

Safety Integrity Level (SIL) Evaluation Safe Failure Fractions Summaries

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Management summary

This report summarizes the results of the Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the Detector Electronics PointWatch Eclipse Infrared Hydrocarbon Gas Detector, Model PIRECL. A Failure Modes, Effects, and Diagnostic Analysis is one of the steps to be taken to achieve functional safety certification per IEC61508 of a device. From the FMEDA, failure rates and Safe Failure Fraction are determined.

The Eclipse Infrared Gas Detector is an isolated 4 – 20 mA. smart device classified as Type B according to IEC61508. It contains self-diagnostics and is programmed to send it's output to a specified failure state, either 1 mA. or 2 mA. upon internal detection of a failure. The unit is externally powered from 24 Volts DC. It is capable of detecting hundreds of flammable hydrocarbon gases and may be used as a stand alone detector or as part of a facility protection system. The 4 – 20 mA output corresponds to 0 – 100% LEL.

In the standard Eclipse mode, fault annunciation through the 4 – 20 mA loop is done by signaling with 1 mA or 2 mA current level. The FMEDA analysis assumes that the receiving device is capable of receiving and programmed to indicate those levels as a fault as well as all overcurrent (> 23.2 mA.) and undercurrent (< 2.4 mA.).

The analysis shows that the device has a safe failure fraction between 90 and 99%.

The failure rates for the unit operating with its 4-20 mA. output are as follows:

$\lambda^H = 17 * 10^{-9}$ failures per hour (classified as SD when logic solver programmed to detect over-current)

$\lambda^L = 635 * 10^{-9}$ failures per hour (classified as DD when logic solver programmed to detect under-current)

$\lambda^{DU} = 73 * 10^{-9}$ failures per hour

$\lambda_{NoEffect} = 284 * 10^{-9}$ failures per hour (classified as safe per IEC 61508 definition but will not false trip)

SFF = 92.8%

IEC 61508 Type B

A user of the Detector Electronics Eclipse Gas Detector can utilize these failure rates in a probabilistic model of a Safety Instrumented Function (SIF) to determine suitability in part for Safety Instrumented System (SIS) usage in a particular Safety Integrity Level (SIL). A full table of failure rates is presented in section 4 along with all assumptions.

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Management summary

This report summarizes the results of the Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the Detector Electronics X3301 Multispectrum IR Flame Detector. A Failure Modes, Effects, and Diagnostic Analysis is one of the steps to be taken to achieve functional safety certification per IEC61508 of a device. From the FMEDA, failure rates and Safe Failure Fraction are determined.

The X3301 Multispectrum IR Flame Detector is a smart device classified as Type B according to IEC61508 with relay outputs or an optional isolated 4 – 20 mA. output. It contains self-diagnostics and is programmed to send it's output to a specified failure state, either 1 mA. or 2 mA. upon internal detection of a failure. The unit is externally powered from 24 Volts DC.

The FMEDA analysis assumes that for the optional current output, the receiving device is capable of receiving and programmed to indicate a fault on 1 mA. or 2 mA. as well as all overcurrent (> 20 mA.) and undercurrent (< 4 mA.).

The analysis shows that the device has a safe failure fraction between 90 and 99%.

The failure rates for the unit operating with its 4-20 mA. output are as follows:

$$\lambda^H = 43 * 10^{-9} \text{ failures per hour (classified as SD when logic solver programmed to detect over-current)}$$

$$\lambda^L = 3023 * 10^{-9} \text{ failures per hour (classified as SD when logic solver programmed to detect under-current)}$$

$$\lambda^{SU} = 63 * 10^{-9} \text{ failures per hour}$$

$$\lambda^{DU} = 228 * 10^{-9} \text{ failures per hour}$$

$$\lambda_{\text{NoEffect}} = 737 * 10^{-9} \text{ failures per hour (classified as safe per IEC 61508 definition but will not false trip)}$$

$$\text{SFF} = 94.4\%$$

The failure rates for the unit operating with relay outputs are as follows:

$$\lambda^{SD} = 2739 * 10^{-9} \text{ failures per hour}$$

$$\lambda^{SU} = 0 * 10^{-9} \text{ failures per hour}$$

$$\lambda^{DD} = 310 * 10^{-9} \text{ failures per hour}$$

$$\lambda^{DU} = 224 * 10^{-9} \text{ failures per hour}$$

$$\lambda_{\text{NoEffect}} = 700 * 10^{-9} \text{ failures per hour (classified as safe per IEC 61508 definition but will not false trip)}$$

$$\text{SFF} = 93.4\%$$

A user of the Detector Electronics X3301 Flame Detector can utilize these failure rates in a probabilistic model of a Safety Instrumented Function (SIF) to determine suitability in part for Safety Instrumented System (SIS) usage in a particular Safety Integrity Level (SIL). A full table of failure rates is presented in section 4 along with all assumptions.

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