SafEye™

Quasar 950/960

Toxic Open-Path Gas Detection System

User and Maintenance Manual

SPECTREX

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1 About this Guide

This guide describes the Quasar 950/960 Open-Path Gas Detection System and its features, and provides instructions on how to install, operate, and maintain the detector.

Note:

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

This guide includes the following chapters and appendices:

- **Chapter 1, About this Guide**, details the layout of the guide, includes the release history, a glossary and abbreviations, and explains how notifications are used in the guide.
- **Chapter 2, Product Overview**, provides a general introduction and overview of the product.
- **Chapter 3, Technical Description**, describes the detector's theory of operation.
- **Chapter 4, Operating Modes**, describes the detector's operation modes, user interface, and indications.
- **Chapter 5, Technical Specifications**, describes the detector's electrical, mechanical, and environmental specifications.
- **Chapter 6, Installation Instructions**, describes how to install the detector, including wiring and mode settings.
- **Chapter 7, Operating Instructions**, describes the operating instructions and power-up procedures.
- **Chapter 8, Maintenance Instructions**, describes the maintenance and support procedures.
- **Chapter 9, Troubleshooting**, describes the solutions to problems that may arise with the detector.
- **Appendix A, Wiring Configurations**, provides wiring diagrams for installation.
- **Appendix B, Accessories**, lists accessories for the detector.
- **Appendix C, SIL-2 Features**, details the special conditions for compliance with SIL-2 requirements.

1.1 Release History

Rev	Date	Revision History	Prepared by	Approved by
0	December 2013	First Release	Ian Buchanan	Eric Zinn
1	September 2014	Second Release	Ian Buchanan	Eric Zinn
2	October 2014	Third Release	Ian Buchanan	Eric Zinn
3	November 2014	Fourth Release	Ian Buchanan	Eric Zinn
4	November 2014	Fifth Release	Ian Buchanan	Eric Zinn
5	November 2014	Sixth Release	Ian Buchanan	Eric Zinn
6	January 2015	Seventh Release	Ian Buchanan	Eric Zinn
7	March 2016	Eighth Release	Ian Buchanan	Eric Zinn
8	June 2016	Ninth Release	Ian Buchanan	Eric Zinn
9	January 2017	Tenth Release	Jay Cooley	Ian Buchanan
10	February 2017	Eleventh Release	Jay Cooley	Ian Buchanan
Ak	July 2018	Twelfth Release	Michal Heller	Udi Tzuri
Al	August 2019	Thirteenth Release	Michal Heller	Udi Tzuri
Am	February 2020	Fourteenth Release	Michal Heller	Udi Tzuri
An	March 2020	Fifteenth Release	Michal Heller	Udi Tzuri

1.2 Glossary and Abbreviations

Abbreviation/Term	Meaning
Analog Video	Video values are represented by a scaled signal
ATEX	Atmosphere Explosives
AWG	American Wire Gauge
BIT	Built-In-Test
CMOS	Complementary Metal-Oxide Semiconductor image sensor
Digital Video	Each component is represented by a number representing a discrete quantization
DSP	Digital Signal Processing
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EOL	End of Line
FOV	Field of View
HART	Highway Addressable Remote Transducer – communications protocol
IAD	Immune at Any Distance
IECEx	International Electro-Technical Commission Explosion
IP	Internet Protocol
IPA	Isopropyl Alcohol
IR	Infrared
IR3	Refers to the 3 IR sensors
JP5	Jet Fuel
LED	Light Emitting Diode
MODBUS	Serial communicatisons protocol using Master-Slave messaging
N/A	Not Applicable
N.C.	Normally Closed
NFPA	National Fire Protection Association
N.O.	Normally Open
NPT	National Pipe Thread
NTSC	National Television System Committee (a color encoding system)
PAL	Phase Alternation by Line (a color encoding system)

Abbreviation/Term	Meaning
P/N	Part Number
RFI	Radio Frequency Interference
RTSP	Real Time Streaming Protocol
SIL	Safety Integrity Level
UNC	Unified Coarse Thread
VAC	Volts Alternating Current

1.3 Notifications

This section explains and exemplifies the usage of warnings, cautions, and notes throughout this guide:

Warning:

This indicates a potentially hazardous situation that could result in serious injury and/or major damage to the equipment.

Caution:

This indicates a situation that could result in minor injury and/or damage to the equipment.

Note:

This provides supplementary information, emphasizes a point or procedure, or gives a tip to facilitate operation.

2 Product Overview

The SafEye Quasar 950/960 UV Open-Path Gas Detector employs an advanced Xenon UV Source and integrated electronics package, both of which are encased in improved stainless steel housings, which provide high quality and performance, fast response, and line-of-sight gas monitoring. The source/detector is backed by a 3-year warranty.

The Quasar 950/960 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 a RS-485 or HART port used with host software supplied by SPECTREX, and a standard PC or IS handheld unit.

The Quasar Source and Detector unit enclosures are ATEX and IECEx approved. They are Exd flameproof with an integral segregated rear, and an Exe terminal compartment, which avoids exposure of the sensors and electronics to the surrounding environment. The detector also has a plug interface for connection to a handheld PC or HART unit, which meets intrinsically safe standards.

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

- To use the WinHost software to change the required functions, and for a description of its maintenance, please refer to *Manual TM899050* for instructions.
- To use the HART Protocol to change the required functions, and for a description of its maintenance, please refer to *Manual TM899030*. To set functions, the HART can be connected on the 0–20mA line or through the IS port.

The SafEye Quasar 950/960 detects and monitors toxic gases, such as NH_3 and H_2S, ppm.m concentrations in the air. SafEye has a response detection time of under 3 seconds, and under 10 seconds to T90.

The SafEye system uses an open path beam of flashlight pulses that provides a long line of sight coverage equivalent to a large number of point detectors along the path. The transmitted beam covers a UV spectrum from 200–300nm. The SafEye Quasar 950/960 constantly monitors for the gas through the collimated beam, over an optical path from 17ft/5m and up to 200ft/60m.

Warning:

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

3 Technical Description

3.1 Features

- Long-range gas detection from 17ft/5m up to 200ft/60m
- Detection of toxic gases (H_2S, NH_3)
- High sensitivity and fast response to toxic 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
- Standard 0–20mA output
- "Maintenance Call Mode" (3mA)
- HART protocol: communications protocol
- RS-485 Output Modbus compatible with PC communications network for a maximum of 247 systems
- Simple one-person installation, alignment, and calibration
- ATEX and IECEx approved per:

  Ex II 2(2) G D

  Ex db eb ib [ib Gb] IIB+H2 T4 Gb

  Ex tb [ib Db] IIIC T135°C Db
- TR CU approved per:

  1Ex db eb ib [ib Gb] IIB + H2 T4 Gb X

  Ex tb IIIC T135°C Db X

  –55°C ≤ Ta ≤ +65°C
- CSA C/US approved per:

Canada	**USA**
Ex db eb ib [ib Gb] IIB+H_2 T4 Gb	Class I Zone 1 AEx db eb ib [ib Gb] IIB+H_2 T4 Gb
Ex tb [ib Db] IIIC T135°C Db	Zone 21 AEx tb [ib Db] IIIC T135°C Db
Ta = -55ºC to +65ºC	Ta = -55ºC to +65ºC

- TUV approved per SIL2 requirements
- Inmetro (UL) approved
- Programmable configuration via the handheld unit
- Fast connection to IS-approved handheld diagnostic/calibration unit
- A 3-year warranty

3.2 Applications

The Quasar 950/960 SafEye system can be used to monitor toxic gas concentration in various applications, such as:

- Petrochemical, pharmaceutical, and other chemical storage and production areas
- Toxic chemical storage sites and hazardous waste disposal areas
- Detection of H_2S in desulfurization processes at refineries, oil platforms, pipelines, refueling stations, and fuel storage facilities
- Transportation depots and shipping warehouses of solvents, degreasing and cleaning solvents
- Styrene monomer, polymers, and plastic industries
- NH_3 production facilities, storage, and transportation
- Air conditioning, refrigeration, and agriculture application areas for NH_3 and derivatives
- Semiconductor industry, in which NH_3 concentration monitoring is required

3.3 Principles of Operation

The Quasar 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.

3.3.1 Definitions of Terms

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

- **TLV-TWA**: The time average concentration for a normal 8-hour workday (40-hour work-week) to which all workers may be repeatedly exposed, day after day, without adverse effects.
- **ppm**: Concentration in parts per million. Defines the amount of gas molecule parts per million molecules of common atmosphere gases.
- **ppm.m**: Integral of concentration in ppm multiplied by the distance in meters.

3.3.2 Spectral Fingerprint

Each hazardous material is detected at a specific wavelength selected according to its specific spectral absorption or "fingerprint." 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.

3.3.3 Optical Path

The presence of toxic 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.

Toxic 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.

3.3.4 Detected Gases

The following toxic gases and vapors are detected by the UV SafEye models according to their unique spectral absorption in the UV solar blind range:

- **Ammonia** (NH_3): A flammable and toxic gas that is highly irritant, colorless, and with a pungent odor.

  The early detection of NH_3 is essential in order to prevent its toxic effects, such as respiratory tract paralysis. In the UV band, NH_3 gas has a typically strong absorption in the solar blind range of 189–210nm that enables its fast and reliable detection at low concentrations.

- **Hydrogen Sulfide** (H_2S): A flammable, poisonous gas with a characteristic smell of rotten eggs.

  H_2S is heavier than air and very dangerous to humans, causing collapse, coma, or death from respiratory failure within a few seconds of inhalation.

  In the UV band, H_2S has a characteristically strong absorption in the solar blind range of 189–270nm, which enables its fast and reliable detection at low concentrations.

3.3.5 UV Source

The Xenon UV Source was introduced in the initial SafEye development, and was designed to overcome false alarms, which were experienced by early generations of the open path system. The new SafEye Quasar 950/960 employs the latest generation of UV bulbs to provide even more power, and an extended operation life.

3.3.6 Heated Optics

SafEye Quasar 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 one of the following modes:

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

See *System Setup,* page 30.

