Manual
TM888200, Rev As
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SafEye™ Quasar 900

Open Path Combustible Gas Detectors

SPECTREX

Legal notice

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

Contents

1 About this guide

This manual describes the SafEye™ Quasar 900 Open-Path Gas Detection System and its features and provides instructions how to install, operate, and maintain the receiver.

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

This guide includes the following chapters and appendices:

- 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.
- Product overview - provides a general introduction and overview of the product and the guide, with a brief description of its content.
- Technical description - describes the receiver's theory of operation.
- Operating modes - describes the receiver's operation modes, user interface and indications.
- Technical specifications - describes the receiver's electrical, mechanical and environmental specifications.
- Installation instructions - describes how to install the receiver, including wiring and mode settings.
- Operating instructions - describes the operating instructions and power-up procedures.
- Maintenance instructions - describes the maintenance and support procedures.
- Troubleshooting - describes the solutions to problems that may arise with the receiver.
- Wiring configurations - provides wiring diagrams for installation.
- Accessories - provides a list of accessories available for the Quasar 900 Open-Path Gas Detection System.
- SIL-2 features - details the special conditions for compliance with the requirements of EN 61508 for SIL-2.

1.1 Release history

Revision	Date	Revision history	Prepared by	Approved by
6	February 2013	First release	Ian Buchanan	Eric Zinn
7	June 2013	Second release	Ian Buchanan	Eric Zinn
8	August 2013	Third release	Ian Buchanan	Eric Zinn
9	January 2014	Fourth release	Ian Buchanan	Eric Zinn
10	August 2014	Fifth release	Ian Buchanan	Eric Zinn
11	January 2015	Sixth release	Ian Buchanan	Eric Zinn
12	January 2017	Seventh release	Jay Cooley	Ian Buchanan
13	February 2017	Eighth release	Jay Cooley	Ian Buchanan
Am	March 2018	Ninth release	Michal Heller	Udi Tzuri
An	February 2020	Tenth release	Michal Heller	Udi Tzuri

Revision	Date	Revision history	Prepared by	Approved by
Ao	February 2021	Eleventh Release	Michal Heller	Udi Tzuri
Ap	October 2021	Twelfth Release	Michal Heller	Udi Tzuri
Ar	January 2023	Thirteenth release	Yisrael Ivri	Emil Cohen

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
JP5	Jet Fuel
LED	Light Emitting Diode
MODBUS®	Serial communications 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
PAL	Phase Alternation by Line (a color encoding system)
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 900 IR Open-Path Gas Detector employs an advanced Xenon Flash transmitter 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 SafEye Quasar 900 Detector is backed by a 3-year warranty.

The Quasar 900 detects ambient combustible gases over a path length of up to 660 ft (200 m), even in harsh environments where dust, fog, rain, snow, or vibration can cause a high reduction of signal. The SafEye Quasar 900 can maintain operation in up to 95% signal obscuration and ±0.5 degree of misalignment.

The Quasar 900 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 HART can be connected on the 0–20 mA line or through the IS port.

The Quasar transmitter and receiver unit enclosures are approved 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 receiver also has a plug interface for connection to a handheld PC or HART unit, which meets intrinsically safe standards. Hence the combined approval:

Ex II 2(2) G D

Ex db eb ib [ib Gb] IIB+H_2 T4 Gb

Ex tb [ib Gb] IIIC T135 °C Db

T_a= -55 °C to +65 °C

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

- For additional settings and trouble shooting, use the software on the product web page.

⚠ WARNING

The transmitter and receiver 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

- One person installation and low maintenance
- Factory calibrated
- Built-in self test continuously monitoring device health
- Accurate and reliable high-speed response in under two seconds
- RTC event recorder; record of the last 375 events
- Automatic gain control ensures accurate detection in challenging conditions with up to 95% signal obscuration
- Three-year warranty
- High false alarm immunity
- Heated optics for operation in challenging conditions
- Easy to use, field configurable via HART® or RS-485 Modbus®
- High reliability-MTBF-minimum 100,000 hours

3.2 Applications

The Quasar 900 system is an optical control fence for combustible gases as defined in the product specification, providing perimeter monitoring and early detection in various applications, such as:

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

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:

Table 3-1: Gas concentrations measurement terms

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

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 two 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 hazardous airborne vapors, gases, or aerosols in a monitored area is detected when the defined substance crosses/enters the optical path between the radiation transmitter unit and the receiver.

Hazardous gases/vapors present in the atmosphere cause absorption of the radiation pulse at specific wavelengths in the optical path between the radiating transmitter and the receiver unit. This causes a change in the signal intensity received by the receiver, which is translated into an output related to the receiver’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 Microprocessor based

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

3.3.5 Gas sensitivity

The SafEye™ Quasar 900 Model uses wavelengths around the 2.3µ spectral band to measure air flammability potential between the transmitter and receiver. At this

wavelength, all hydrocarbon materials have an absorption peak. This enables the receiver to achieve regular sensitivity of 0–5 LEL.m.

The Quasar 900 detects hydrocarbon gases including methane, ethylene, propane, ethane, butane, and others.

3.3.6 Gas calibration

The Quasar 900 has three calibrations that can be changed by function setup:

- Gas 1 – 100% methane
- Gas 2 – 100% propane
- Gas 3 – 100% ethylene

The full scale of methane and propane is 5 LEL.m, while the full scale of ethylene is 8 LEL.m. Gas calibration is available to LEL values defined by NFPA 325 and IEC 60079-20. Instruments certified to ATEX/IECEx, UKCA, EAC, and Inmetro are calibrated to LEL values defined by the IEC standard, while configurations certified to FM/FMC are calibrated per the NFPA norm.

The full scale of methane and propane is 5 LEL.m.

3.3.7 Transmitter

The Xenon Flash transmitter was originally introduced in the first SafEye™ development and was designed to overcome false alarms, which were experienced by early generations of the open path system. The new SafEye Quasar 900 employs the latest generation of flash bulbs to provide even more power and an extended operation life.

3.3.8 Heated optics

SafEye™ Quasar 900 includes heated optics for the transmitter and receiver. To improve performance in conditions where there is ice, condensation, or snow, the heater increases the temperature of the optical surface to 68 °F (20 °C) above the ambient temperature while operating at high power. The heated optics are configured to automatically operate when the change in temperature requires heating (default).

- OFF – Heating is always OFF
- ON – LOW – Heating is always ON – Low power
- ON – HIGH – Heating is always ON – High power
- AUTO – LOW – Low power
- AUTO – HIGH – High power

See System setup.

If Auto is selected, the user can define the start temperature measured inside the device below which the window will be heated. If the selected start temperature is above the selected value, the heater will stay off.

3.3.9 HART® protocol

The Quasar 900 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:

- Receiver setup
- Receiver troubleshooting
- Receiver health and status

For additional settings and trouble shooting use the software on the product web page.

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

3.3.10 Modbus® RS-485

For more advanced communications, the Quasar 900 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.

3.3.11 Tilt mount

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

3.4 Product certification

3.4.1 ATEX, IECEx

The Quasar 900 is ATEX approved per SIRA 12ATEX1212X and IECEx per IECEx SIR 12.0086X per:

- Ex II 2(2)G D
  Ex db eb ib [ib Gb] IIB+H_2 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+H_2 group vapors present, and zones 21 and 22 with IIIC combustible dust types.

3.4.2 UKCA

The Quasar 900 is UK CA approved per CSAE 21UKEX1173X:

- 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

3.4.3 FM/FMC

The Quasar 900 is approved to FM/FMC Explosion Proof per:

- Class I, Div. 1 Group B, C and D, T6 –58 °F/–50 °C ≤ T_a ≤ 149 °F/65 °C
- Dust Ignition Proof – Class II/III Div. 1, Group E, F, and G
- Ingress Protection – IP66 and IP68, NEMA 250 Type 6P

IP68 is rated for 2-meter depth for 45 minutes.

