PEPPERL+FUCHS

# SIL Declaration of Conformity

Functional safety of an inductive proximity switch according to IEC 61508.

Pepperl+Fuchs GmbH, Lilienthalstr. 200, 68307 Mannheim
declares as manufacturer, that for the inductive proximity switch, type mentioned below, are suitable for SIL 2 applications.

**Products**
Inductive proximity switch with NAMUR interface in accordance with IEC 60947-5-6:1999 or EN 60947-5-6:2000, see product list.

**Safety Function**
**The safety function is only given if the target is within the assured release distance.**

**Product List, Nominal Sensing Distance ($s_n$), Assured Release Distance ($s_{ar}$) and Targets**

| Part No. | Product Name | $s_n$ | $s_{ar}$ | Reference Target |
|---|---|---|---|---|
| 181120 | NCB10-30GM40-N0 | 10.0 mm | 7.00 mm | 30 x 30 x 1 $mm^3$, Fe 360 |

The nominal sensing distance $s_n$ and therefore the assured release distance $s_{ar}$ depends on the dimensions and the material of the target. **The safety characteristics are evaluated when the target is within the assured release distance $s_{ar}$. It is important that the distance between the damping material and the active faces of the sensor is closer than $s_{ar}$.**

If customized targets are used it must be guaranteed that the distance between the damping material and the active face of the sensor is closer than 0.7 times the individual measured real sensing distance or 0.6 times the real sensing distance measured at an even reference sensor.

**General**

The failure rates are based on the Siemens standard SN 29500. According to IEC 61508-1 table 2 the average *PFD* for systems operating in low demand mode has to be lower than $10^{-2}$ for SIL 2 safety functions. However, as the sensor under consideration is only one part of an entire safety function it should not claim more than 25 % of this range, i.e. it should be better than or equal to $2.5 \cdot 10^{-3}$.

The sensor is considered to be Type A component. Therefore the *SFF* has to be 60 % to 90 % according to IEC 61508-2 table 2 for SIL 2 (sub-) systems with a hardware fault tolerance of 0.

**Characteristics**

| Parameter | Symbol | Condition [2)] | Value | Unit |
|---|---|---|---|---|
| Type | | | A | |
| Hardware Fault Tolerance | *HFT* | | 0 | |
| Safe Failure Rate | $\lambda_{safe}$ | | 9.90E-08 | 1 / h |
| No Effect Failure Rate | $\lambda_{no\ effect}$ | | 5.50E-08 | 1 / h |
| Dangerous Failure Rate | $\lambda_{dangerous}$ | | 7.51E-08 | 1 / h |
| Total Failure Rate | $\lambda_{total}$ | | 2.29E-07 | 1 / h |
| Total Safe Failure Rate | $\lambda_S$ | | 1.54E-07 | 1 / h |
| Total Dangerous Failure Rate | $\lambda_D$ | | 7.51E-08 | 1 / h |
| Safe Failure Fraction | *SFF* | | 67.23 | % |
| Mean Time to Failure | *MTTF* | | 4.37E+06 | h |
| Average Probability of Failure on Demand | $PFD_{avg}$ [1)] | $T_{proof}$ = 1 year | 3.30E-04 | |
| Average Probability of Failure on Demand | $PFD_{avg}$ [1)] | $T_{proof}$ = 2 years | 6.60E-04 | |
| Average Probability of Failure on Demand | $PFD_{avg}$ [1)] | $T_{proof}$ = 5 years | 1.65E-03 | |
| Probability of Dangerous Failure per Hour | *PFH* [1)] | | 7.51E-08 | 1 / h |
| Safety Integrity Level | *SIL* | | 2 | |

[1)] 1oo1 structure

### [2] Conditions and Assumptions

- Failure rates are constant. wear out mechanisms are not included.
- Propagation of failures is not relevant.
- All component failure modes are known (Type A).
- The repair time after a safe failure is 8 hours.
- The average temperature over a long period of time is 40 °C.
- The stress levels are average for an industrial environment and can be compared to the Ground Fixed classification of MIL-HDBK-217F. Alternatively. the assumed environment is similar to IEC 60645-1. Class C (sheltered location) with an average temperature over a long period of time of 40 °C.
- The sensor is operated in the low demand mode of operation.
- For the high impedance state the object is within the assured release distance ($s < s_{ar} = 0.7 \cdot s_n$. see table "Product List. Nominal Sensing Distance ($s_n$). Assured Release Distance ($s_{ar}$) and Targets").
- The 2-wire connection cable between the sensor and the switching amplifier must meet the qualities as follows: Line resistance $R_{series} < 50\ \Omega$ (both leads in series); Insulation resistance $R_{insulation} > 1\ M\Omega$.
- *PFD* and *PFH* values are calculated when used in an 1oo1 structure.

### Definitions

The following definitions for the failure of the product were considered.

Application according to EN 60947-5-6 (DC interface for proximity sensors and switching amplifiers (NAMUR)):

| | |
|---|---|
| Fail-Safe State | **The fail-safe state is defined as the output being below 1.2 mA (high impedance).** |
| Fail Safe | Failure that causes the module / (sub)system to go to the defined fail-safe state without a demand from the process. |
| Fail Dangerous | Failure leading to an output current above 1.2 mA (i.e. being unable to go to the defined fail-safe state). |
| Fail No Effect | Failure of a component that is part of the safety function but that has no effect on the safety function. For the calculation of the *SFF* it is treated like a safe undetected failure. |

For the calculation of the Safe Failure Fraction (*SFF*) the following has to be noted:

$\lambda_{total} = \lambda_{safe} + \lambda_{dangerous} + \lambda_{no\ effect}$

$SFF = 1 - \lambda_{dangerous} / \lambda_{total} = (\lambda_{safe} + \lambda_{no\ effect}) / \lambda_{total}$

The failure categories listed above expand on the categories listed in IEC 61508 which are only safe and dangerous. It is important to realize that the „no effect" failures are included in the „safe" failure category according to IEC 61508. Note that these failures on its own will not affect system reliability or safety. and should not be included in spurious trip calculations.