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 to 122°F/50°C. Heating stops when the temperature is 27°F/15°C above the start temperature.

3.3.7 HART Protocol

The Quasar 950/960 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 the *HART Manual TM899030*.

HART communication can be connected on the 0–20mA line, or through the IS connection, with a standard handheld unit loaded with the host software and attached by a special harness.

3.3.8 Modbus RS-485

For more advanced communications, the Quasar 950/960 has a RS-485 Modbus-compatible output that provides data communication from a network (up to 247 detectors) to a host computer or universal controller for central monitoring. This feature enables easy maintenance, with local and remote diagnostic tools.

3.3.9 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.

3.4 Product Certification

The SafEye 950/960 Series is approved by the following certifications:

3.4.1 ATEX, IECEx

The Quasar 950/960 is approved per ATEX and IECEx certifications:

- ATEX Ex II 2(2)G D

  Ex db eb ib [ib Gb] IIB+H2 T4 Gb

  Ex tb [ib Db] IIIC T135°C Db

- T Ambient –55°C to +65°C

This product is suitable for use in hazardous zones 1 and 2 with IIB+H2 group vapors present, and zones 21 and 22 with IIIC combustible dust types.

3.4.2 SIL-2

The Quasar 950/960 is TUV approved for SIL-2 requirements per IEC 61508.

According to SIL-2 requirements, the alert condition can be implemented by an alert signal via the 0–20mA current loop.

3.4.3 TR CU/EAC

The Open Path Quasar 950/960 is in compliance with the standard TR CU 012/2011 per:

1Ex db eb ib [ib Gb] IIB+H2 T4 Gb X

Ex tb IIIC T135°C Db X

–55°C ≤ Ta ≤ +65°C

For more details, see TR CU certificate No. TR CU C- US.МЮ62.B.05536.

3.4.4 Inmetro (UL)

The Quasar 950/960 is in compliance with the standards ABNT NBR IEC 60079-0, ABNT NBR IEC 60079-1, ABNT NBR IEC 60079-7, ABNT NBR IEC 60079-11, ABNT NBR IEC 60079-31, and INMETRO decree No. 179 as of May 18th, 2010. Further details may be found on Certificate of Compliance No. UL-BR 16.106XX.

3.4.5 CSA C/US

The Quasar 950/960 is approved per CSA C/US for Hazardous & Ordinary Locations:

Canada	USA
Ex db eb ib [ib Gb] IIB+H_2 T4 Gb	Class I Zone 1 AEx db eb ib [ib Gb] IIB+H_2 T4 Gb
Ex tb [ib Db] IIIC T135°C Db	Zone 21 AEx tb [ib Db] IIIC T135°C Db
Ta = -55ºC to +65ºC	Ta = -55ºC to +65ºC

The Quasar 950/960 is a 'Class 1 Laser Product' per IEC 60825-1:2014 ed. 05.

3.5 Models and Types

The Quasar 950/960 is available in 3 models for each type. Each model has the same detector but a different source. This allows for detection at distances of 5–60m. The various options are listed in Table 1.

Table 1: Model Numbers and Installation Distances

Model No.	Detector	Source	Min. Installation Distance (ft/m)	Max. Installation Distance (ft/m)
H_2S				
951	QRU-X-11X	QTU-X-11X	17/5	52/16
952	QRU-X-11X	QTU-X-21X	46/14	132/40
953	QRU-X-11X	QTU-X-31X	115/35	200/60
NH_3				
961	QRU-X-21X	QTU-X-11X	17/5	52/16
962	QRU-X-21X	QTU-X-21X	46/14	132/40
963	QRU-X-21X	QTU-X-31X	115/35	200/60

The Quasar 950/960 can be ordered as separate parts: source (P/N QTU-XX1X), detector (P/N QRU-XX1X), and commissioning kit. Refer to Figure 1.

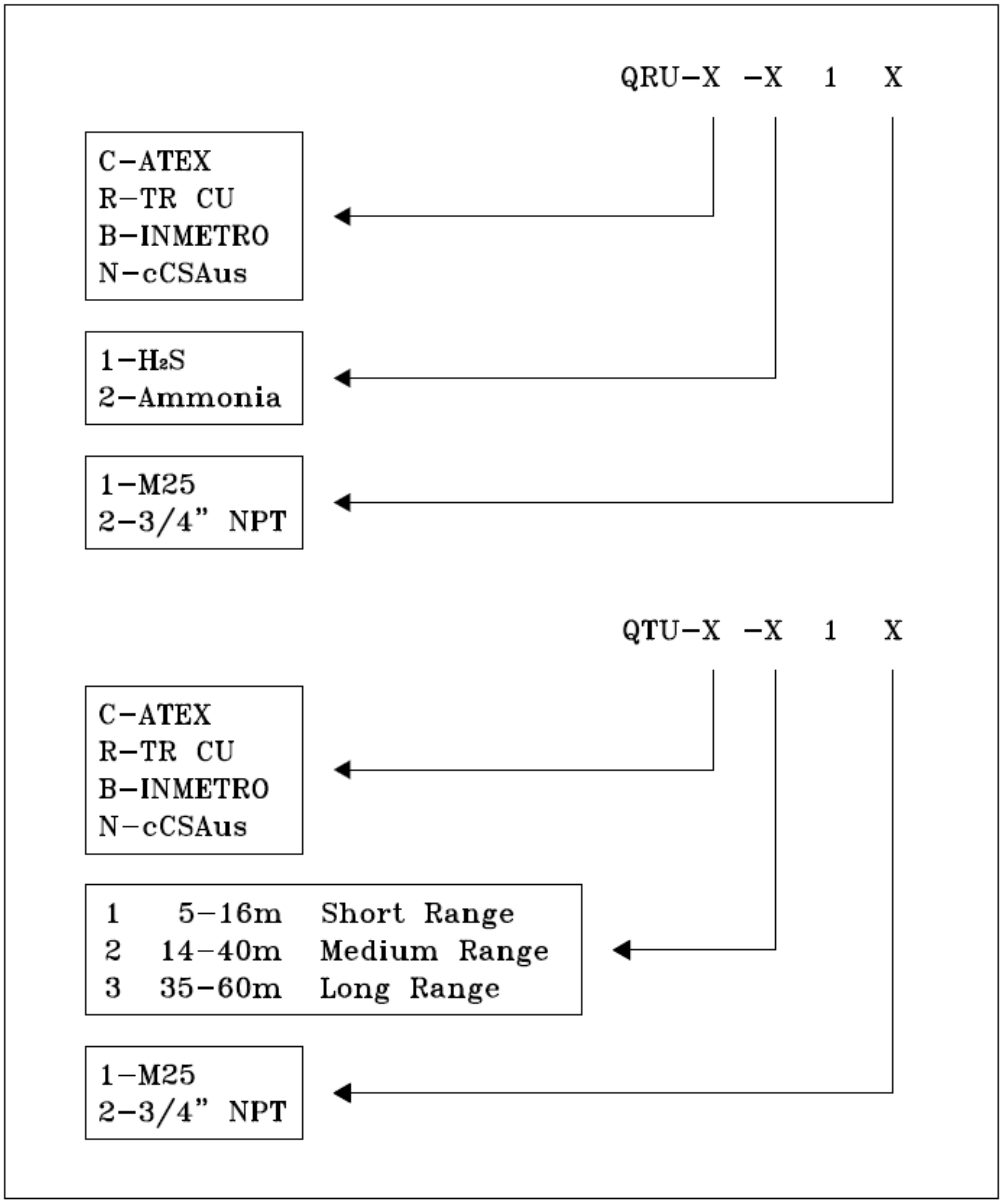


Figure 1: P/N Definition of Quasar 950/960

3.6 Description

The SafEye system consists of 2 main units:

- UV source (transmitter)
- Infrared detector (receiver)

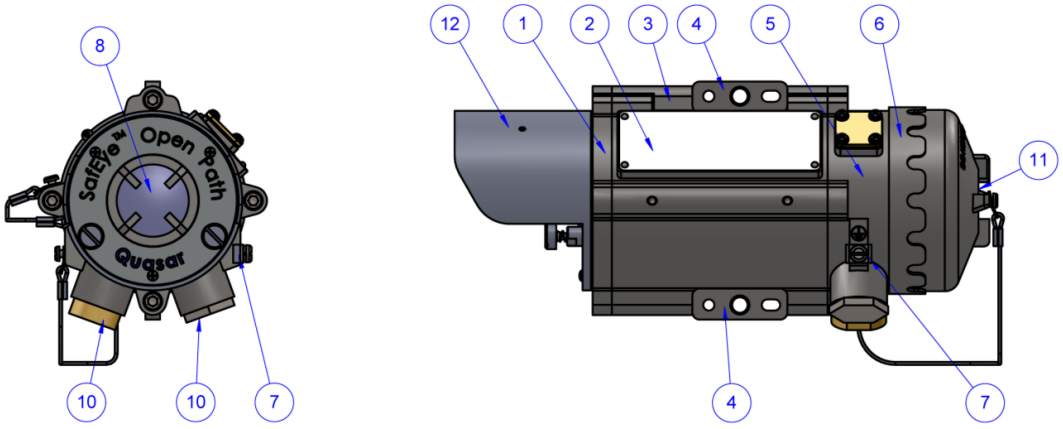
Quasar 950/960 detects gases over an open path transmitted from the UV source to the detector.

3.6.1 UV Source Unit

The UV source unit emits UV radiation pulses at the rate of 1 pulse per second. The pulse width (5–10µsec) is very powerful. The front of the SafEye Source has an internal reflector that collimates the UV beam for maximum intensity. The front window is heated to improve performance in ice, condensation, and snow conditions.