3.4.4 TR CU (EAC) - pending

1Ex d e ib [ib Gb] IIB + H2 T4 Gb X

Ex tb [ib Db] IIIC T135 °C Db X

3.4.5 Inmetro (UL)

The product complies with Inmetro approval per the following standards:

ABNT NBR IEC 60079-0

ABNT NBR IEC 60079-1

ABNT NBR IEC 60079-7

ABNT NBR IEC 60079-11

ABNT NBR IEC 60079-28

ABNT NBR IEC 60079-31

Marking:

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

Ex tb [ib Db] IIIC T135 °C Db

(–55 °C ≤ T_a ≤ +65 °C)

Certificate number UL-BR 16.1063X (Rosemount) and UL-BR 22.4058X (Spectronix).

3.4.6 SIL-2

The Quasar 900 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 0–20 mA current loop.

For more details and guidelines on configuring, installing, operating, and servicing, see SIL-2 features, and TUV report no. 968/EZ 619.XX/XX .

3.4.7 Performance approvals

Functional performance certified per FM 6325, EN60079-29-4 and DNV.

The Quasar 900 was functional tested by FM per EN60079-29-4 and Ansi/FM 60079-29-4.

3.5 Models and types

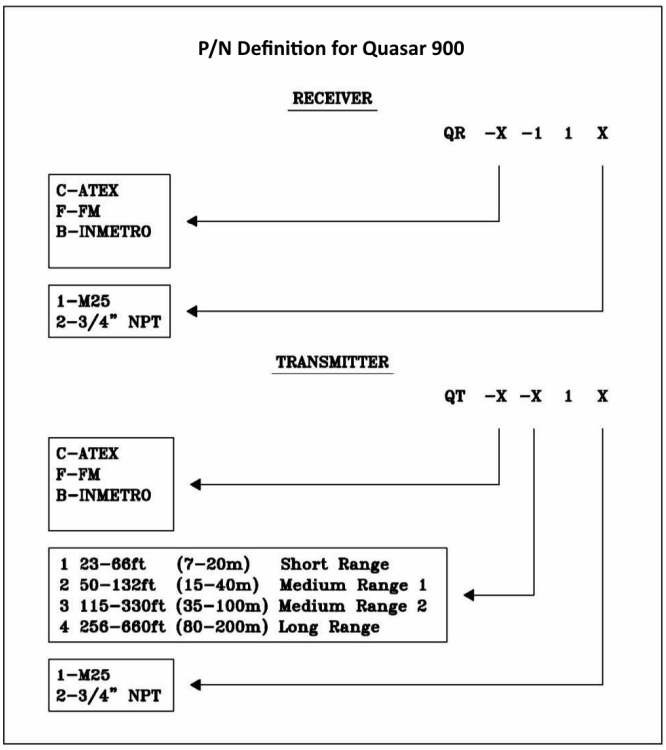
The Quasar 900 is available in four models. Each model has the same receiver but a different transmitter. This allows for detection at distances of ~23–656 ft.(7–200 m)

Table 3-2: Model numbers and installation distances

Model number	Receiver	Transmitter	Minimum installation distance (ft./m)	Maximum installation distance (ft./m)
901	QR-X-11X	QT-X-11X	23/7	66/20
902	QR-X-11X	QT-X-21X	50/15	132/40
903	QR-X-11X	QT-X-31X	115/35	330/100
904	QR-X-11X	QT-X-41X	265/80	656/200

The Quasar 900 can be ordered as separate parts: transmitter (P/N QT-XX1X), receiver (P/N QR-X11X), and comissioning kit (P/N 888257-X). Refer to Figure 3-1.

Figure 3-1: P/N Definition of Quasar 900



3.6 Description

The SafEye™ Quasar 900 is comprised of two main units:

- The Flash Infrared Transmitter
- The Infrared Receiver

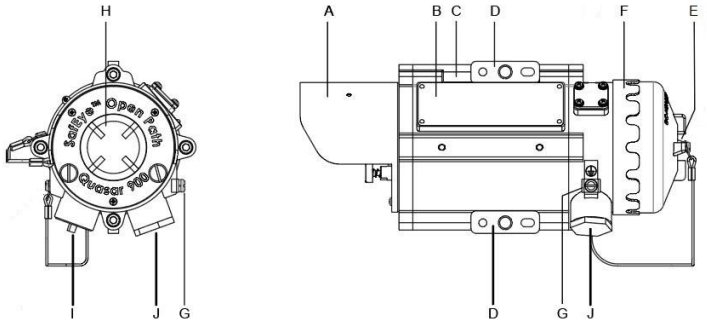
3.6.1 Transmitter unit

The transmitter unit emits a powerful IR pulse (5-10ms width) at the rate of 2 pulses per second. The front of the transmitter unit has a lens that collimates the IR beam for maximum intensity. The front window is heated to improve performance in ice, condensation, and snow conditions.

There are 4 transmitter types:

For Short Range	901 – transmitter P/N QT-X-11X
For Medium Range 1	902 – transmitter P/N QT-X-21X
For Medium Range 2	903 – transmitter P/N QT-X-31X
For Long Range	904 – transmitter P/N QT-X-41X

Figure 3-2: Transmitter



A. Front window section
B. Label
C. Main housing
D. Mounting plate
E. Indicator LED
F. Back cover
G. Earth terminal
H. Front window
I. Inlet conduit
J. Inlet conduit

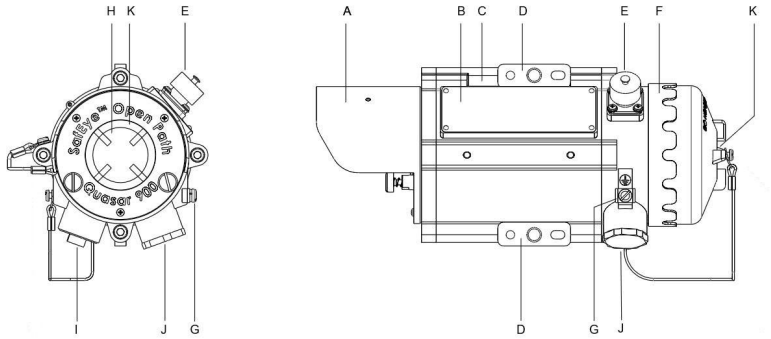
3.6.2 Receiver unit

The receiver receives the transmitted pulsed radiation signals from the transmitter. 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 receiver is heated to improve performance in ice, condensation, and snow conditions.

The P/N QR-X-11X receiver is suitable for Quasar models 901, 902, 903, and 904.

Figure 3-3: Receiver



A. Front window section
B. Label
C. Main housing
D. Mounting plate
E. Intrinsically safe connector (RS-485/HART)
F. Back cover
G. Earth terminal
H. Front window
I. Inlet conduit
J. Inlet conduit
K. Indicator LED

4 Operating modes

4.1 Operational modes

The Quasar 900 has four operational modes:

- Normal mode
- Maintenance call mode (3 mA output)
- Fault mode
- Zero calibration mode (1 mA output)

4.1.1 Normal mode

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

- Normal (N) - Signal received from gas detection is at safe levels.
- Warning (W) - Gases have been detected at warning levels.
- Alarm (A) - Gases have been detected at alarm levels.

Note
For the standard 0–20 mA output, the warning and alarm levels are not relevant. The user chooses these alarm levels at the controller. The receiver output is 4 mA at zero reading and 20 mA for full-scale reading.

Warning and alarm states can be seen through the LED, RS-485, and HART®. If the RS-485 output is used, the receiver changes its status from “N” to “W” at warning level, and to “A” at alarm level.

4.1.2 Maintenance call mode (3 mA output)

This mode indicates a low signal or low signal ratio that may be caused by a dirty window, misalignment, weak transmitter signal, or that one of the receiver’s parameters is at the “limit” value.

