Safety Manual
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Spectrex SharpEye™ 40/40 Series

Flame Detectors

SPECTREX

Contents

1 Spectrex SharpEye 40/40 series

The flame detectors series SharpEye 40/40 fulfills the requirements of the IEC 61508 for a Safety Integrity Level (SIL) 2 in a one-channel configuration or up to SIL 3 of IEC 61508 in a redundant configuration.

2 Certified product identification of the device

Kind of product: Infrared and ultraviolet flame detector series

Type designation: Spectrex SharpEye 40/40:
C-I, C-M, C-LB, C-L4B, D-I, D-M, D-LB, D-L4B

Technical data:

Spectral response:	Infrared and ultraviolet bands
Supply voltage:	18-32 Vdc
Max. power consumption:	300 mA
Max. current:	9.6 W
Output:	0-20 mA
	Fault relay
	Alarm relay
	0-5 V

3 Applied standards

N1 **IEC 61508 Part 1 - 7:2010**

Functional safety of electrical/electronic/programmable electronic safety-related systems

N2 **EN 54-10:2002 and EN 54-10/A1:2005**

Fire detection and fire alarm systems

Part 10: Flame detectors - Point detectors

4 Safety parameters

4.1 Safety function

The safety function of the SharpEye 40/40 flame detector series is to detect flames in which carbon dioxide (CO_2) is produced in the combustion process and announce this over the 4-20 mA interface, analog output interface, and/or by opening the alarm-relay-contact.

4.2 Characteristics as per IEC 61508

Safety Integrity Level (SIL)	2 (one-channel configuration) and 3 (redundant configuration)
HFT (intern)	0
Device type	B
Mode of operation	Low demand mode and high demand or continues mode
Average ambient temperature	Max. 55 °C
Main time to repair	0 h
Proof-test interval	365 days

4.3 Safety relevant parameters

	40/40D-I, 40/40C-I, 40/40D-M, 40/40C-M (IR)				**40/40D-LB, 40/40C-LB 40/40D-L4B, 40/40C-L4B (UV/IR)**			
	MAO	**RYO**	**RYO2**	**FDO**	**MAO**	**RYO**	**RYO2**	**FDO**
λ_S **(fit)**	988	1290	1290	835	923	1226	1226	770
λ_D **(fit)**	988	1285	1285	835	923	1221	1221	770
λ_{DU} **(fit)**	104	107	107	102	79	82	82	77
λ_{DD} **(fit)**	884	1179	1179	732	844	1139	1139	693
SFF	95%	96%	94%	94%	96%	97%	97%	95%
DC	89%	92%	88%	88%	91%	93%	93%	90%
PFD_{avg} (1oo1)	4.6E- 04	4.7E- 04	4.5E- 04	4.5E- 04	3.5E- 04	3.6E- 04	3.4E- 04	3.4E- 04
$PFD_{\%\_SIL2}$	4.6%	4.7%	4.5%	4.5%	3.5%	3.6%	3.4%	3.4%
PFH (1oo1, 1/h)	1.0E- 07	N/A	1,0E- 07	N/A	7.9E- 08	N/A	7.7E- 08	N/A
$PFH_{\%\_SIL2}$	10.4%	N/A	10.2%	N/A	7.9%	N/A	7.7%	N/A
PFD_{avg} (1oo2)	9.4E- 06	9.6E- 06	9,3E- 06	9.2E- 06	7.1E- 06	7.3E- 06	3.4E- 04	6.9E- 06
$PFD_{\%\_SIL3\_}$	0.9%	1.0%	0.9%	0.9%	0.7%	0.7%	3.4%	0.7%
PFH (1oo2, 1/h)	2.2E- 09	2.2E- 09	2.1E- 09	2.1E- 09	1.6E- 09	1.7E- 09	7.7E- 08	1.6E- 09
$PFH_{\%\_SIL3\_}$	2.2%	2.2%	2.1%	2.1%	1.6%	1.7%	7.7%	1.6%

Remarks:

- **N/A:** Not allowed for high demand mode
- **RYO:** Using only the alarm-relay for alarming
- **RYO2:** Using alarm and acc-relay for alarming (serial connected contacts)
- **MAO:** Using the 4-20 mA - interface for alarming
- **FDO:** Using the analog OUT interface for alarming
- Failure rates of the electronic components as per Siemens SN 29500, calculated based upon an ambient temperature of 55 °C and statistical data of the sensor elements
- The calculation was performed based on a proof-test interval
  T1 = 365 days.
- Without knowledge of the partly redundant internal structure of the detector a calculation with other proof-test intervals (e.g., two years) leads only to an approximate result.