There are 3 source types:

- For short range – 951/961 – Source P/N QTU-X-11X
- For medium range – 952/962 – Source P/N QTU-X-21X
- For long range – 953/963 – Source P/N QTU-X-31X



1	Front window section	**7**	Earth terminal
2	Label	**8**	Front window
3	Main housing	**10**	Cable inlet
4	Mounting plate	**11**	Indicator LED
5	Junction box	**12**	Weather shield
6	Back cover		

Figure 2: UV Source

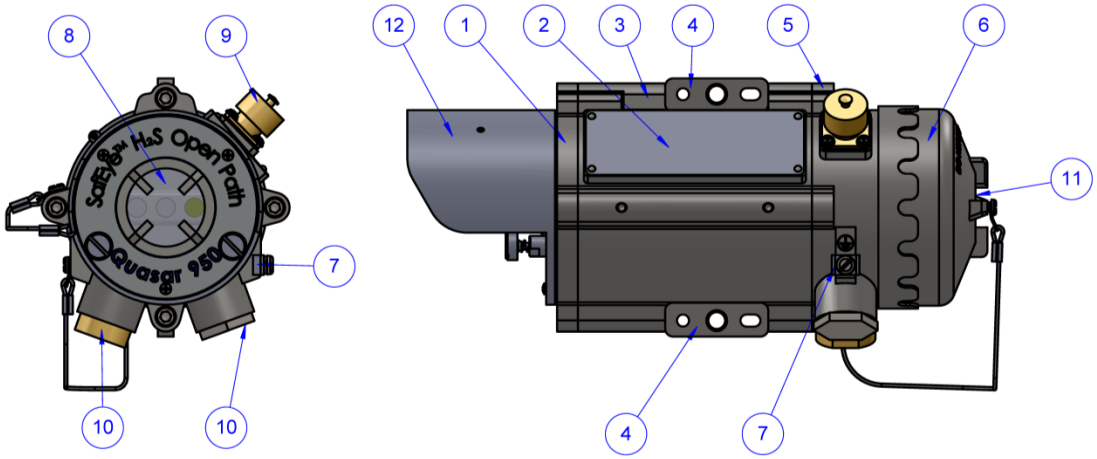
The sources for models 951, 952, and 953 are the same electronically and optically. The only distinction between them is that each detector apparatus is suitable for a different distance.

3.6.2 Detector Unit

The detector receives the transmitted pulsed radiation signals from the UV 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 compensates for them. This allows the signals to be maintained even in severe weather conditions. The data is sent to the output interface section.

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

The P/N QRU-X-11X Detector is suitable for Quasar models 951, 952, and 953. The P/N QRU-X-21X Detector is suitable for Quasar models 961, 962, and 963.



1	Front window section	**7**	Earth terminal
2	Label	**8**	Front window
3	Main housing	**9**	Handheld fast connection
4	Mounting plate	**10**	Cable inlet
5	Junction box	**11**	Indicator LED
6	Back cover	**12**	Weather shield

Figure 3: Detector

4 Operating Modes

4.1 Operational Modes

The Quasar 950/960 has 4 operational modes.

4.1.1 Normal Mode

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

- Normal (N): Gases have been detected at safe levels.
- Warning (W): Gases have been detected at warning levels.
- Alarm (A): Gases have been detected at alarm levels.

Note:

The user defines the alarm levels at the controller. The output detector is 4mA at zero reading and 20mA for full-scale reading

For the standard 0–20mA output, the warning and alarm levels are not relevant.

If the RS-485 output is used, the detector status changes from N to W at warning level, and to A at alarm level.

4.1.2 Maintenance Call Mode (3mA Output)

The maintenance call mode indicates a low signal or low signal ratio that may be caused by a dirty window, misalignment, poor source, or that one 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.

4.1.3 Fault Mode

In fault mode, there are 3 fault types:

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

  This occurs due to a blockage, misalignment, low signal, partial obscuration, or full beam block. With a fault of this type, detection is no longer possible. Operation can be restored (auto reset) if the condition causing the problem is removed or resolved. There is a delay of 60sec after the fault before switching to this mode. This delay is important to rule out a momentary obscuration due to passing through the beam.

- **Low Voltage Fault (1mA Output)**

  Detection is disabled due to a low voltage supply. The detector returns to proper operation when the correct voltage level is restored.

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

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

  If there is a fault in the 0–20mA loop, the output is 0mA.

4.1.4 Zero Calibration Mode (1mA Output)

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

It should only be performed when the following criteria are met:

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

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

4.2 Visual Indicators

One 3-color LED indicator is located in the back of the detector/source and can be seen through the back cover window (Figure 2 and Figure 3, Item 11).

The detector statuses are listed in Table 2.

Table 2: Detector LED Indications

Detector Status	LED Color	LED Mode
Fault	Yellow	4Hz, flashing
Alignment/Standby	Yellow	1Hz, flashing
Zero Calibration	Yellow	Constant
Normal	Green	1Hz, flashing
Warning	Red	2Hz, flashing
Alarm	Red	Constant

The source statuses are listed in Table 3.

Table 3: Source LED Indications

Source Status	LED Color	LED Mode
Fault	Yellow	4Hz, flashing
Normal	Green	1Hz, flashing

4.3 Output Signals

The SafEye system provides the following outputs:

- 0–20mA Current Output
- RS-485 Interface

4.3.1 0–20mA Current Output

The 0–20mA output provides the detector status measurement with a continuous reading of exact gas concentration.

The 0–20mA output functions as current Sink, but it can be configured as Source (see).

The maximum permitted load resistance for the 0–20mA output is 500Ω.

Table 4: Standard (default) 0–20mA Current for the Gas Channel

Current Reading	Status and Description
0mA +0.2mA	Fault in 0–20mA loop
1mA ±0.2mA	Zero calibration (in progress), Fault 2
2mA ±0.2mA	Fault 1 (non-critical)
3mA ±0.2mA	Maintenance call
4mA ±0.2mA	No gas present
4–20mA	Continuous measuring of gas concentration at a range between 0 and full scale. This translates to 3.2mA per every 100 PPM.m
21mA	Concentration is over the range limit (more than full-scale concentration)

4.3.2 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.

4.4 System Setup

4.4.1 Detection Function Programming

The SafEye Quasar 950/960 incorporates several functions that can be set by the customer, using:

- Host software: Refer to the manual for programming instructions.
- HART handheld diagnostic unit provides an easy, economical connection to the quick plug. This unit provides verification, status and instructions for correcting the detector's parameters. It also includes a harness and a special host for maintenance and commissioning.

4.4.2 Detection Setup Function

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

Setup includes the following options:

- Address Setup
- Heated Optics Operation
- Range

4.4.2.1 Address Setup

The detector provides up to 247 addresses that can be used with the RS-485 communication link.

4.4.2.2 Heated Optics Operation

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

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

In Auto mode, the start temperature below which the window will be heated can be defined. Heating stops when the temperature is 27°F/15°C above the start temperature.

The temperature can be defined between 32–122°F / 0–50°C.

This feature applies only to the detector.

The source heated optics must be defined when the detector is ordered as 1 of 2 options:

- Heated continuously

  Or

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

4.4.2.3 Range

Selection between short and mid/long range

4.4.3 Detector Default Setup

The detector has 3 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 5: Detector Default Setup

Function	Setup
0–20mA	Continuous
Heat mode	Auto
Heat on	5

Table 6: Source Default Setup

Function	Setup
Heat mode	Auto
Heat on	5

The source default can be changed with the same host.

5 Technical Specifications

5.1 General Specifications

Detected Gases: H_2S, NH_3,

Detection Distance Range: Table 7

Table 7: Detection Distance Range

Model No.	Detector	Source	Minimum Installation Distance (ft/m)	Maximum Installation Distance (ft/m)
H_2S				
951	QRU-X-11X	QTU-X-11X	17/5	52/16
952	QRU-X-11X	QTU-X-21X	46/14	132/40
953	QRU-X-11X	QTU-X-31X	115/35	200/60
NH_3				
961	QRU-X-21X	QTU-X-11X	17/5	52/16
962	QRU-X-21X	QTU-X-21X	46/14	132/40
963	QRU-X-21X	QTU-X-31X	115/35	200/60

Response Time: <3 sec, <10 sec to T90

Spectral Response: 200–300nm

Sensitivity Range:

Full Scale	Warning	Alarm
ppm.m	ppm.m	**ppm.m**
500	100	**300**

Field of View: Line of sight

Alignment Tolerance: ± 1°

Drift: Long: term ± 5% of full scale

Minimum Detectable Level: 50 ppm.m

Temperature Range: –67°F/–55°C to +149°F/+65°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

5.2 Electrical Specifications

Operating Voltage: 18–32VDC

5.2.1 Current Consumption

Table 8: Detector and Source Maximum Current Consumption

	Without Heated Optic (Max.)	With Heated Optic (Max.)
Detector	150mA	300mA
Source	200mA	300mA

5.2.2 Electrical input protection

The input circuit is protected against voltage-reversed polarity, voltage transients, surges, and spikes, according to EN50270.

5.2.3 Electrical outputs

5.2.3.1 0–20mA Current Output

The 0–20mA is an isolated Sink option. This output can also be configured as Source (see *Wiring Configurations* on page 67). The maximum permitted load resistance is 500Ω.

5.2.3.2 Communication Network

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

Communication is compatible with the Modbus protocol:

- This protocol is standard and 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.

5.2.3.3 HART Protocol

The HART protocol is a digital communication signal at low levels in addition to the 0–20mA.

This bi-directional field communication protocol is 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

5.3 Mechanical Specifications

Enclosure:	The detector, source and tilt mount are stainless steel 316 electrochemical and passivated coating	
Explosion Proof:	ATEX and IECEx	Ex II 2(2)G D Ex db eb ib [ib Gb] IIB+H2 T4 Gb Ex tb [ib Db] IIIC T135°C Db
Water and Dust Tight:	IP66 and IP68 IP68 is rated for 2m depth for 45 minutes NEMA 250 type 6p	
Electrical Modules:	Conformal coated	
Electrical Connection:	(2 options, specified at time of order) 2 X M25 (ISO) 2 X 3/4" – 14 NPT conduits	
Dimensions:	Detector	10.5" x 5.1" x 5.1" / 267 x 130 x 130mm
	Source	10.5" x 5.1" x 5.1" / 267 x 130 x 130mm
	Tilt mount	4.7" x 4.7" x 5.5" / 120 x 120 x 40mm
Weight:	Detector	11lb/5kg
	Source	11lb/5kg
	Tilt mount	4.2lb/1.9kg

5.4 Environmental Specifications

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

5.4.1 High Temperature

The SafEye system is designed to meet DNVGL-CG-0339, class D.