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

4.1.3 Fault mode

In fault mode, there are three fault types. In all fault types, the LED flashes amber at 4 Hz:

- **Misalignment (2.5 mA output)**
  This occurs due to poor alignment. Detection is no longer possible.
- **Fault 1 (2 mA output)**
  Fault 1 is due to a blockage, very low signal, partial obscuration, or full beam block. Detection is no longer possible. The receiver’s proper operation can be restored (auto reset) during operation if the condition causing the problem is removed or resolved. There is a delay of 60 sec after the fault before switching to this mode. This delay is important to eliminate momentary obscuration due to passing through the beam.
- **Fault 2 (1 mA Output)**

Detection is disabled due to an electrical/software operational failure, central device (memory/processor) fault, or low voltage. A fault of this type causes the receiver to cease operation.
If there is a fault in the 0–20 mA loop, the output is 0 mA.

4.1.4 Zero calibration mode (1 mA 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 flash transmitter and receiver
- Clear weather conditions

Note
Zero calibration must be performed after installation, re-alignment, window cleaning, or any change in receiver or transmitter position, using the handheld unit or host software on a PC.

Zero calibration can be done through HART® or RS-485.

4.2 Visual indicators

One 3-color LED indicator is located in the back of the receiver/transmitter and can be seen through the back cover window. The receiver unit has a bright front LED in addition to the back LED for convenience. Refer to Figure 3-2 (Item J) and Figure 3-3 (Item K).

The receiver statuses are listed in Table 4-1.

Table 4-1: Receiver LED indications

Receiver status	LED color	LED mode
Fault	Amber	4 Hz – flashing
Alignment/standby	Amber	1 Hz – flashing
Zero calibration	Amber	Constant
Normal	Green	1 Hz – flashing
Warning	Red	2 Hz – flashing
Alarm	Red	Constant

The transmitter statuses are listed in Table 4-2.

Table 4-2: Transmitter LED indications

Transmitter status	LED color	LED mode
Fault	Amber	4 Hz – flashing
Normal	Green	1 Hz – flashing

4.3 Output signals

The SafEye™ system provides the following outputs:

- 0–20 mA current output

- RS-485 interface

4.3.1 0-20 mA current output

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

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

Table 4-3: Standard (default) 0–20 mA current for the gas channel

Current reading	Status and description
0 mA + 0.2 mA	Fault in 0–20 mA loop
1 mA ± 0.2 mA	Zero calibration (in progress), Fault 2
2 mA ± 0.2 mA	Fault 1
2.5 mA ± 0.2 mA	Misalignment fault
3 mA ± 0.2 mA	Maintenance call
4 mA ± 0.2 mA	No gas present
4–20 mA	Continuous measuring of gas concentration at a range between 0 and full scale. For methane and propane, this translates to 3.2 mA per LEL.m, and for ethylene to 2 mA per LEL.m.
21 mA	Concentration is over the range limit (more than full-scale concentration)

4.3.2 RS-485 interface

The receiver 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

This section includes the following topics:

- Field configuration
- Receiver configuration
- Receiver default setup

4.4.1 Field configuration

The SafEye™ Quasar 900 incorporates several functions that can be set by the customer, using:

- Host software: For additional settings and trouble shooting, use the software on the product web page.
- The HART® handheld diagnostic unit (P/N 888810) provides an easy, economical connection to the quick plug. This unit provides verification, status, and instructions for correcting the receiver's parameters. It also includes a harness and a special host for maintenance and commissioning.

4.4.2 Receiver configuration

See Receiver default setup for default settings.

Setup includes the following options:

- Gas calibration
- Address setup
- Heated optics operation
- Front LED
- RTC

For details, use the configuration software guides posted to the product web page.

Gas calibration

Three gas types can be selected for maximum compatibility with the required measured gas/es.

Gas Types:

- Methane – full scale 5 LEL.m.
- Propane – full scale 5 LEL.m.
- Ethylene – full scale 8 LEL.m.

These three calibrations are standard calibrations.

Address setup

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

Heated optics operation

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

- OFF – Heating is always OFF
- ON – LOW – Heating is always ON – Low power
- ON – HIGH – Heating is always ON – High power
- AUTO – LOW – Low power
- AUTO – HIGH – High power

If Auto is selected, the user can define the start temperature measured inside the device below which the window will be heated. If the selected start temperature is above the selected value, the heater will stay off.

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.

4.4.3 Receiver default setup

The receiver has four 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 4-4: Receiver default setup

Function	Setup
Gas type	Methane
Heat mode	Auto
Heater power	High
Heat On temperature	5°
Front LED (Revised model with firmware number containing Py for the primary CPU and Ey for the secondary CPU)	Disabled
Address	1

Table 4-5: Transmitter default setup

Function	Setup
Heat mode	Auto
Heater power	High
Heat On temperature	5°
Address	1

5 Technical specifications

5.1 General specifications

Detected gases: Simultaneous detection of C1-C8 flammable gases

Detection distance range: Table 5-1

Table 5-1: Detection distance range

Model number	Receiver	Transmitter	Minimum installation distance (ft. (m))	Maximum installation distance (ft. (m))
901	QR-X-11X	QT-X-11X	23 (7)	66 (20)
902	QR-X-11X	QT-X-21X	50 (15)	132 (40)
903	QR-X-11X	QT-X-31X	115 (35)	330 (100)
904	QR-X-11X	QT-X-41X	265 (80)	660 (200)

Signal intensity

	Minimum installation condition	Maximum installation condition
Gain	1	4
Signals	1.2 V ÷ 2.5 V	> 1 V

Response time: < 2 seconds

Spectral response: 2.0–3.0 micron

Sensitivity range:

		Full scale LEL.m	Warning LEL.m	Alarm LEL.m
Gas 1	Methane	5	1	3
Gas 2	Propane	5	1	3
Gas 3	Ethylene	8	1.6	4.8

Methane, propane, and ethylene at LEL levels defined by NFPA 325 and IEC 60079-20.

Field of view: Line of sight

Alignment tolerance: ± 0.5°

Drift: ± 7.5 % of the reading or ± 4 % of the full scale (whichever is greater)

Minimum detectable level: 0.15 LEL.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
- Other external IR or UV radiation sources
- Rain conditions or water spray

Per the requirements listed in the following performance standards:

- EN 60079-29-4
- Ansi/FM 60079-29-4
- FM6325

5.2 Electrical specifications

Operating Voltage: 18-32 VDC

5.2.1 Typical Power consumption

Table 5-2: Transmitter and receiver typical power consumption

	Without heated optic	With heated optic
Receiver	85 mA	220 mA
Transmitter	60 mA	240 mA

5.2.2 Electrical input protection

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

5.3 Electrical outputs

5.3.1 0–20 mA current output

The 0–20 mA is an isolated Sink option. This output can also be configured as Transmitter (see Wiring configurations).

The maximum permitted load resistance is 600 Ω.

5.3.2 Communication network

The receiver is equipped with RS-485 communication 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 receivers.
- The protocol enables connections between different types of Spectrex receivers or other Modbus devices to the same network.

5.3.3 HART® protocol

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

This bi-directional field communication protocol is used to communicate between intelligent field instruments and the host system.

5.4 Mechanical specifications

Enclosure: The receiver, transmitter, and tilt mount are stainless steel 316 electrochemical and passivated coating.

