FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

80 series proximity switch

manufactured by

Topworx, Inc.
3300 Fern Valley Road
Louisville
Kentucky 40213
USA

has been assessed by Sira Certification Service with reference to the CASS methodologies and found to meet the requirements of

IEC 61508-2:2010
Systematic Capability (SC3)

The product and its associated data contained herein can be considered for use in the design of safety functions up to and including

SIL 3*

When used in accordance with the scope and conditions of this certificate

* The product that has been certified is not implicit of the achieved Safety Integrity Level (SIL) of the safety related system

Certification Manager:

James Lynskey

Initial Certification: 12th June 2012
This certificate issued: 23re September 2022
Renewal date: 11th June 2027

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Report Summary

80 Series of proximity switch		
Safety Function: *'To open the normally closed (N/C) contacts in response to the proximity of a ferrous object'*		
80 Series		
Architectural constraints:	Type A HFT = 0 (SPDT variant) HFT = 1 (DPDT variant) SFF = 69%	SIL 3 (Based on DPDT)
Probability of Dangerous failure on safety function:	PFH = $1.62E^{-08}$ (High Demand Mode, based on SPDT & 1000cycles / year at 105°C)	SIL 3
Overall SIL-capability achieved[3]	**SIL 3 (Based on DPDT variant)**	
Hardware safety integrity compliance[1]	Route 1_H	
Systematic safety integrity compliance[1]	Route 1_S	
Systematic Capability[2]	SC 3	
Safety Function: *'To close the normally open (N/O) contacts in response to the proximity of a ferrous object'*		
Architectural constraints:	Type A HFT = 0 (SPDT variant) HFT = 1 (DPDT variant) SFF = 19%	SIL 2 (Based on DPDT)
Probability of Dangerous failure on safety function:	PFH = $2.39E^{-08}$ (High Demand Mode)	SIL 3
Overall SIL-capability achieved[3]	**SIL 2 (Based on DPDT variant)**	
Hardware safety integrity compliance[1]	Route 1_H	
Systematic safety integrity compliance[1]	Route 1_S	
Systematic Capability[2]	SC 3	

[1] These are parameters used in IEC61508 Part 2 Sections 7.4.2 & 7.4.4.
[2] This is a measurable scale for the systematic safety integrity level; refer to IEC61508 Part 4 Section 3.5.9.
[3] This is determined by the lowest SIL indicated by each of the parameters given above.

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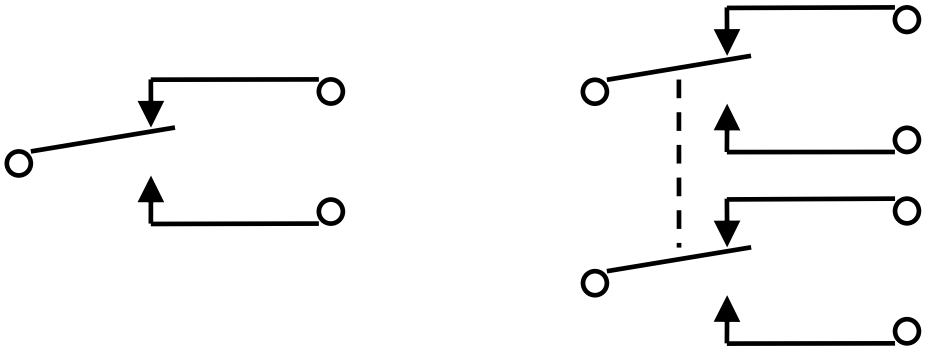
Product description and scope of certification

The magnetic proximity switches incorporate a permanent magnet to create a magnetic field which is interrupted by an external ferrous or magnetic object as it comes within the switch's sensing range. This interaction causes an armature in the switch to snap to its alternative position and thereby change the state of the electrical contacts.



Form C - SPDT

Form CC - DPDT

Figure 1: Electrical contacts used in safety functions

The 80 series are available with SPDT or DPDT switch contacts as shown in Figure 1 above. All switches use the same mechanism and are housed in a stainless steel rectangular enclosure.

Use in safety functions

The product's functionality which has been assessed for use in safety functions is:

- To close the normally open (N/O) contacts in response to the proximity of a ferrous object
- To open the normally closed (N/C) contacts in response to the proximity of a ferrous object

Product identification and configuration

The product is defined in the manufacturer's drawings listed in Table 1 below.