- **Operating temperature**: +149ºF/+65ºC
- **Storage temperature**: +149ºF/+65ºC

5.4.2 Low Temperature

The SafEye system is designed to meet DNVGL-CG-0339, class D.

- **Operating temperature**: –67ºF/–55ºC
- **Storage temperature**: –67ºF/–55ºC

5.4.3 Humidity

The SafEye system is designed to meet DNVGL-CG-0339, class B.

5.4.4 Enclosure

The SafEye system is designed to meet DNVGL-CG-0339, class C.

5.4.5 Water and Dust

- IP68 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.

5.4.6 Vibration

The SafEye system is designed to meet DNVGL-CG-0339, class B.

5.4.7 Electromagnetic Compatibility (EMC)

This product is in conformance with EMC per EN50270:

Radiated Emission:	EN55022
Conducted Emission:	EN55022
Radiated Immunity:	EN61000-4-3
Conducted Immunity:	EN61000-4-6
ESD:	EN61000-4-2
Burst:	EN61000-4-4
Surge:	EN61000-4-5
Magnetic Field:	EN61000-4-8

To fully comply with EMC directive 2014/30/EU and protect against interference caused by RFI and EMI, the cable to the detector must be shielded and the detector must be grounded. The shield should be grounded at the detector end.

6 Installation Instructions

6.1 Introduction

The detector and UV 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.

6.2 General Considerations

6.2.1 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 wiring installation.

6.2.2 Required Tools

The detector can be installed using general-purpose common tools and equipment. Table 9 lists the specific tools required to install the detector.

Table 9: Tools

Tools	Function
Hex key 10mm	Mount the detector on the tilt mount
Hex key 3/16”	Align the detector
Hex key 5/16”	Screw detector plug
Flat screwdriver 4mm	Connect the ground terminal
Flat screwdriver 2.5mm	Connect wires to the terminal blocks

6.2.3 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

6.2.4 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 UV signal due to adverse weather, it is recommended to use a detector that is not at the limit of its operating range. The general recommendation is to install the detector at a distance from the Source of no 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.

6.2.5 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 sources and potential ignition sources.
- In areas with expected heavy fog, rain, snow, or extremely hot conditions, consider the effects of long-range installation and install the detector at no more than 80% from the maximum installation distance.

6.2.6 Separation Distances

To avoid cross talk between adjacent Open Path Gas Detector Systems where Transmitters are installed on the same side, keep the relevant separation distance between the neighboring OPGD systems according to the installation lengths as listed in Table 10.

Table 10: Separation Distances

Installation Line of Sight Distance, m (ft.)	Minimum Separation, m (ft)
10 (33)	1 (3.3)
20 (66)	1.5 (5)
30 (98)	2.5 (6.5)
40 (131)	3.5 (11.5)
50 (164)	4.5 (15)
60 (197)	5 (16.5)

6.2.7 Wiring

- For wiring, use color-coded conductors, suitable wire markings, or labels. The wire cross-section must be between 0.5–2.5mm² / 28–14AWG.
- The selected wire gauge should be based on the number of detectors used on the same loop, and the distance from the control unit. The maximum number of wire connections in a terminal is 2 wire cross-sections, each of 1mm².
- To fully comply with EMC directive and protect against interference caused by RFI and EMI, the cable to the detector must be shielded and the detector must be grounded. The shield should be grounded at the detector end.

6.3 Preparations for Installation

6.3.1 General

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.

6.3.2 Equipment

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

- Detector unit: QRU-X-X1X (See *Models and Types,* page 22)
- Source unit: QTU-X-X1X (See *Models and Types*, page 22)
- 2 tilt mount bases:
  - 1 base is used for the detector
  - 1 base is used for the UV source
- The commissioning kit for H_2S or NH_3 includes:
  - Magnetic mode selector
  - Handle for cover opening
  - Alignment tool kit
  - Function check filter: H_2S or NH_3
- Other accessories are available (per customer request):
  - Pole mount:
    - U-bolt 2-3”
    - U-bolt 4-5”
  - HART handheld diagnostic unit
  - HART handheld harness kit
  - USB/RS-485h harness converter kit
  - Protective cover

For additional details, see *Accessories* on page 71.

6.3.3 Unpacking the Product

Upon receipt of the detector, check and record the following:

- Verify that the model matches the purchase order.
- Record the part number (P/N) and serial number of the detectors and source units, and the installation date in an appropriate logbook.
- Open the container package immediately, prior to detector installation, and visually inspect the detectors, sources, and accessories.
- Verify that all components required for the detector installation are readily available before beginning the installation. In the event that the installation is not completed in a single session, secure and seal the detectors and conduits.

6.4 Certification Instructions

6.4.1 General Instructions

Warning:

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

Use the following certification instructions:

- The cable entry point may not exceed 182°F/83°C. Suitable precautions should be taken when selecting the cable.
- Only suitably certified cable entry devices or conduit shall be used for connections and unused openings shall be blanked off using a suitably certified stopping plugs.
- The marking of the equipment is: Ex II 2(2)G D
  Ex db eb ib [ib Gb] IIB+H2 T4 Gb
  Ex tb [ib Db] IIIC T135°C Db
- The equipment may be used with flammable gases and vapors with apparatus groups IIA and IIB +H2 T4 in the ambient temperature range –67°F/–55°C to +149°F/+65°C.
- Installation should be carried out by suitably trained personnel, in accordance with the applicable code of practice, e.g. EN 60079-14:1997.
- Inspection and maintenance of this equipment should be carried out by suitably trained personnel, in accordance with the applicable code of practice, e.g. EN 60079-17.
- Repair of this equipment should be carried out by suitably trained personnel, in accordance with the applicable code of practice, e.g. EN 60079-19.
- The certification of this equipment relies upon use of the following materials in its construction:
- **Enclosure**: 316L Stainless Steel
- **Window**: Sapphire Glass
- **Seals**: EPDM
- If the equipment is likely to come into contact with aggressive substances as described below, then it is the responsibility of the user to take suitable precautions to prevent the equipment from being adversely affected, thus ensuring that the type of protection provided by the equipment is not compromised.
  - Examples of aggressive substances: acidic liquids or gases that may attack metals, solvents that may affect polymeric materials

- Examples of suitable precautions: routine inspections, establishing resistance to specific chemicals from the material's data sheets.

- The output of the optical radiation source with respect to explosion protection meets Exception 3 from the scope of UL 60079-28.
- Special conditions for safe use: The Quasar 950/960 Open Path Gas Detectors and UV Source Units should not be used as safety related devices, in accordance with directive 2014/34/EU.

6.4.2 Intrinsically Safe Outputs

Intrinsically safe outputs through the I.S. port have the following parameters:

Parameter	Channels						
	LED 1	**LED 2**	**HART CON**	**RS485+**	**RS485-**	**5V**	**All combined**
Uo	6.51V	6.51V	6.51V	6.51V	6.51V	6.51V	6.51V
Io	68.5mA	68.5mA	68.5mA	68.5mA	68.5mA	68.5mA	68.5mA
Po	111.5mW	111.5mW	111.5mW	111.5mW	111.5mW	111.5mW	111.5mW
Ci	0µF	0µF	0µF	0µF	0µF	0µF	0µF
Li	0µH	0µH	0µH	0µH	0µH	0µH	0µH
Co	22 µF	22 µF	22 µF	22 µF	22 µF	22 µF	22 µF
Lo	7.5 mH	7.5 mH	7.5 mH	7.5 mH	7.5 mH	514 µH	96.9 µH

Co @ 6.6 V is 22 µF, as per Table A.2 of IEC 60079-11:2011

Lo calculated based on 1.5 times current, for IIC, 40 µJ using E = 0.5 *(LI)2

6.4.3 Special Conditions for Safe Use for ATEX/IECEx Only

- The dimensions of the flameproof joints differ from the relevant minimum or maximum values required by Table 2 of IEC/EN 60079-1:2007 for IIB + H_2, as detailed below:

Flamepath Description	Type of Joint	Minimum Width "L" (mm)	Maximum Gap "i_c" (mm)
Cylindrical section of spigot (both ends of Ex d compartment)	Cylindrical	15	0.08
30mm diameter window fitted against enclosure	Flanged	10.7	0.02
39.5mm diameter window fitted against enclosure	Flanged	10	0.02

- Gaps, "i_c," should not be modified to be any larger, and widths, "L," should not be modified to be any shorter than the values shown in the table above.

1. Connections to the IS port on the side of the detector enclosure should be made using equipment that maintains the intrinsically safe levels of protection.

- The Um should be installed in accordance with one of the following:
  - The Um is 18–32VDC, in a SELV/PELV system
  - Via a safety isolating transformer complying with the requirements of IEC 61588-2-6 or technically equivalent standard
  - Directly connected to apparatus complying with IEC 60950, IEC 61010-1, or technically equivalent standard
  - Fed directly from cells or batteries

6.4.4 North American Conditions of Acceptability from certificate CSA 80023016

6.4.4.1 Conditions for Canadian Installations

1. The dimensions of the flameproof joints are other than the relevant minimum or maximum values required by Table 2 of CAN/CSA-C22.2 No 60079-0:19 Ed.4 for IIB + H2, as detailed below:

Flamepath Description	Type of Joint	Minimum Width "L" (mm)	Maximum Gap "i_c" (mm)
Cylindrical section of spigot (both ends of Ex d compartment)	Cylindrical	15	0.08
30 mm diameter window fitted against enclosure	Flanged	10.7	0.02
39.5 mm diameter window fitted against enclosure	Flanged	10	0.02

Gaps shall not be machined to be any larger than the values of 'i_c', and widths shall not be modified to be any smaller than the values of 'L', shown in the table above.