Explosion proof:

ATEX, IECEx, and UKCA	Ex II 2(2) G D Ex db eb ib [ib Gb] IIB+H_2 T4 Gb Ex tb [ib Gb] IIIC T135 °C Db T_a= -55 °C to +65 °C
FM/FMC	Class I Div. 1 Groups B, C, and D Class II/III Div. 1 Groups E, F, and G –58 °F/-50 °C ≤ T_a ≤ 149 °F/65 °C

Functional approvals: EN60079-29-4 and DNV CG-0339, EN 50270, IEC 60079-29-4, FM 6325

Water and dust tight:
IP66 and IP68
IP68 is rated for 2-meter depth for 45 minutes
NEMA 250 type 6p

Electrical connection:
(2 options – specified at time of order)
2 X M25 (ISO)
2 X ¾-in. – 14 NPT conduits

Dimensions:

Receiver	10.5 x 5.1 x 5.1-in.	267 x 130 x 130 mm
Transmitter	10.5 x 5.1 x 5.1-in.	267 x 130 x 130 mm
Tilt Mount	4.7 x 4.7 x 5.5-in.	120 x 120 x 40 mm

Weight:

Receiver	11 lb	5 kg
Transmitter	11 lb	5 kg
Tilt mount	4.2 lb	1.9 kg

5.5 Environmental specifications

The SafEye™ system is designed to withstand harsh environmental conditions. The transmitter and receiver units compensate for adverse conditions while maintaining accuracy.

5.5.1 High temperature

The SafEye™ system conforms to DNVGL-CG-0339, class D.

Operating temperature:	+149 °F (+65 °C)
Storage temperature:	+149 °F (+65 °C)

5.5.2 Low temperature

The SafEye™ system conforms to DNVGL-CG-0339, class D.

Operating temperature:	–67 °F (–55 °C)
Storage temperature:	–67 °F (–55 °C)

5.5.3 Humidity

The SafEye™ system conforms to DNVGL-CG-0339, class B.

5.5.4 Enclosure

The SafEye™ system conforms to DNVGL-CG-0339, class C.

5.5.5 Water and dust

- IP66 per EN60529
- IP68 per EN60529

Dust:	Completely protected against dust.
Liquids:	Protected against immersion between 15 cm and 1 m in depth. Protected against water jets from all directions.

5.5.6 Vibration

The SafEye™ system conforms to DNVGL-CG-0339, class B.

5.5.7 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 receiver must be shielded and the receiver must be grounded. The shield should be grounded at the receiver end.

6 Installation instructions

6.1 Introduction

The receiver and transmitter 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 receiver can be installed using general-purpose common tools and equipment. Table 6-1 lists the specific tools required to install the receiver.

Table 6-1: Tools

Tools	Function
Hex key 8 mm	Mount the receiver on the tilt mount
Hex key 3/16-in.	Align the receiver
Hex key 5/16-in.	Screw receiver plug
Flat screwdriver 4 mm	Connect the ground terminal
Flat screwdriver 2.5 mm	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 receiver should have a direct view of the transmitter
- 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, above human height to avoid partial obscuration.

6.2.4 The transmitter and receiver

The suitable model of the transmitter should be selected according to the length of open path to be monitored. To allow for ageing of the transmitter and a reduction of the IR signal due to adverse weather, it is recommended to use a receiver that is not at the limit of its operating range.

The open path between the transmitter and receiver 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 receiver location

The following are some tips for selecting gas receiver 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.
- In areas with expected heavy fog, rain, or snow, consider the effects of long-range installation and install the receiver at a shorter range with the maximum intensity model available.

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 6-2.

Table 6-2: Separation distances

Installation line of sight distance, ft. (m)	Minimum separation, ft. (m)
33 (10)	3.3 (1)
66 (20)	5 (1.5)
98 (30)	6.5 (2.5)
131 (40)	11.5 (3.5)
164 (50)	15 (4.5)
197 (60)	16.5 (5)
230 (70)	20 (6)
262 (80)	23 (7)
295 (90)	26 (8)
328 (100)	28 (8.5)
361 (110)	29.5 (9)
394 (120)	33 (10)
427 (130)	34.5 (10.5)
459 (140)	38 (11.5)
492 (150)	42.5 (13)

Table 6-2: Separation distances *(continued)*

Installation line of sight distance, ft. (m)	Minimum separation, ft. (m)
525 (160)	47.5 (14.5)
558 (170)	49 (15)
591 (180)	51 (15.5)
623 (190)	52.5 (16)
656 (200)	54 (16.5)

6.2.7 Wiring

- For wiring, use color-coded conductors, suitable wire markings, or labels. The wire cross-section must be between 28–14 AWG (0.5–2.5 mm^2).
- The selected wire gauge should be based on the number of receivers 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 1 mm^2.
- To fully comply with EMC directive and protect against interference caused by RFI and EMI, the cable to the receiver must be shielded and the receiver must be grounded.

6.3 Preparations for installation

6.3.1 General

Installation should comply with local, national, and international regulations and norms, as applicable to gas detection systems and approved electrical devices installed in hazardous areas. The gas detection systems 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:

- Receiver Unit - QR-X-11X (See Models and types)
- Transmitter Unit - QT-X-X1X (See Models and types)
- Two tilt mount bases - P/N 888270
  - 1 base is used for the receiver
  - 1 base is used for the flash transmitter
- 888257 Extended Commissioning Kit - includes methane, propane and ethylene check filters, a universal harness, alignment tool and allen keys. See Accessories for details and other accessories.

6.3.3 Unpacking the product

Upon receipt of the gas detection system, check and record the following:

Procedure

1. Verify that the model matches the purchase order.

2. Record the part number (P/N) and serial number of the receivers and transmitter units, and the installation date in an appropriate logbook.
3. Open the container package immediately, prior to installation, and visually inspect the receivers, transmitters, and accessories.
4. Verify that all components required for the receiver installation are readily available before commencing the installation. In the event that the installation is not completed in a single session, secure and seal the receivers and conduits.

6.4 Certification instructions

6.4.1 General instructions

⚠ WARNING

Do not open the unit, 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.
- The marking of the equipment is:
  Ex II 2(2)G D
  Ex db eb ib [ib Gb] IIB+H_2 T4 Gb
  Ex tb [ib Gb] IIIC T135 °C Db
- The equipment may be used with flammable gases and vapors with apparatus groups IIA and IIB +H_2 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: Stainless Steel 316
  — 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 suitable precautions: routine inspections, establishing resistance to specific chemicals from the material's data sheets.
  — Examples of aggressive substances: acidic liquids or gases that may attack metals, solvents that may affect polymeric materials.

6.4.2 Special conditions for safe use

- The dimensions of the flameproof joints differ from the relevant minimum or maximum values required by Table 3-2 of IEC/EN 60079-1:2007 for IIB + H_2, as detailed below:

Flamepath description	Type of joint	Minimum width “L” (mm)	Maximum gap “lC” (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, “l_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.
- Connections to the IS port on the side of the receiver 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 18–32 VDC, 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
- If the product is to be used as a safety related device, an appropriate independent certification, would be required meeting all the requirements.

6.5 Conduit/cable installation

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

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

6.6 Receiver/transmitter mounting

Mount the transmitter or receiver with the tilt mount kit, P/N 888270. The tilt mount enables the transmitter or receiver to be rotated up to 60° in all directions, with a fine alignment of up to 10°.

6.6.1 Tilt kit

The following contents are included with the tilt mount kit (P/N 888270):

Table 6-3: Tilt mount kit

Item	Quantity	Type/model
Tilt mount	1	888269
Screw	1	M10 x 1.5
Spring washer	1	Number 10

6.6.2 Transmitter and receiver installation

The transmitter and receiver can be installed in two ways with the same tilt mount. Refer to Figure 6-1 and Figure 6-2.

To install the transmitter and receiver:

Procedure

1. Place the tilt mount holding plate (1) in its designated location and secure it with four fasteners through four holes of an 8.5 mm diameter.

   Note
   - Skip this step if the tilt mount is already installed.
   - Receiver removal for maintenance purposes does not require tilt mount removal.

2. Place the receiver, with its conduit/cable inlets pointing downwards, on the receiver holding plate of the tilt mount (B). Secure the receiver with M10 x 1.5 screws with No. M10 spring washers (I, J). Secure the receiver to the tilt mount using Hex Key No. 7 for M10 x 1.5 screws (I).
3. Repeat Step 1 and Step 2 for installing the transmitter.