Table 1: Certified product drawings

Document no.	Pages	Rev	Date	Document description
ES-02787-1	1	01	08-Jun-2011	80 Series Master Assy
S-DP-0582	1	10	31-Jan-2005	Magnet Holder for 80 Series
S-KO30	1	03	-	80 series IOM

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Certified 'Base Data Set' in support of safety integrity capability

The assessment has been carried out with reference to the *Conformity Assessment of Safety-related Systems* (CASS) methodology.

A Failure Mode and Effect Analysis (FMEA) has established the failure modes and predicted the random hardware failure rates. Summary details are shown below.

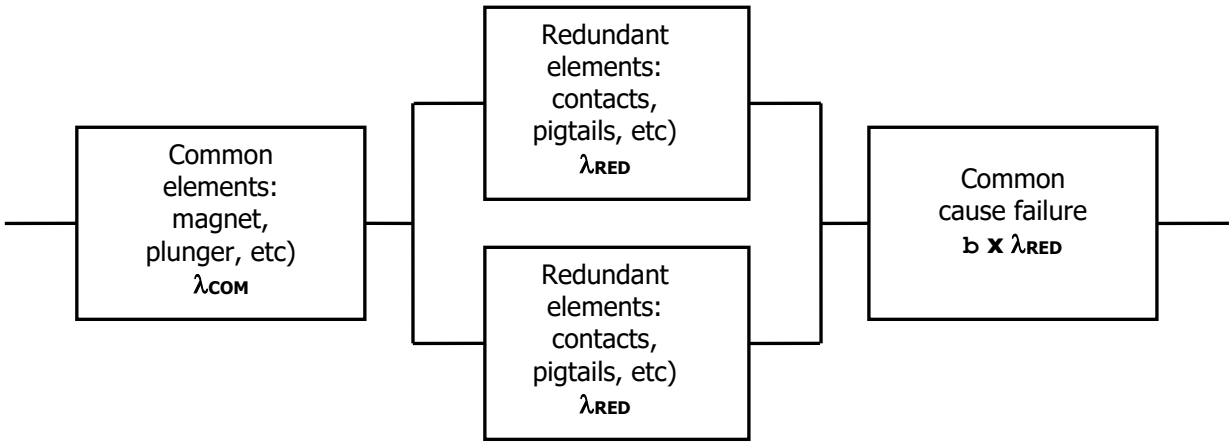
Failure rates have been modelled using PD IEC TR 62380:2004 reliability data handbook for the two failure modes below. Allowance has been made for the number of cycles/year and the mean operating temperature, assumed to be 2/3rds of the (maximum) rated operating temperature.
Probabilistic failure rates (symbol: λ) are expressed in failures per hour. Allocation of failures to safe or dangerous are given in Table 2a below.

For value of "λ" in the following tables, refer to either Graph 1, Graph 2 or Graph 3 below, depending on the expected duty of the switch (cycles/year).

Table 2a: Base Data for SPDT contacts or one contact pair of a DPDT switch

Failure mode	Probability of safe failures (λ_S)	Probability of dangerous failures (λ_D)
Failure of the N/O contacts to close	0.45 x λ	0.55 x λ
Failure of the N/C contacts to open	0.62 x λ	0.38 x λ

When two contact pairs in a DPDT switch are wired together (in series or parallel) to provide redundancy, the Reliability Block Diagram (RBD) below applies.



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Dormant failures in either of the redundant elements are detected by a suitable proof test which the user is required to perform. The figures in the table above are used to calculate the fail-danger figure ($\lambda_{D\text{-}REDUNDANT}$) and fail-safe figure ($\lambda_{S\text{-}REDUNDANT}$) using the following equations:

$$\lambda_{D\text{-}REDUNDANT} = \lambda_{COM} + (\lambda_{RED}^2 \times T) + (b \times \lambda_{RED})$$