2. Connections to the I.S. port on the side of the detector enclosure shall be made via equipment which maintains the intrinsically safe levels of protection.
   - Where Um marked on the associated apparatus is less than 250V it shall be installed in accordance with one of the following:
   - Where Um does not exceed 50 Vac or 120 Vdc, in a SELV or PELV system or,
   - Via a safety isolating transformer complying with the requirements of CAN/CSA-C22.2 No. 66.1 or technically equivalent standard, or
   - Directly connected to apparatus complying with CAN/CSA-C22.2 No. 60950-1, CAN/CSA-C22.2 No. 61010-1 or technically equivalent standard, or
   - Fed directly from cells or batteries.
3. The output of the optical radiation source with respect to explosion protection meets Exception 3) from the scope of CAN/CSA-C22.2 No. 60079-28:16 Ed.1
4. Upon installation remove the plastic transit plug from the cable entry and use a cable fitting or a conduit fitting with the following specification to connect the cable to the equipment:
   - Ex marking: Ex eb IIC Gb, Ex tb IIIC Db
   - Temperature rating: -55°C to +83°C or better
   - Connecting thread: M25x1.5 or ¾" NPT
5. Equipment is only to be installed by manufacturer trained personnel.

6. Equipment has only been tested for electrical safety. No evaluation of functional safety and performance characteristics has been conducted.

7. The equipment shall be supplied with Limited Energy Circuit (LEC) as defined in CSA C22.2 No. 61010-1-12 or Limited Power Source (LPS) as defined in CAN/CSA C22.2 No. 60950-1.

6.4.4.2 Conditions for US Installations

1. The dimensions of the flameproof joints are other than the relevant minimum or maximum values required by Table 2 of UL 60079-0:2019 Ed. 7 for IIB + H2, as detailed below:

Flamepath Description	Type of Joint	Minimum Width "L" (mm)	Maximum Gap "i_c" (mm)
Cylindrical section of spigot (both ends of Ex d compartment)	Cylindrical	15	0.08
30 mm diameter window fitted against enclosure	Flanged	10.7	0.02
39.5 mm diameter window fitted against enclosure	Flanged	10	0.02

Gaps shall not be machined to be any larger than the values of 'i_C', and widths shall not be modified to be any smaller than the values of 'L', shown in the table above.

2. Connections to the I.S. port on the side of the detector enclosure shall be made via equipment which maintains the intrinsically safe levels of protection.

3. Where Um marked on the associated apparatus is less than 250V it shall be installed in accordance with one of the following:

   - Where Um does not exceed 50 Vac or 120 Vdc, in a SELV or PELV system or,
   - Via a safety isolating transformer complying with the requirements of UL 5085-1 or technically equivalent standard, or
   - Directly connected to apparatus complying with UL 60950-1, UL 61010-1 or technically equivalent standard, or
   - Fed directly from cells or batteries.

4. The output of the optical radiation source with respect to explosion protection meets Exception 3) from the scope of UL 60079-28:2017 Ed.2

5. Upon installation remove the plastic transit plug from the cable entry and use a cable fitting or a conduit fitting with the following specification to connect the cable to the equipment:

   - Ex marking: Class I Zone 1 AEx eb IIC Gb, Zone 21 AEx tb IIIC Db
   - Temperature rating: -55°C to +83°C or better

- Connecting thread: M25x1.5 or ¾" NPT

6. Equipment is only to be installed by manufacturer trained personnel.
7. Equipment has only been tested for electrical safety. No evaluation of functional safety and performance characteristics has been conducted.
8. The equipment shall be supplied with Class 2 as defined in article 725.121 of NFPA 70

6.5 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 downward.
- 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.

6.6 Detector/Source Mounting

Mount the detector source with the tilt mount kit. The tilt mount enables the detector to be rotated up to 60º in all directions, with a fine alignment of up to 10º.

6.6.1 Tilt Kit

The following contents are included with the tilt mount kit:

Table 11: Tilt Mount Kit

Item	Qty	Type
Tilt mount	1	
Screw	1	M10 x 1.5
Spring washer	1	No. 10

6.6.2 Detector/Source Installation

(Figure 4 and Figure 5)

The detector and the source can be installed in 2 ways with the same tilt mount.

- **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 with an M10 x 1.5 screw with No. M10 spring washers (9, 10). Secure the detector to the tilt mount using Hex Key No. 7 for M10 x 1.5 screws (Item 9).

3 Repeat Steps 1–2 for installing the source.

6.7 Detector Wiring

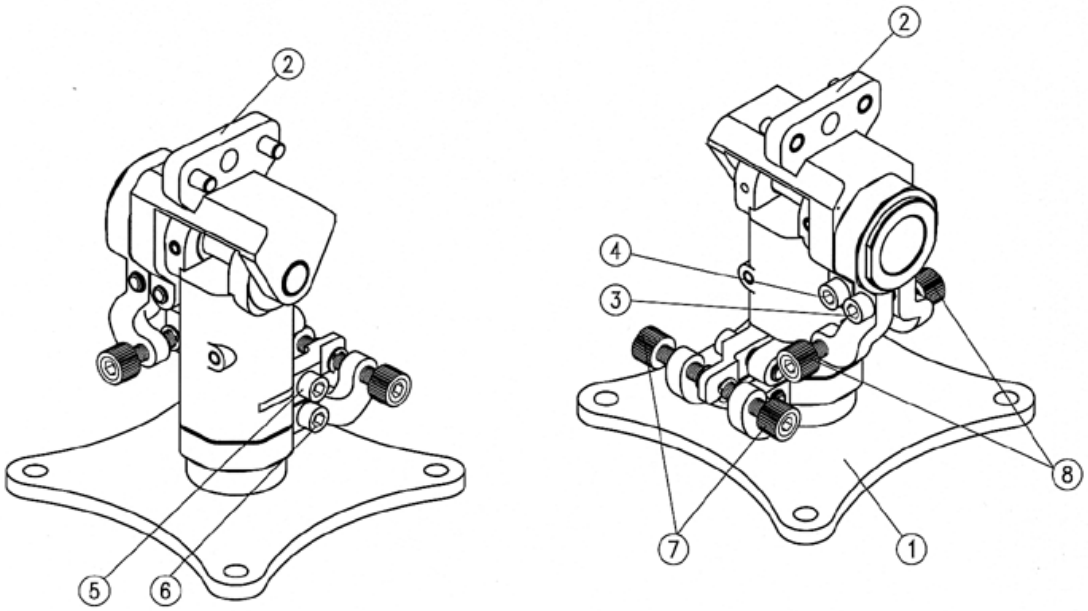
- **To install the detector wiring:**

1. Release the back cover secure bolt (Figure 5, Item 15), and open the detector back cover (Figure 5, Item 14). 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 (Figure 6, Item 4). Use a 3/4" – 14 NPT or M25x1.5 conduit connection/cable gland to assemble the cable/ conduit to the detector.
3. Connect the wires to the required terminals (Figure 6, Item 2) according to the wiring diagram. See *Detector Terminal Wiring,* page 54 and Figure 8, Figure 10, Figure 12, and Figure 13 in *Wiring Configurations* on page 67.
4. Connect the grounding wire to the ground screw located on the exterior of the detector (Figure 6, Item 3). The detector must be well grounded to earth ground.

Note:

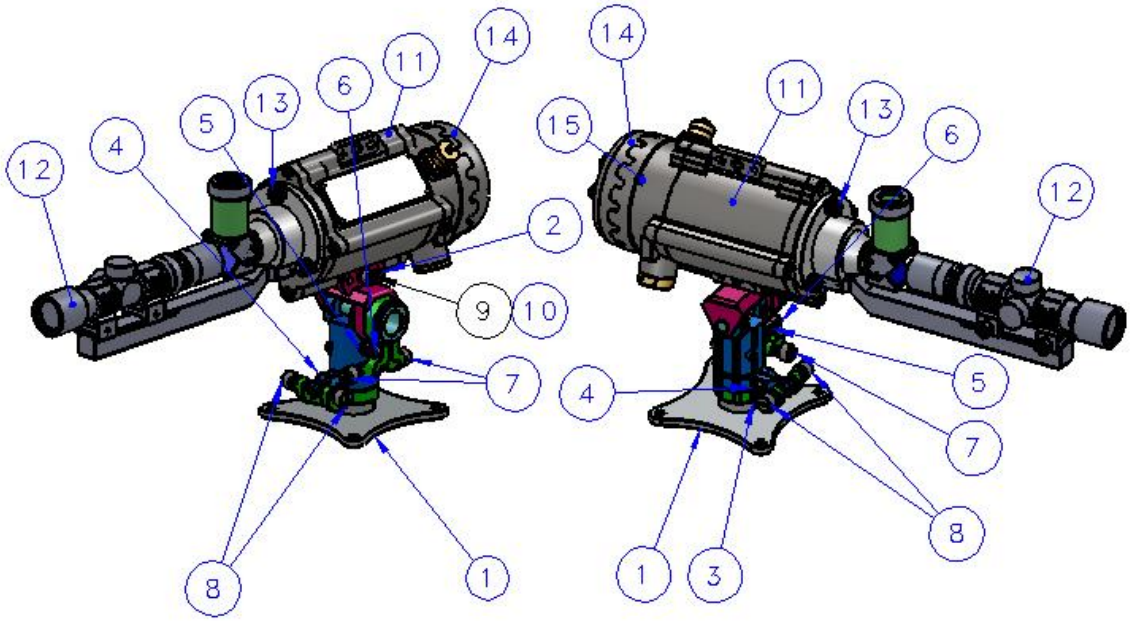
In case of installations in the US, the internal grounding connection shall be used for the equipment grounding connection and the external connection is for a supplementary bonding connection where local codes or authorities permit or require such connection. The external bonding conductor shall be manufactured from copper and shall have a size of 4 mm2 . A tightening torque of 16 inlb (1.8 Nm) shall be used to secure the bonding conductor.

5. Place and secure the detector's back cover by screwing on the cover and securing it using the secure bolt (Figure 5, Item 15).