6.7 Receiver wiring

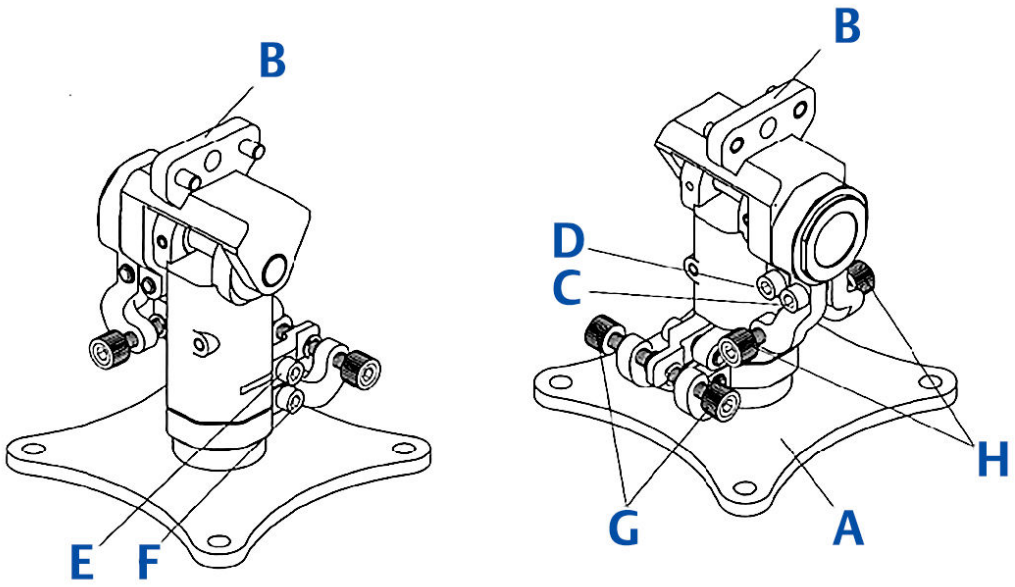
To install the receiver wiring:

Procedure

1. Release the back cover secure bolt (Figure 6-2, Item O), and open the receiver back cover (Figure 6-2, Item N). The chamber is now exposed.
2. Remove the protective plug mounted on the receiver conduit/cable entry inlet and pull the wires through the receiver inlet (Figure 6-3, Item D). Use a ¾-in. – 14 NPT or M25x1.5 explosion-proof conduit connection/cable gland to assemble the cable/explosion-proof conduit to the receiver.
3. Connect the wires to the required terminals (Figure 6-3, Item B) according to the wiring diagram. See Receiver terminal wiring, and Figure A-1, Figure A-2, Figure A-3, and Figure A-4 in Wiring configurations.

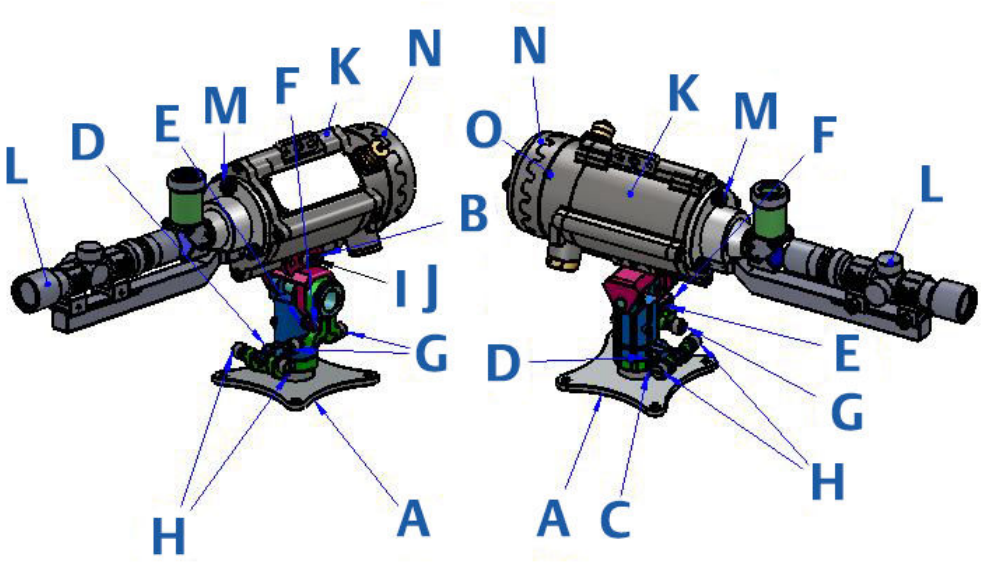
4. Connect the grounding wire to the ground screw located on the exterior of the receiver (Figure 6-3, Item C). The receiver must be well grounded to earth ground.
5. Place and secure the receiver's back cover by screwing on the cover and securing it using the secure bolt (Figure 6-2, Item O).

Figure 6-1: Tilt mount



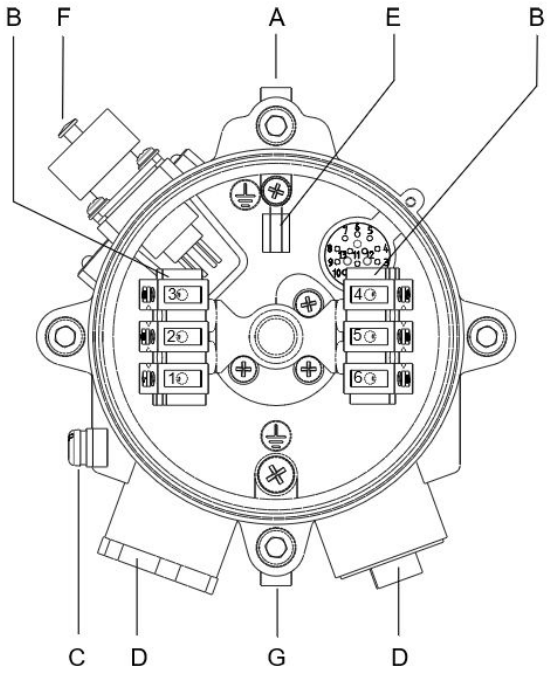
A. Tilt mount holding plate
B. Transmitter or receiver holding plate
C. Vertical crude alignment tightening screw
D. Vertical fine alignment tightening screw
E. Horizontal fine alignment tightening screw
F. Horizontal crude alignment tightening screw
G. Horizontal fine alignment screw
H. Vertical fine alignment screw

Figure 6-2: Receiver and tilt mount assembly



A. Tilt mount holding plate
B. Transmitter or receiver holding plate
C. Horizontal crude alignment tightening screw
D. Horizontal fine alignment tightening screw
E. Vertical fine alignment tightening screw
F. Vertical crude alignment tightening screw
G. Vertical fine alignment screw
H. Horizontal fine alignment screw
I. Receiver tightening screw
J. Receiver tightening washer
K. Receiver
L. Alignment tool
M. Alignment tool tightening bolt
N. Receiver back cover
O. Receiver back cover secure bolt

Figure 6-3: Receiver with cover removed



A. Housing
B. Terminal board
C. Earth terminal
D. Inlet conduit
E. Internal earth connection
F. Connection to handheld unit
G. Receiver holding plate

6.8 Receiver terminal wiring

The receiver has six wiring terminals.

The following table lists the functions of each electrical terminal of the receiver:

Table 6-4: Wiring options

Terminal number	Function
1	Power +24 VDC
2	Return –24 VDC
3	0–20 mA In (+)
4	0–20 mA Out (–)
5	RS-485 (+)
6	RS-485 (–)

6.9 Transmitter wiring

6.9.1 Wiring

To install the transmitter wiring:

Procedure

1. Release the back screw bolt (Figure 6-2, Item O), and open the transmitter back cover (Figure 6-2, Item N). The chamber is now exposed.
2. Remove the protective plug mounted on the transmitter conduit/cable entry inlet and pull the wires through the transmitter inlet (Figure 6-4, Item D). Use a ¾-in. – 14 NPT or M25x1.5 explosion-proof conduit connection/cable gland to assemble the cable/explosion-proof conduit to the receiver.
3. Connect the wires to the required terminals (Figure 6-4, Item B) according to the wiring diagram. See Terminal wiring, and Figure A-4 in Wiring configurations.
4. Connect the grounding wire to the ground screw located on the exterior of the receiver (Figure 6-4, Item C). The transmitter must be well grounded to earth ground.
5. Place and secure the transmitter unit's back cover by screwing on the cover and securing the back screw bolt.