Where:

b is the Common Cause Factor (CCF) = 10%

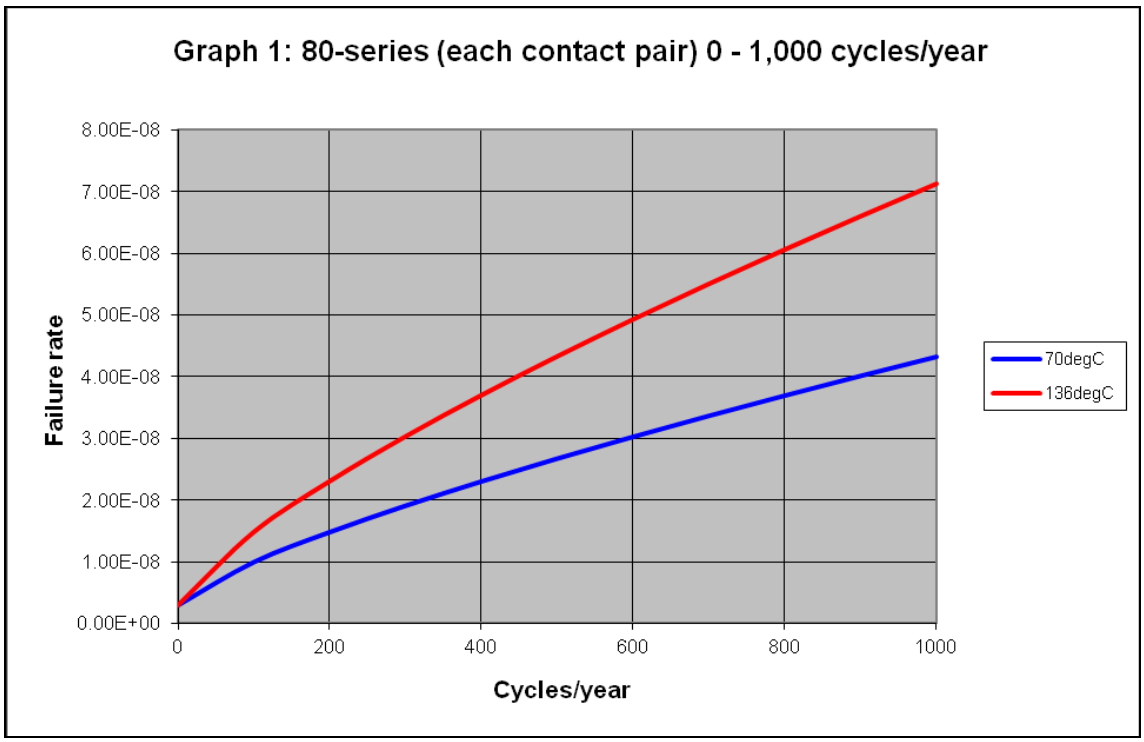
T = Proof test interval (hours)

The total failure rate (safe and dangerous) of this redundant configuration can be calculated as follows:

$$\lambda_{TOTAL} = \lambda_{COM} + (2 \times \lambda_{RED})$$

The safe failures are therefore calculated as follows:

$$\lambda_{S\text{-}REDUNDANT} = \lambda_{TOTAL} - \lambda_{D\text{-}REDUNDANT}$$



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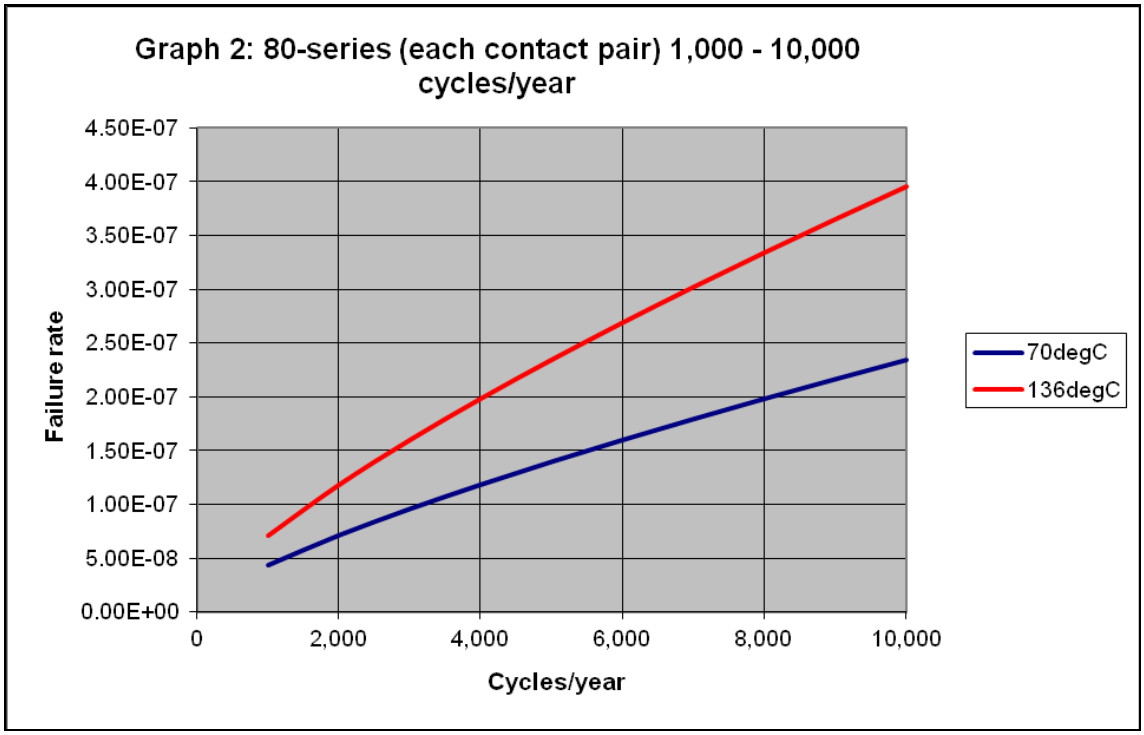