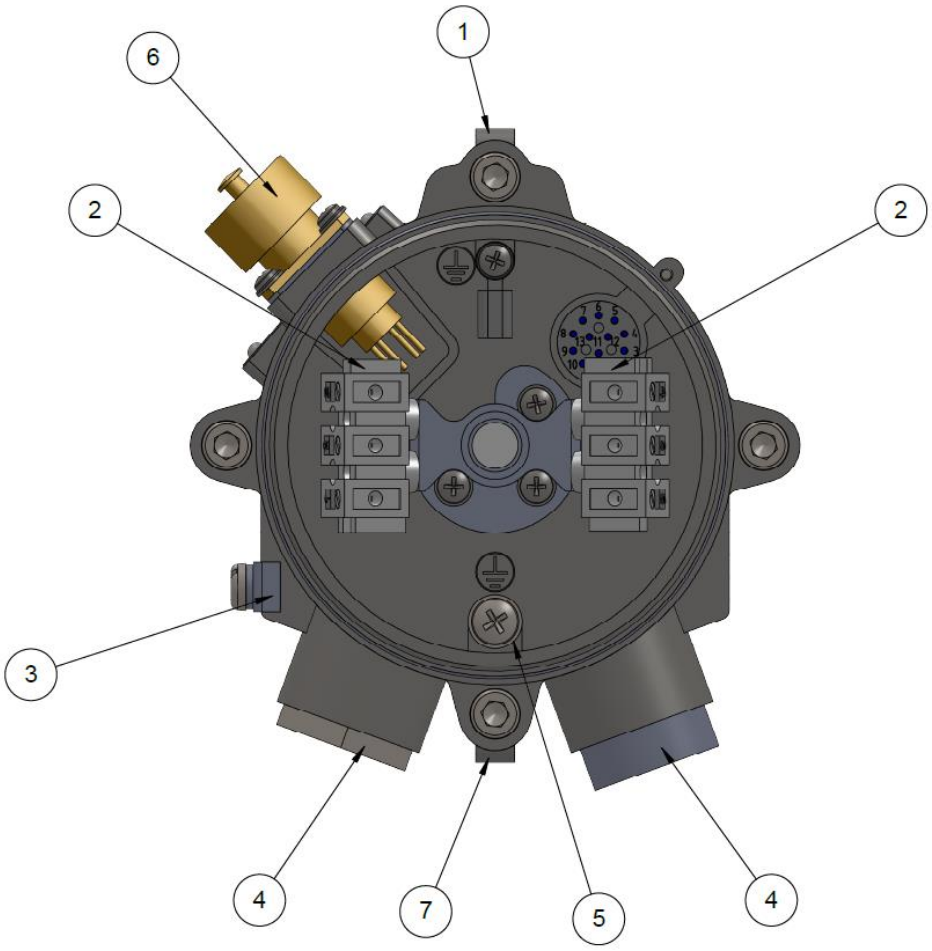
1	Tilt mount holding plate	**5**	Vertical fine alignment tightening screw
2	Detector/source holding plate	**6**	Vertical crude alignment tightening screw
3	Horizontal crude alignment tightening screw	**7**	Vertical fine alignment screw
4	Horizontal fine alignment tightening screw	**8**	Horizontal fine alignment screw

Figure 4: Tilt Mount



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**	Alignment tool
5	Vertical fine alignment tightening screw	**13**	Alignment tool tightening bolt
6	Vertical crude alignment tightening screw	**14**	Detector back cover
7	Vertical fine alignment screw	**15**	Detector back cover secure bolt
8	Horizontal fine alignment screw		

Figure 5: Detector and Tilt Mount Assembly



1	Housing	**5**	Internal earth connection
2	Terminal board	**6**	Connection to handheld unit
3	Earth terminal	**7**	Detector holding plate
4	Inlet conduit		

Figure 6: Detector with Cover Removed

6.8 Detector Terminal Wiring

The detector has 6 wiring terminals.

Table 12 lists the functions of each electrical terminal of the detector.

Table 12: Wiring Options

Terminal No.	Function
1	Power +24VDC
2	Return –24VDC
3	0–20mA In (+)
4	0–20mA Out (–)
5	RS-485 (+)
6	RS-485 (–)

6.9 UV Source Wiring

6.9.1 Wiring

- **To install the wiring:**

1. Release the back screw bolt (Figure 5, Item 15), and open the source back cover (Figure 4, Item 14). The chamber is now exposed.
2. Remove the protective plug mounted on the source conduit/cable entry inlet, and pull the wires through the source inlet (Figure 7, Item 4). Use a 3/4" – 14 NPT or M25x1.5 conduit connection/cable gland to assemble the cable/ conduit to the detector.
3. Connect the wires to the required terminals (Figure 7, Item 2) according to the wiring diagram. See *Terminal Wiring*, page 55 and Figure 12 in *Wiring Configurations* on page 67.
4. Connect the grounding wire to the ground screw located on the exterior of the detector (Figure 7, Item 3). The source must be well grounded to earth ground.

Note:

In case of installations in the US, the internal grounding connection shall be used for the equipment grounding connection and the external connection is for a supplementary bonding connection where local codes or authorities permit or require such connection. The external bonding conductor shall be manufactured from copper and shall have a size of 4 mm2 . A tightening torque of 16 inlb (1.8 Nm) shall be used to secure the bonding conductor.

5. Place and secure the source unit's back cover by screwing on the cover and securing the back screw bolt.

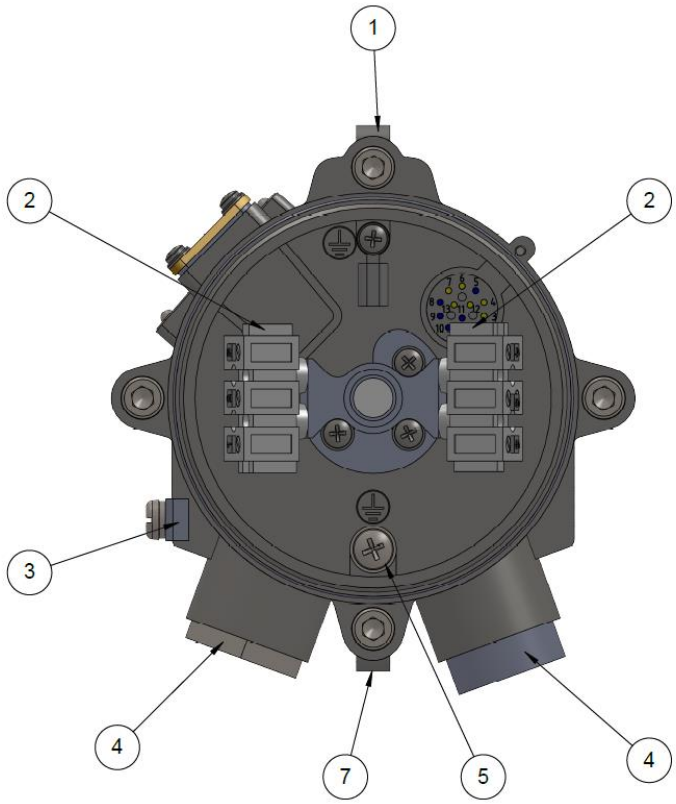
6.9.2 Terminal Wiring

The UV source contains 6 wiring terminals.

Table 13 lists the functions of each electrical terminal of the UV source.

Table 13: UV Source Wiring Options

Terminal No.	Function
1	Power +24VDC
2	Return –24VDC
3	Spare
4	Spare
5	RS-485 (+)
6	RS-485 (–)



1	Housing	**5**	Internal earth connection
2	Terminal board	**6**	N/A
3	Earth terminal	**7**	Detector holding plate
4	Inlet conduit		

Figure 7: Source with Cover Removed

7 Operating Instructions

7.1 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 of the SafEye System.

Caution:

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

7.2 Alignment of Unit

The alignment tool is used to perform full alignment.

Perform the alignment procedure in 2 stages:

- Crude alignment
- Fine adjustment

The alignment tool includes a periscope that consists of a prism and an ocular that are located vertical to the alignment tool assembly. This allows the user to look 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 alignment tool installation, verify that the alignment tool and its sight mounting are free of dirt.
- To ensure optimal alignment, do not attempt to change any factory calibration of the alignment tool or its mounting.

- **To align the unit (see Figure 4):**

1. Ensure that the detector and the UV source are installed properly. Installation instructions are described in *Installation Instructions*, page 39.
2. Remove the front shield using the 2 captive screws.
3. Install the alignment tool assembly (Item 12) on the front of the detector/source. Fasten the alignment tool with fastening screws (Item 13).
4. **Crude Alignment**:
   a. Use a ¼" Allen screwdriver for all alignment screws.

b Loosen screws 5 and 6.

c Approximately aim the source horizontally toward the detector.

d Tighten screw 6.

e Loosen screws 3 and 4.

f Approximately aim the source vertically toward the detector.

g Tighten screw 3.

5 Repeat Step 4 for the detector towards the source.

6 **Fine Alignment**:

a Aim the source toward the detector within a horizontal axis using screw 7. Aim the alignment tool cross toward the center of the front window of the detector or source (see Figure 2 and Figure 3, Item 8).

b Tighten screw 5.

c Aim within the vertical axis using screw 8.

d Tighten screw 4.

e Make sure the alignment tool cross is pointing to the center of the detector and source window.

7 Repeat Step 6 for the detector alignment.

8 Remove the alignment tool and replace the front shield.

7.3 Powering up the System

Warning:

Prior to any operation or maintenance, check the *Safety Precautions,* page 59.

To power up the system:

1 Connect the source and detector to the power source.

2 Connect the 4–20mA meter to the detector.

3 Power up the system using 18–32VDC.

After 30 seconds, the current meter indicates 4mA.

Note:

Perform zero calibration after powering up the system (see *Zero Calibration*, page 60).

7.4 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.

7.5 Signal Verification

Perform signal verification through the host software supplied by SPECTREX (refer to *Manual TM899050*) or by the HART handheld unit (refer to *Manual TM899030*).