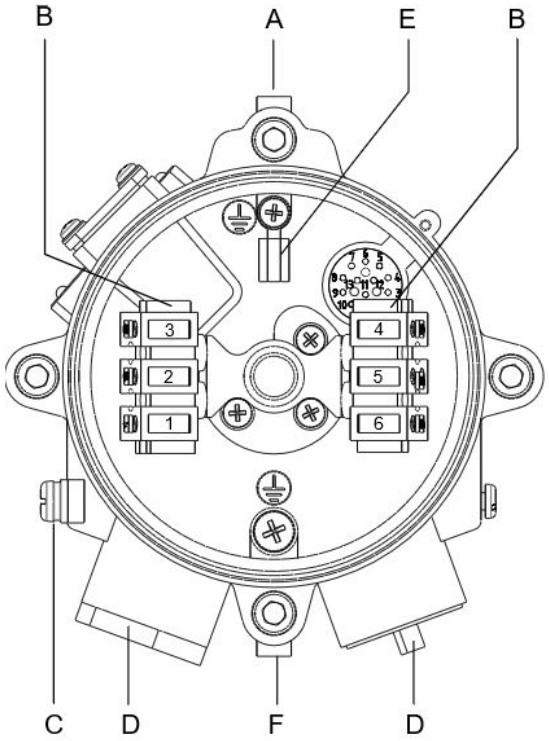
6.9.2 Terminal wiring

The transmitter contains six wiring terminals.

Table 6-5: Transmitter wiring options

Terminal number	Function
1	Power +24 VDC
2	Return –24 VDC
3	Spare
4	Spare
5	Spare
6	Spare

Figure 6-4: Transmitter with cover removed



A. Housing
B. Terminal board
C. Earth terminal
D. Inlet conduit
E. Internal earth connection
F. Transmitter holding plate

7 Operating instructions

For information on communicating with the device, see the principles of operation topics.

7.1 Safety 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 two stages: crude alignment and 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.

Note

- 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 factory calibration of the alignment tool or its mounting.

To align the unit (see Figure 6-2):

Procedure

1. Ensure that the receiver and the transmitter are installed properly. Refer to Installation instructions.
2. Remove the front shield using the two captive screws.
3. Install the alignment tool assembly (Item L) on the front of the receiver or transmitter. Fasten the alignment tool with fastening screws (Item M).
4. Crude Alignment:
    a. Use a ¼-in. Allen screwdriver for all alignment screws.
    b. Loosen screws E and F.
    c. Approximately aim the transmitter horizontally toward the receiver.
    d. Tighten screw F.
    e. Loosen screws C and D.
    f. Approximately aim the transmitter vertically toward the receiver.

g. Tighten screw C.

5. Repeat Step 4 for the receiver towards the transmitter.
6. Fine Alignment:
   a. Aim the transmitter toward the receiver within a horizontal axis using screw G. Aim the alignment tool cross toward the center of the front window of the receiver or transmitter (see Figure 3-2 and Figure 3-3, Item H).
   b. Tighten screw E.
   c. Aim within the vertical axis using screw H.
   d. Tighten screw D.
   e. Make sure the alignment tool cross is pointing to the center of the transmitter and receiver window.
7. Repeat Step 6 for the receiver 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.

To power up the system:

Procedure

1. Connect the transmitter and receiver to the power source.
2. Connect the 4–20 mA meter to the receiver.
3. Power up the system using voltage in the range of 18–32 VDC.
   After 60 seconds, the current meter indicates 4 mA.

Note
Perform zero calibration after powering up the system (see Zero calibration).

7.4 Safety precautions

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

- Follow the manual instructions, and refer to the drawings and specifications issued by the manufacturer.
- Do not open the transmitter or receiver 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 your vendor or by the HART® handheld unit.

7.5.1 Signal values limitation

Table 7-1 describes the maintenance data channels limitation values.

Table 7-1: Maintenance channel limitation values

Channel	Installation distance		
	Short range	**Medium range**	**Long range**
Reference	1 V Gain 1	1 V Gain 2	1 V Gain 5
Signal	1 V Gain 1	1 V Gain 2	1 V Gain 5
Ratio	0.6–1.4	0.6–1.4	0.6-1.4
NQRat	0.98–1.02		
LEL	0 LEL.m		
Temperature	Up to 77 °F/25 °C beyond ambient temperature		
Voltage	18 VDC < V < 32 VDC		

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 transmitter or receiver position

Zero calibration can be done with HART® or Modbus® using the RS-485 interface. Zero calibration must be performed after installation, re-alignment, window cleaning, or any change in receiver or transmitter position, using the handheld unit or host software on a PC.

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:

Use the HART software (refer to the product web page), or Modbus software on the RS-485 interface (refer to the product web page).

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

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.

Note

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

To perform the functional check:

Procedure

1. Position the functional check filter in front of the SafEye™ receiver.
2. Center the functional check filter's window over the receiver’s viewing window.
3. Wait 20 seconds.
4. Read the 0–20 mA current. Determine the difference between the reading taken with and without the functional check filter. This difference is the 0–20 mA current variance.
5. Record the 0–20 mA 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 900 at maximum performance and reliability levels. The transmitter and receiver 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 transmitter and receiver viewing windows should be kept as clean as possible. The frequency of cleaning operations depends on the existing environmental conditions and the applications used.

To perform periodic maintenance:

Procedure

1. Perform alignment procedures each time that the transmitter or receiver unit are opened or moved for any reason.
2. The signal verification check corroborates the proper alignments. This check should be performed every 6–12 months. The signal should be checked according to threshold levels (see Signal verification).
3. Perform a functional check every 6 months (see Functional check).
4. Perform the alignment procedure only if the signals are below threshold value (see Signal verification).
5. Set the baseline (see Zero calibration) every time the transmitter or receiver 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 transmitter and receiver viewing windows.

To clean the optical window:

Procedure

1. Disconnect the power to the SafEye transmitter and receiver.
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 transmitter and receiver.
8. Perform signal verification (see Signal verification).
9. Perform zero calibration (see Zero calibration).

10. Perform a functional check (see Functional check).

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 transmitter or receiver. Use the PC Host software to measure the signal verification.

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 for instructions.