For the calculation of the accumulated Failure Rates ($\lambda_S$ and $\lambda_D$) the following has to be noted:

$\lambda_S = \lambda_{safe} + \lambda_{no\ effect}$

$\lambda_D = \lambda_{dangerous}$

DIN EN ISO 9001 — Zertifiziertes Qualitätsmanagementsystem — DQS
Reg. Nr. 14 760-02

| | | |
|---|---|---|
| Hersteller-Unterschrift: Signature of manufacturer | ppa. Helm | i. A. Schober |
| Funktion des Unterzeichners: Function of the signer | Leiter GF Sensoren Fabrikautomation | Referent Qualitätsmanagement |
| Datum/Date: | Februar 2010/February 2010 | |

# SCATTERGOOD & JOHNSON LTD

ELECTRICAL ENGINEERING & FLUID CONTROL DISTRIBUTORS

Est.1899

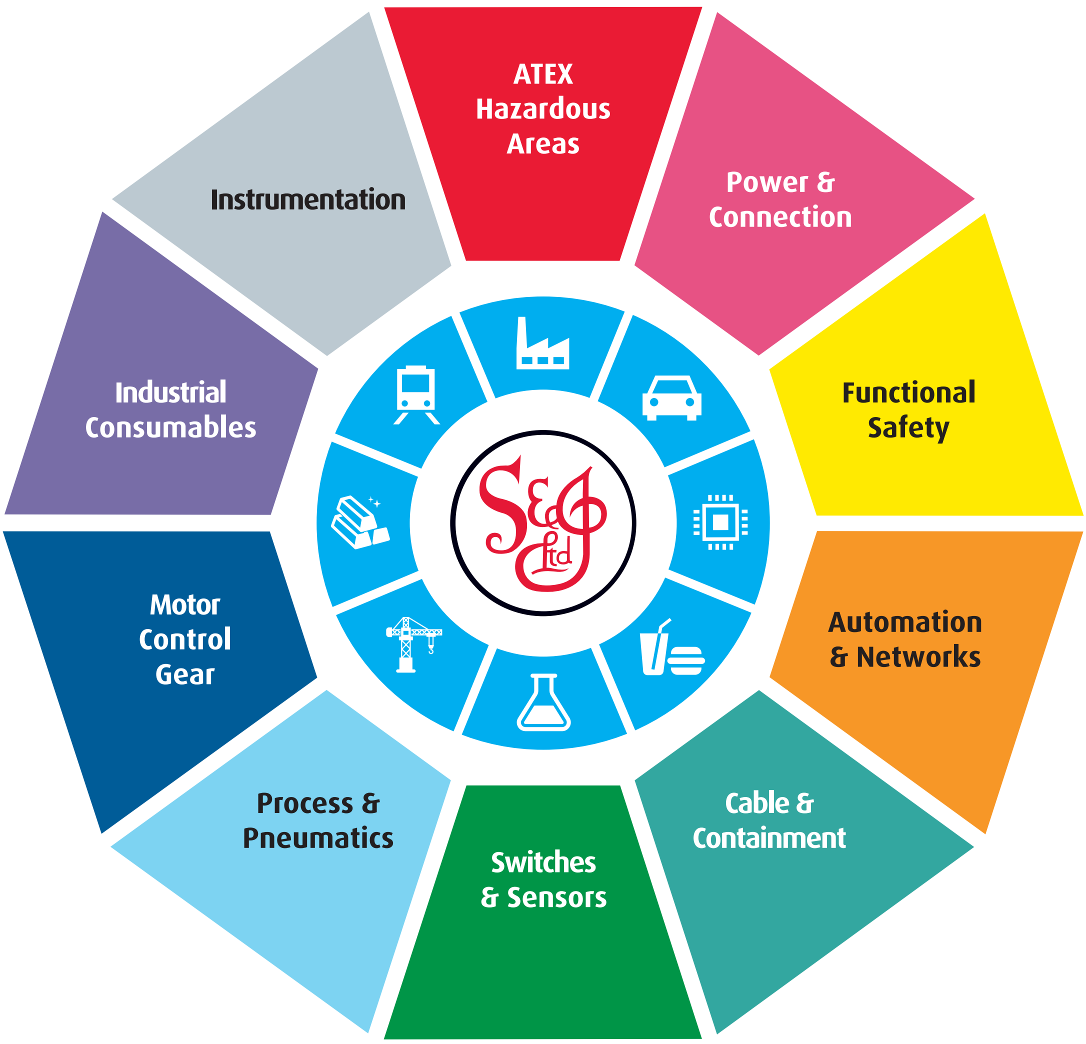
At Scattergood & Johnson Ltd, we pride ourselves on being a technical distributor to specialist industries.

Working with a range of quality product suppliers across a number of specialist markets, we are not your average ‘box shifter’ - we are your technical and supply chain partner.

We fully support every product we sell - for free! Our internal team and external sales engineers can answer any product or application question, no matter the complexity.

Backing up this technical ability is a range of 50,000+ products available from stock for nationwide next day delivery (same day if required!), or you can collect what you need from any of our trade counters around the UK.

Select your specialist interest below to learn more about how we can help.




Online, In Branch and On the Road - Scattergood & Johnson Ltd, there when you need us.

**www.scatts.co.uk**