7.5.1 Signal Values Limitation

Table 14 describes the maintenance data channels limitation values.

Table 14: Maintenance Channel Limitation Values

	Short Range		Medium Range		Long Range		
Channel	**5m**	**16m**	**14m**	**40m**	**35m**	**60m**	**Maintenance**
Reference	2V Gain 0	1.5V Gain 2	2V Gain 0	1V Gain 1	2V Gain 1	1V Gain 2	The minimum signal allowed is 2V at Gain 4
Signal 1 and 2	2V Gain 0	1.5V Gain 2	2V Gain 0	1V Gain 1	2V Gain 1	1V Gain 2	The minimum signal allowed is 2V at Gain 4
Ratio 1 and 2	0.6–1.4						0.5–3
NQRat 1 and 2	0.97–1.03						Must be 0.97–1.03
ppm.m	0ppm.m						0ppm.m
Temperature	Up to 77°F/25°C beyond room temperature						Up to 77°F/25°C beyond room temperature
Voltage	32VDC > V > 18VDC						32VDC > V > 18VDC

Note:

The installation information refers to the installation distance.

- **Short Range**: The minimum distance, as defined on the model number
- **Medium Range**: Half of the maximum distance, as defined on the model number
- **Long Range**: The maximum distance, as defined on the model number

7.6 Zero Calibration

Zero calibration must be performed after any of the following:

- 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.
4. The 0–20mA output should now be at 1mA.
5. Wait up to 60 seconds until the mode changes to normal and the detector reading is normal.

   The 0–20mA output now indicates 4mA.

   Use the Host HART (refer to *Manual TM899030*) or RS-485 (refer to *Manual TM899050*) to switch between each mode, or move the magnetic mode selector above the magnetic switch (see Figure 8).

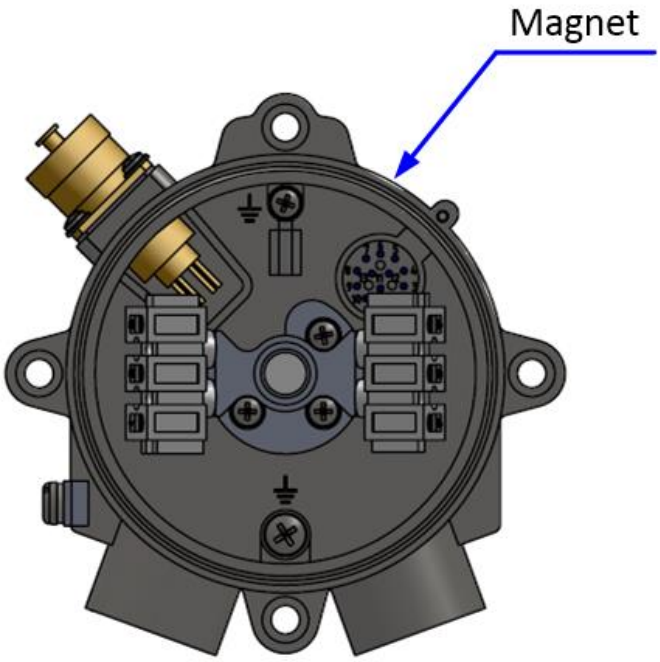


Figure 8: Magnetic Mode Selector

7.7 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 a 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 viewing window of the detector.
3. Wait 20 seconds.
4. Read the 0–20mA current. Determine the difference between the reading taken with and without the functional check filter. This difference is the 0–20mA current variance.
5. Record the 0–20mA current variance in the maintenance logbook. If the variance is more than a 30% change when compared to the previous check (see delivery form), repeat the alignment.

8 Maintenance Instructions

8.1 General Maintenance

Only basic periodic maintenance is required to keep the SafEye Quasar 950/960 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.

8.2 Periodic Maintenance

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:**

1. Perform alignment procedures each time that the source or the detector unit are opened or moved for any reason.
2. The signal verification check corroborates the current signals from the UV 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 59).
3. Perform a functional check every 6 months (see *Functional Check*, page 61).
4. Perform the alignment procedure only if the signals are below threshold value (see *Signal Verification*, page 59).
5. Perform zero calibration (see *Zero Calibration*, page 60) every time the detector or source is realigned, or the windows are cleaned.

8.2.1 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 window:**

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 the maintenance logbook.
7. Reconnect the power to the SafEye detector and source.
8. Perform signal verification (see *Signal Verification*, page 59).
9. Perform zero calibration (see *Zero Calibration*, page 60).
10. Perform a functional check (see *Functional Check,* page 61)

8.2.2 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 the manual or use the IS handheld unit.

8.2.3 Functional Check of Unit

The SafEye Quasar has been calibrated at the factory according to the user's specific gas or vapor detection requirements. Use the check filters included in the commissioning kit according to the corresponding calibrating gas to validate correct installation. Refer to *Functional Check*, page 61 for instructions.

Caution:

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

9 Troubleshooting

Table 15: Troubleshooting

Problem	Cause	Solution
"Maintenance call" Status OMN: Signals are below 2.5VDC at Gain 4 Status RMN: Ratios are below 0.5	Poor alignment	Perform alignment
	Dirt on the window	Clean the window
	Poor light source	Replace the light source
	Detector fault	Replace/repair detector
NQR at below the permitted limit	Gas in the path	Make sure that the path is clean and that the weather conditions are good
NQR at above the permitted limit	Poor alignment	Perform alignment
Temperature higher than 77°F/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: Wiring Configurations