⚠ CAUTION

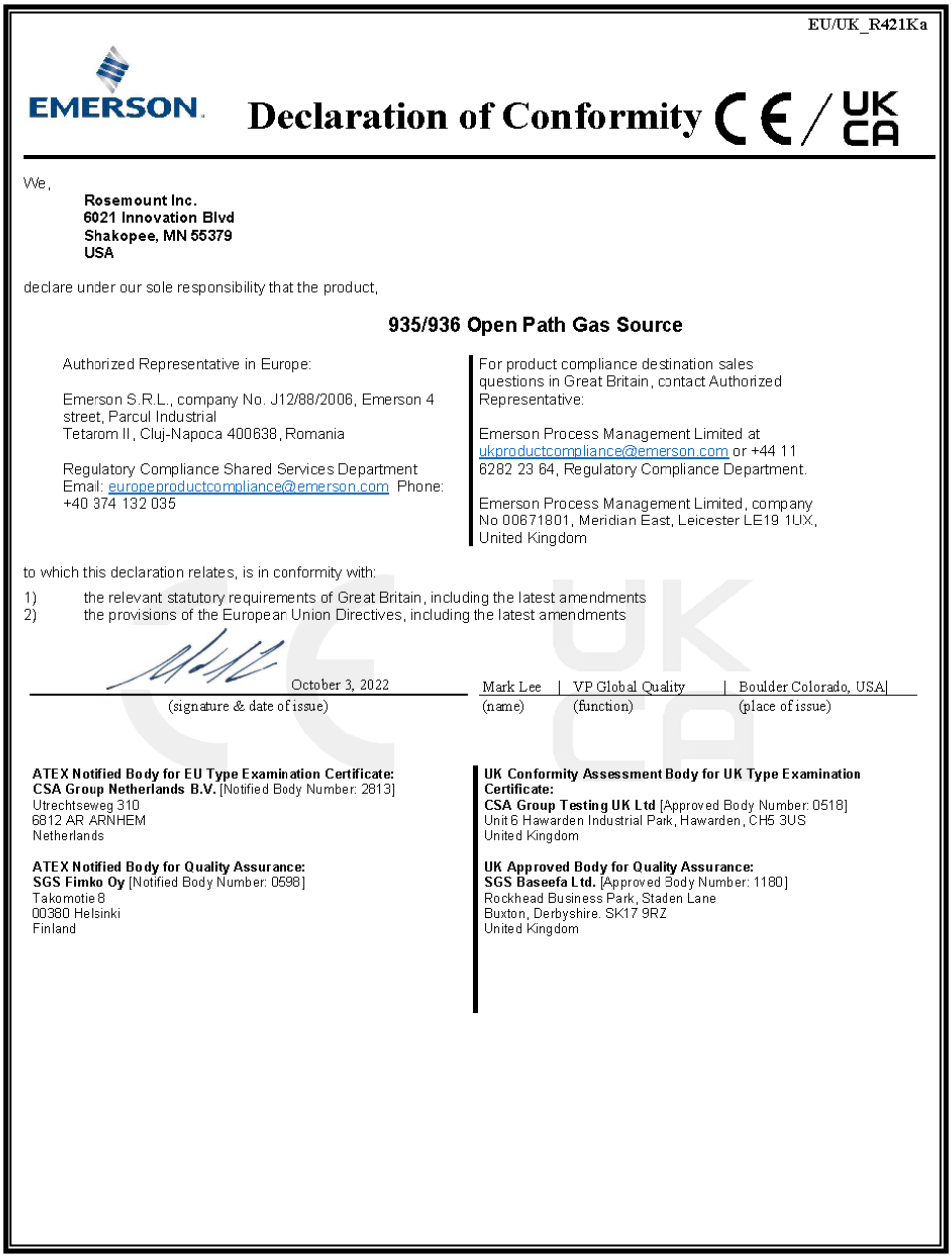
Disable automatic activation and disconnect any external device that should not be activated during the calibration check.

9 Troubleshooting

Table 9-1: Troubleshooting

Fault Indication	Problem	Cause	Solution
Host status: "C" 0–20= 3 mA	“Maintenance call” status or R and S are below 2 VDC at Gain 9 LED - Green blinking 1 Hz.	Poor alignment	Perform alignment
		Dirt on the window	Clean the window
		Poor light source	Replace the light source
		Receiver fault	Replace/repair receiver
Host status: "O" or "I" 0–20= 2 mA LED - Amber blinking	The receiver is in constant obscuration mode.	Poor alignment	Perform alignment
		Dirt on the window	Clean the window
		Poor light source	Replace the light source
		Receiver fault	Replace/repair receiver
	The receiver is in constant saturation mode.	Installation distance is lower than allowed	Use different model
		Receiver fault	Replace/repair receiver
Host status: "M" 0–20= 2.5 mA LED - Amber blinking	The receiver is in constant misalignment mode.	Poor alignment	Perform alignment
		Receiver fault	Replace/repair receiver
Host status: "V" 0–20= 1 mA LED - Amber blinking	The receiver is at "V" fault	Low/High input voltage	Check the power supply and installation
		Receiver fault	Replace/repair receiver
Host status: "F" 0–20= 1 mA LED - Amber blinking	Internal fault	Internal Fault	Replace the receiver
	NQRat below the permitted limit	Gas in the path	Make sure that the path is clean and the weather conditions are good
	NQRat above the permitted limit	Poor alignment	Perform alignment
	Ratio 1 and Ratio 2 out of the limit	Poor alignment	Perform alignment
		Dirt on the window	Clean the window
		Receiver fault	Replace/repair receiver
Amber LED blinking at the transmitter	Transmitter fault	Low/high input voltage	Check the power supply and installation
		Internal fault	Replace the transmitter

10 Declaration of Conformity



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Declaration of Conformity CE / UKCA

We,

Rosemount Inc.
6021 Innovation Blvd
Shakopee, MN 55379
USA

declare under our sole responsibility that the product,

935/936 Open Path Gas Source

Authorized Representative in Europe:

Emerson S.R.L., company No. J12/88/2006, Emerson 4 street, Parcul Industrial
Tetarom II, Cluj-Napoca 400638, Romania

Regulatory Compliance Shared Services Department
Email: europeproductcompliance@emerson.com Phone: +40 374 132 035

For product compliance destination sales questions in Great Britain, contact Authorized Representative:

Emerson Process Management Limited at ukproductcompliance@emerson.com or +44 11 6282 23 64, Regulatory Compliance Department.

Emerson Process Management Limited, company No 00671801, Meridian East, Leicester LE19 1UX, United Kingdom

to which this declaration relates, is in conformity with:

1) the relevant statutory requirements of Great Britain, including the latest amendments
2) the provisions of the European Union Directives, including the latest amendments

October 3, 2022	Mark Lee	VP Global Quality	Boulder Colorado, USA
(signature & date of issue)	(name)	(function)	(place of issue)

ATEX Notified Body for EU Type Examination Certificate:
CSA Group Netherlands B.V. [Notified Body Number: 2813]
Utrechtseweg 310
6812 AR ARNHEM
Netherlands

ATEX Notified Body for Quality Assurance:
SGS Fimko Oy [Notified Body Number: 0598]
Takomotie 8
00380 Helsinki
Finland

UK Conformity Assessment Body for UK Type Examination Certificate:
CSA Group Testing UK Ltd [Approved Body Number: 0518]
Unit 6 Hawarden Industrial Park, Hawarden, CH5 3US
United Kingdom

UK Approved Body for Quality Assurance:
SGS Baseefa Ltd. [Approved Body Number: 1180]
Rockhead Business Park, Staden Lane
Buxton, Derbyshire. SK17 9RZ
United Kingdom

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Declaration of Conformity CE / UKCA

ATEX Directive (2014/34/EU)
SIRA 16ATEX1224X
Ex II 2 (2) G D
Ex db eb ib [ib Gb] IIB + H2 T4 Gb
Ex tb [ib Db] IIIC T135°C Db
Ta = -55 °C to +65 °C

Harmonized Standards:
EN 60079-0:2018/AC:2020
EN 60079-1:2014/AC:2018
EN 60079-7:2015+A1:2018
EN 60079-11:2012
EN 60079-28:2015
EN 60079-31:2014

EMC Directive (2014/30/EU)
Harmonized Standards:
EN 50270:2016
EN 61000-6-3:2007+A1:2011+AC:2012

RoHS Directive (Amended 2015/863/EU)
Harmonized Standards:
EN IEC 63000:2018

Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016 (S.I. 2016/1107)
CSAE 21UKEX1175X
Ex II 2 (2) G D
Ex db eb ib [ib Gb] IIB + H2 T4 Gb
Ex tb [ib Db] IIIC T135°C Db
Ta = -55 °C to +65 °C

Designated Standards:
EN 60079-0:2018/AC:2020
EN 60079-1:2014/AC:2018
EN 60079-7:2015+A1:2018
EN 60079-11:2012
EN 60079-28:2015
EN 60079-31:2014

Electromagnetic Compatibility Regulations 2016 (S.I. 2016/1091)
Designated Standards:
EN 50270:2016
EN 61000-6-3:2007+A1:2011+AC:2012

