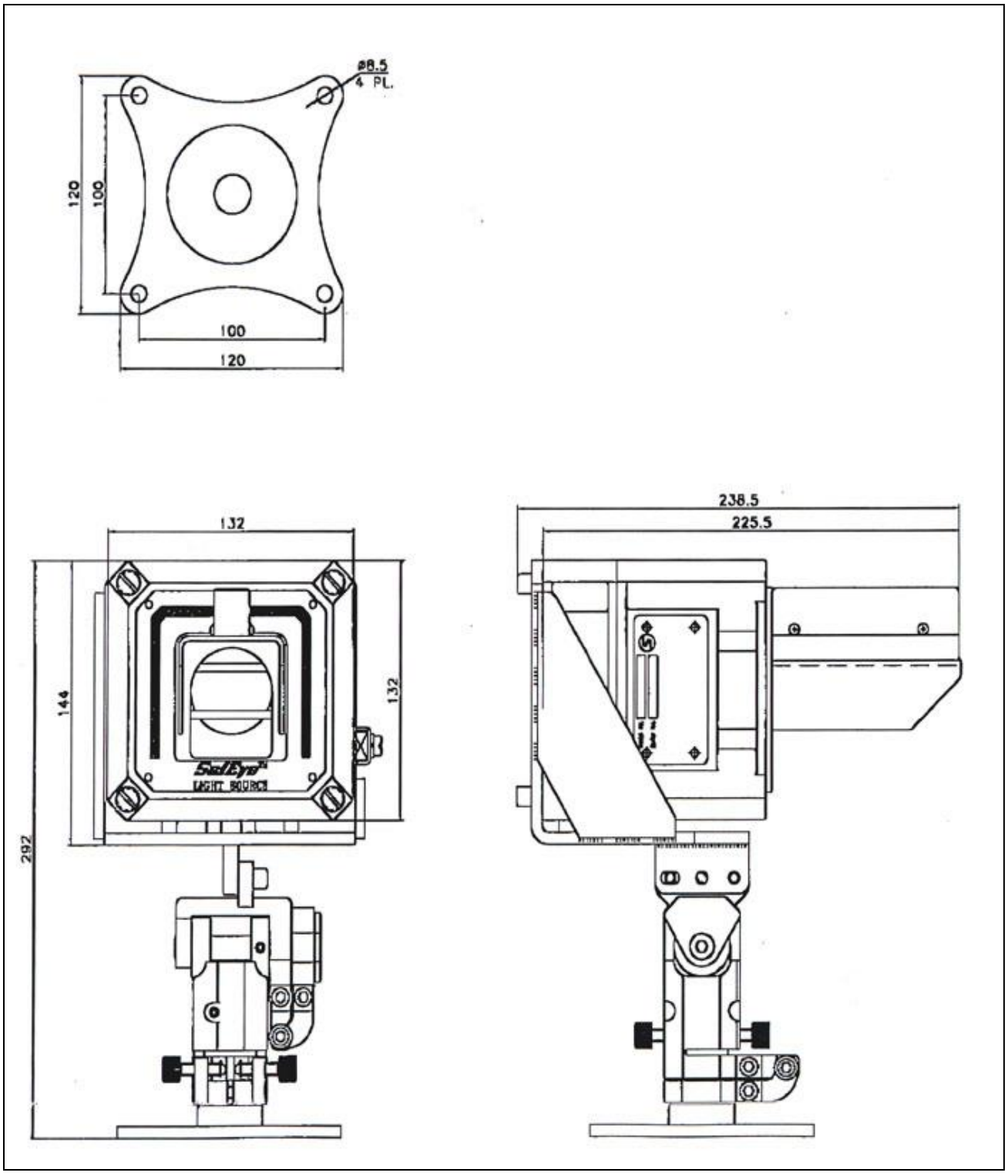


Figure 24: Source and Tilt Mount Outline Drawing

Appendix D: Special Conditions to Comply with SIL-2 Requirements

This appendix details the special conditions to comply with the requirements of EN 61508 for SIL-2. The SafEye 300 can be used in low or high demand mode applications. See *IEC 61508.4*, Chapter 3.5.12.

A.3 Safety Relevant Parameters

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

(See *Periodic Maintenance* on page 65 and *Functional Check of Unit* on page 62*)*.

- HFT: 0.
- PFD: 3 x 10^{-4} (3% of SIL-2).
- PFH: 1.4 x 10^{-4} (14% of SIL-2) for 4–20mA signal current application. Relays, alarm relays, and accessory relays must be configured as the second alarm relay. The contacts of both alarm relays must be connected in series.
- SFF: Fulfils the conditions of EN61508 for SIL-2.

A.4 Guidelines for Configuration, Installation, Operation, and Maintenance

Alarm conditions complying with SIL-2 can be implemented in 1 of 2 ways: Using 2 alarm relays, and using the fault relay.

A.4.1 Conditions for Safe Operation

- The SafEye 300 should consist only of the approved hardware and software modules.
- The 24C power supply must comply with the conditions for "safe low voltage" according to EN60950 (PELV/SELV).
- After installation and configuration, the setup parameters must be verified and the function of the SafEye 300 (gas detection, the 4–20mA interface function, and relay functions) must be checked completely.

A.4.2 Alarm Operation Using the 4–20mA Signal Current

- The connected controller has to monitor the 4–20mA signal current for valid values (see *Output Signals* on page 24).

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 4–20mA signal current for values below 4mA and above 20mA.

A.4.3 Alarm Operation Using Relay Outputs

- **Low Demand**: Only 1 alarm relay is needed
- **High Demand**: The accessory relay has to be configured as the second alarm relay. The contacts of both alarm relays have to be connected in series.
- The fault relay error message has to be monitored by the connected controller.
- The relay contacts must be protected with a fuse rated at 0.6 of the nominal specified relay contact current.

A.5 Miscellaneous

- The complete functional performance of the gas detector has to be verified every 6 months (gas detection, fault detection, performance of the 4–20mA signal current and the relays), gas alarms On and Off.
- The HART and RS-485 interface may not be used for the transmission of safety-related data.

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