5 Guidelines for configuring, installing, operating, and service

The alert conditions according to SIL 2 can be implemented by an:

- Alert signal via 20 mA current loop

or

- Alert signal via alarm relay and the fault relay

6 Conditions for safe operating

1. The flame detector shall consist only of the approved hardware and software modules.
2. The 24 V power supply must fulfill the requirements for PELV/SELV of EN 60950.
3. The automatic Built-In Test (BIT) must be activated.
4. The function of the Spectrex 40/40 Flame Detector (flame detector, function of the 0-20 mA interface, and relay functions) must be checked completely.

6.1 Using the 0-20 mA interface for alerting

The following parameters shall be set:

- Automatic built-in test: On
- Connected to 0-20 mA terminals

The following allowed output current must be supervised with an accuracy of ±5 percent:

- Normal state: 4 mA
- Warning state: 16 mA
- Alarm state: 20 mA

The 0-20 mA can be used as low and high demand mode.

⚠ CAUTION

The receiving device must be programmed to indicate a fault condition when current levels reach overcurrent or undercurrent.

6.2 Using the alarm relay contact for alerting

The following parameters shall be set:

- Automatic built-in-test: On
- Connected to Normally Closed (NC) contact of alarm relay terminals
- Connected to fault relay terminals

The relay contacts (alarm and faulty relay) must be protected with a fuse rated at 0.6 of the nominal specified relay contact current.

The maximum contact rating that is allowed per SIL-2 is 30 Vdc.

The contact of the alarm relay opens if there is a fire alarm.

During the forwarding and evaluation of the alarm, the relay contact opens.

The alarm relay can be used as low demand only.

6.3 Using the alarm and acc-relay for alarming

The following parameters shall be set:

- Automatic built-in-test: On
- Connected to Normally Closed (NC) contact of alarm relay terminals.
- Connected to fault relay terminals.
- The relay contacts of alarm relay and faulty relay must be protected with a fuse rated at 0.6 of the nominal specified relay contact current.
- The contacts (N.C.) of the alarm relay open if there is a fire alarm.
- During the forwarding and evaluation of the alarm, the relay contacts open.

Or

- Connected to normally open (N.O.) contact of alarm relay terminals and auxiliary relay terminals.
- The contacts (N.O.) of the alarm relay and auxiliary relay close if there is a fire alarm.
- The contact (N.O.) of alarm relay and auxiliary relay must be connected in parallel.
- Connected to fault relay terminals.
- The relay contacts of auxiliary relay, alarm relay and faulty relay must be protected with a fuse rated at 0.6 of the nominal specified relay contact current.
- The contacts of the alarm relay and auxiliary closed if there is a fire alarm.
- During the forwarding and evaluation of the alarm, the relays contacts close.
- The maximum contact rating that is allowed per SIL-2 is 30 Vdc.

6.4 Using the analog voltage output for alerting

The following parameters shall be set:

- Automatic built-in-test: On
- Connected to analog voltage output terminal.
  The following allowed output voltage must be supervised with an accuracy of ±20 percent:
  - **Normal state:** 2 V
  - **Fault state:** <1 V
  - **Alarm state:** 5 V

The analog voltage output can be used as low demand only.

6.5 Other

1. The complete function of the flame detector (flame detection, function of the 0-20 mA interface, the relays, and the analog output interface) must be examined every six or twelve months, or whenever the flame detector must be switched off and on.
2. The window of the sensor must be examined at appropriate time intervals for partial contamination.
3. The HART® and the RS-485 interfaces must not be used for the transmission of the safety-related data.

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For more information: **Spectrex.net**

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