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (S.I. 2012/3032)
Designated Standards:
EN IEC 63000:2018

A Wiring configurations

Figure A-1: Receiver wiring terminal

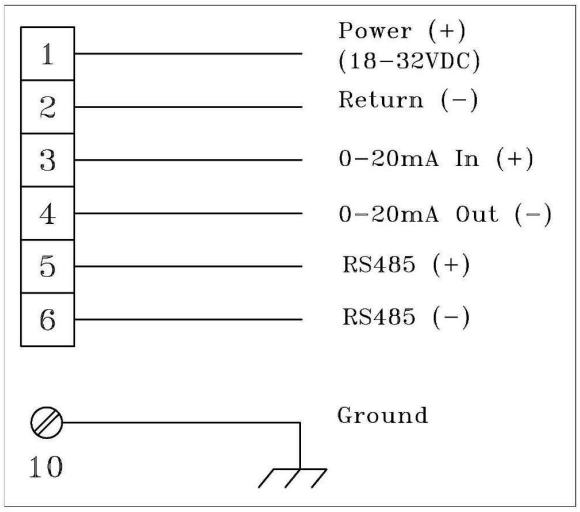


Figure A-2: Transmitter wiring terminal

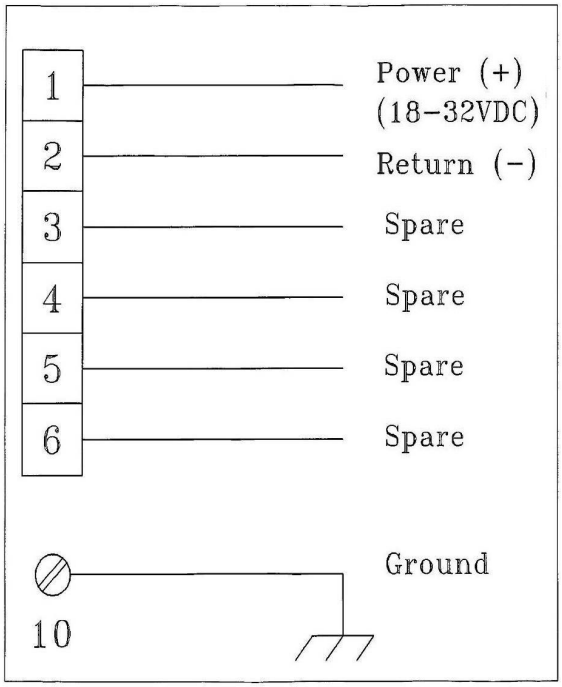


Figure A-3: 0–20 mA sink 4-wire

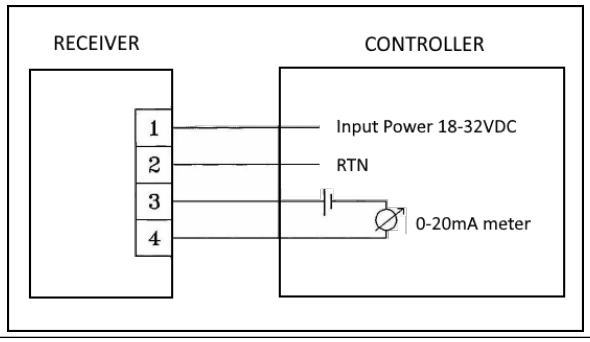


Figure A-4: 0–20 mA non-isolated sink 3-wire

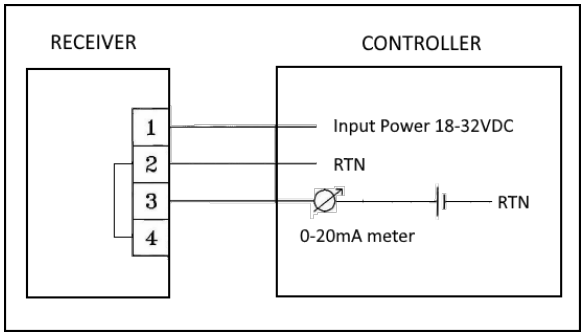
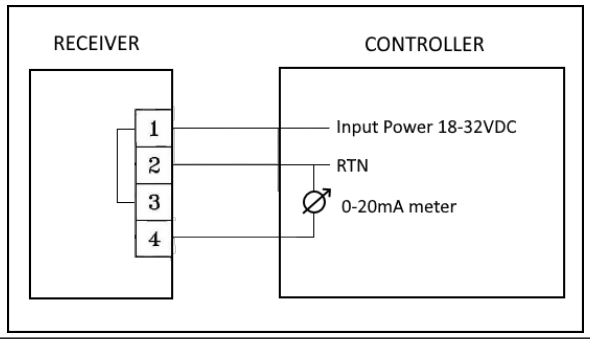


Figure A-5: 0–20 mA transmitter 3-wire



B Accessories

B.1 Tilt mount

The tilt mounting brackets (P/N 888270) allow for accurate alignment of the transmitter and receiver for proper operation of the open path. The brackets give crude alignment of ±60°, and a fine alignment of ±10°.

B.2 Pole mount (U-Bolt 4-5-in.)

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

B.3 Pole mount (U-Bolt 2-3-in.)

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

B.4 Wall mount

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

B.5 Commissioning kit

The Extended Commissioning Kit is required for commissioning and future maintenance checks. The part number is 888257. Only one kit is required per site.

The kit includes the following:

- Alignment tool (P/N 888240)
- 6 Functional check filters for system installation and periodical functioning testing
- USB RS-485 harness
- Allen keys

Table B-1: Check Filters

Check filter part number	Gas concentration
888260-1	110-270% LEL.m propane
888260-2	270-490% LEL.m propane
888260-3	140-250% LEL.m methane
888260-4	270-480% LEL.m methane
888260-5	180-370% LEL.m ethylene
888260-3 or 888260-6	490-760% LEL.m ethylene

- The check filters are used for installation verification.
- The ranges in the table are for reference only.
- The purpose of the check filters is to activate alarm or warning status. Readings above or below the range is acceptable as long as the device goes into alarm or warning.

Note
For LEL conversion, see Table 3-1.

B.6 HART® handled diagnostic unit

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

B.7 Universal RS-485 and HART® IS harness kit

It includes a quick plug connection for a HART handheld unit and an RS-485 interface. The HART unit can be loaded with Spectrex host software. The RS-485 interface is for connecting to a PC and using the Modbus® Manager host software which is available from the vendor website. The part number is P/N 888820.

B.8 USB/RS-485 harness converter kit

The USB RS-485 Harness Kit with RS-485/USB converter (P/N 794079), together with Modbus® Manager host software, enables the user to connect to any available PC or laptop to reconfigure settings or perform diagnostics on the Quasar 900 gas detection system.

B.9 Protective cover

The protective cover (P/N 888263) is designed to protect the detector from the heat of the sun.

C SIL-2 features

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

The SafEye™ Quasar 900 IR 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
Main time to repair:	72 hr
Ambient temperature:	max 149 °F/65 °C
Proof-Test-Interval:	52 weeks

λ_S = 2056.1 fit

λ_D = 1976.1 fit

λ_{DU} = 114.8 fit

λ_{SD} = 1933.4 fit

λ_{DD} = 1861.4 fit

SFF = 97%	DC = 94%
PFDavg = 6.45 x 10-4	PFD%_SIL2 = 6.4%
PFH = 1.15 x 10-7 1/h	PFH%_SIL2 = 11.5%

C.2 General conditions for safe use

- The SafEye™ Quasar 900 IR 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 24 V 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 20 mA current loop.
- After installation and configuration, the setup parameters must be verified and the function of the SafEye Quasar 900 IR 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 900 IR Open-Path Gas Detector must be switched off and on.

- The connected controller must monitor the 0–20 mA signal current for values below 4 mA and above 20 mA.
- Defects found in the detector must be repaired within 72 hours.

TM888200
Rev. As
2023

For more information: **Emerson.com/global**

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