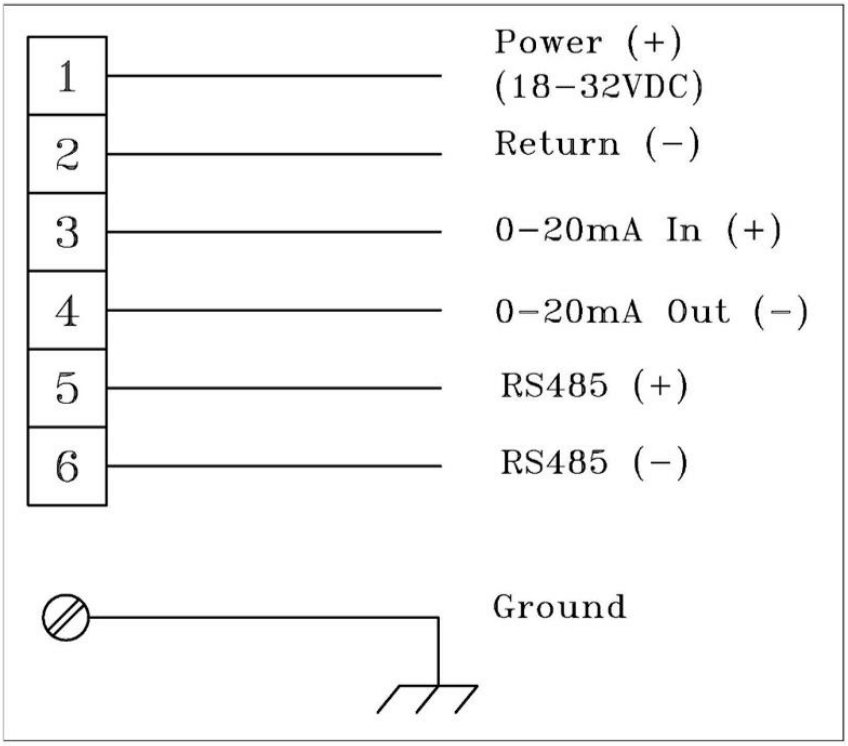


Figure 9: Detector Wiring Terminal

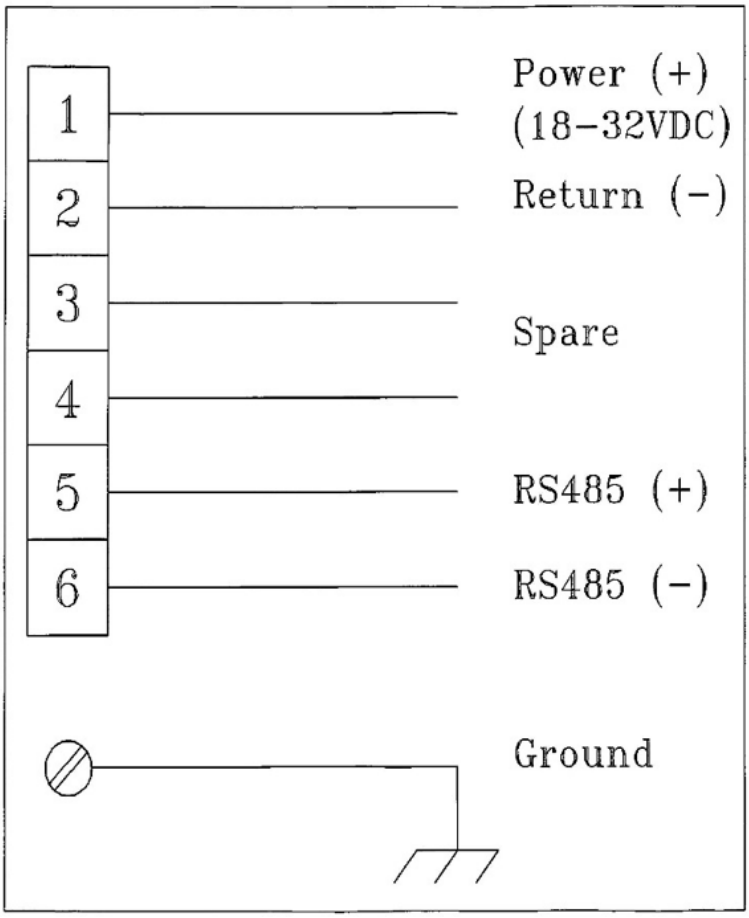


Figure 10: Source Wiring Terminal

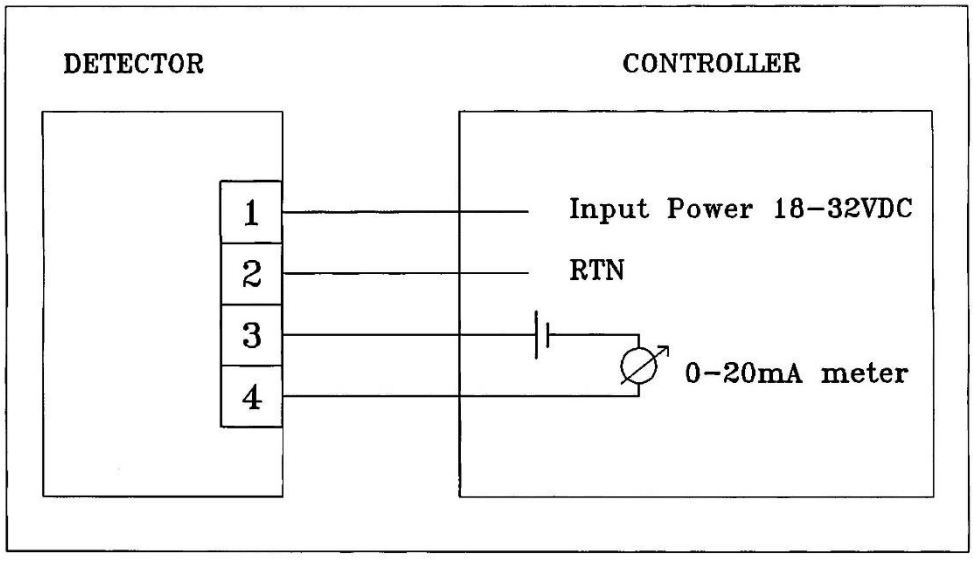


Figure 11: 0–20mA Sink 4-Wire

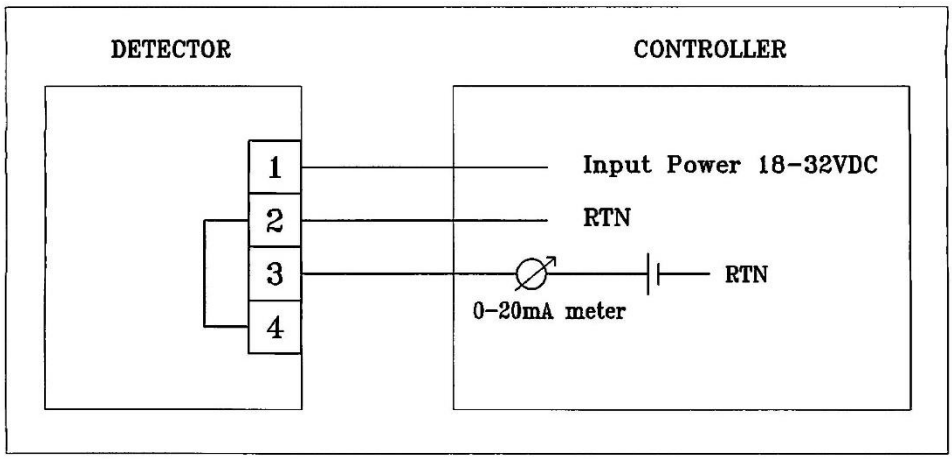


Figure 12: 0–20mA Non-Isolated Sink 3-Wire

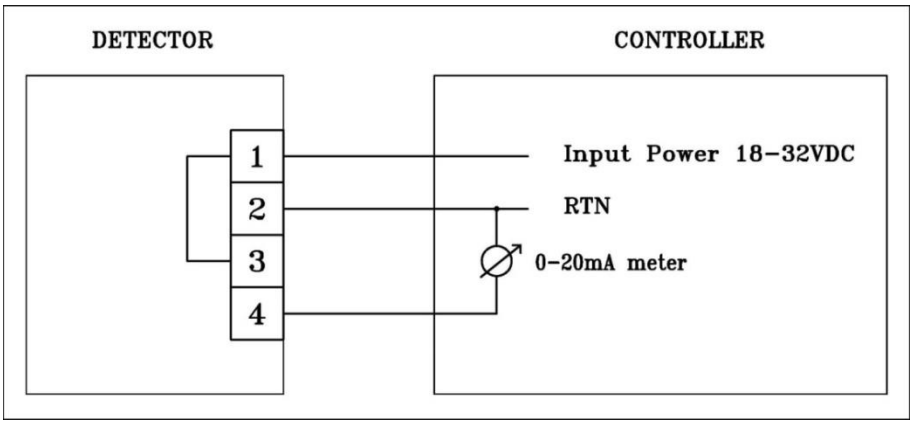


Figure 13: 0–20mA Source 3-Wire

A.1 RS-485 Communication Network

By using the RS-485 network capability of the SafEye Quasar 950/960 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.

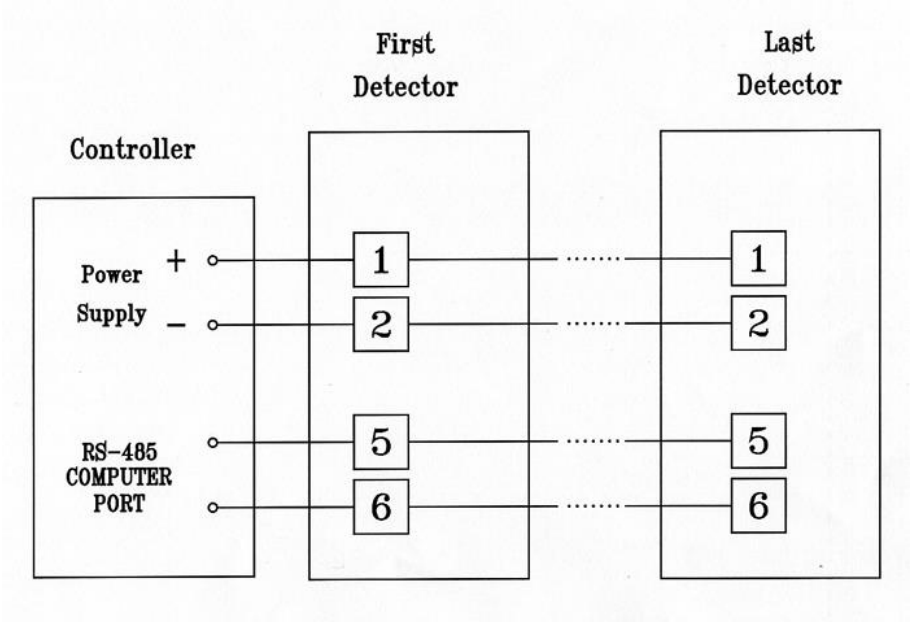


Figure 14: RS-485 Networking for Wiring Option 3

Appendix B: Accessories

B.1 Tilt Mount

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

B.2 Pole Mount (U-Bolt 2–3”)

The U-bolt mount is available to facilitate 2”–3” pipe mounting.

B.3 Pole Mount (U-Bolt 4–5”)

The U-bolt mount is available to facilitate 4”–5” pipe mounting.

B.4 Wall Mount

The wall mount is available to facilitate wall mounting.

B.5 Commissioning Kit

The commissioning/alignment kit unit for H_2S or for NH_3 is required for commissioning and future maintenance checks. Only 1 kit is required per site.

The kit includes an alignment tool, a magnetic mode selector, a functional check filters (H_2S or NH_3) for system installation and periodical functional testing, and socket keys for access to units.

Table 16: Check Filters

Check Filter Part Number	Gas Concentration
888280-1	>120ppm.m H_2S
888280-2	>120ppm.m Ammonia

B.6 HART Handheld Diagnostic Unit

The HART handheld diagnostic unit 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 IS-approved, with a special harness to suit the detector, and a host for maintenance and commissioning.

B.7 HART Handheld Harness Kit

A quick-plug connection with a harness is connected on one side to a standard HART handheld unit. This includes the Spectrex host software that can be uploaded to an existing handheld unit. The kit does not include the handheld unit.

Refer to the manual for more information.

B.8 USB/RS-485 Harness Converter Kit

The USB RS-485 Harness Kit with RS-485/USB converter, together with Spectrex host software, enables the user to connect to any available PC or laptop to reconfigure settings or perform diagnostics on the Quasar 950/960 Gas Detector.

Refer to the manual for programming instructions.

B.9 Protective Cover

The protective cover is designed to protect the detector from the heat of the sun.

Appendix C: SIL-2 Features

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

The SafEye Quasar 950/960 Open-Path Gas Detector can be used in low and high demand mode applications – see *IEC 61508-4:2010, Chapter 3.5.16.*

C.1 Safety Relevant Parameters

Type:	B
Structure:	1oo1
HFT:	0
Mean time to repair:	72hr
Ambient temperature:	max. 149°F/65°C
Proof-Test-Interval:	52 weeks (1 year)

λS = 1762·fit

λD = 1722·fit

λDU = 97.4·fit

λSD = 1660.7·fit

λDD = 1624.7·fit

DC = 94%

SFF = 97%

PFD_{avg} = 5.5 E− 04; $PFD_{\%\_SIL2}$ = 5.5%

PFH = 9.7 E−08 1/h; $PFH_{\%\_SIL2}$ = 9.7%

C.2 General Conditions for Safe Use

- The SafEye Quasar 950/960 Open-Path Gas Detector should consist only of the approved hardware and software modules.
- Take note of the application advice and limitations listed in this manual. The regional and national regulations should be considered when performing calibration/maintenance tasks.
- The 24V power supply must fulfill the requirements for SELV/PELV of EN 60950.
- Do not use the HART and RS-485 interfaces for transmission of safety-related data.
- According to SIL-2 requirements, the alert conditions can be implemented by an alert signal via the 0-20mA current loop.
- After installation and configuration, the setup parameters must be verified and the function of the SafEye Quasar 950/960 Open-Path Gas Detector must be checked completely.
- The alarm conditions of the transmitter must be checked periodically together with standard gas calibration checks. The SafEye Quasar 950/960 Open-Path Gas Detector must be switched off and on.
- The connected controller must monitor the 0–20mA signal current for values below 4mA and above 20mA.
- Mean time to repair should be 72 hours.

Technical Support

For technical assistance or support, contact:

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