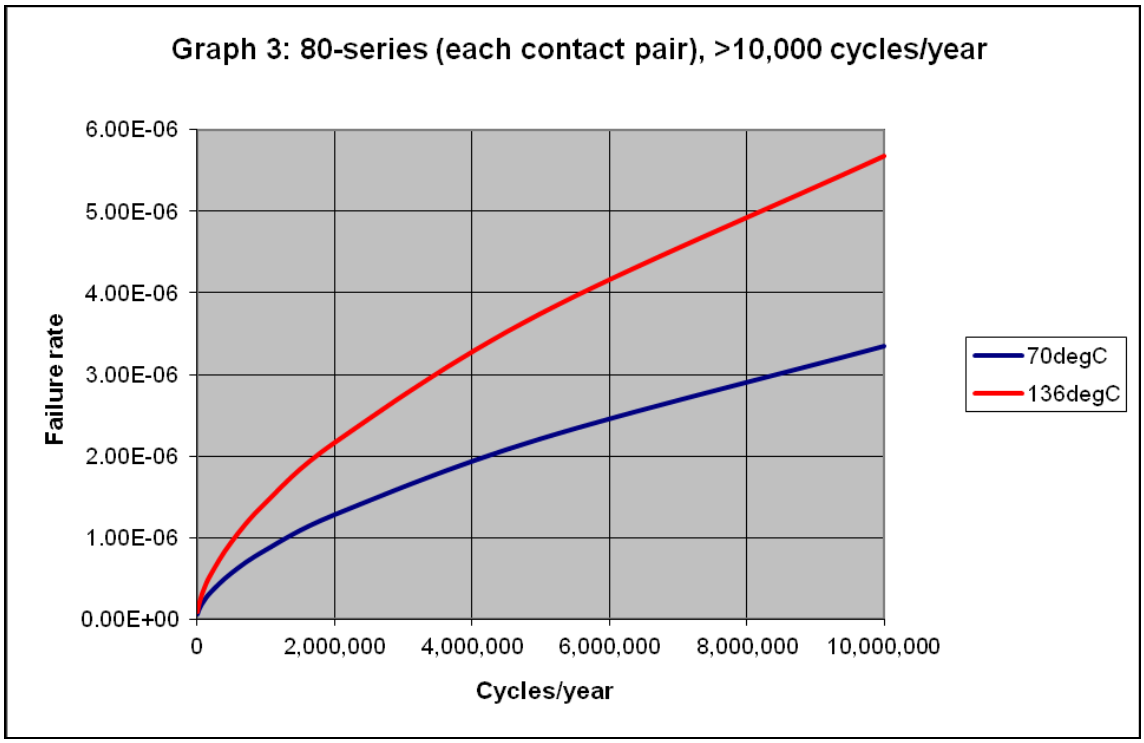

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The assessment has produced the supporting information given in Table 3 below.

Table 3: Base Information

1	Product ID:	Leverless limit switch series 80, model 81 as described in Manufacturer's product catalogue, ES-01259-1 R1
2	Functional specification:	SPDT and DPDT switch contacts change state in response to the proximity of a ferrous object. Full specification given in Manufacturer's product catalogue.
3	Environment / stress criteria:	Failure rates modelled using 'Ground; stationary; non-weather protected' conditions.
4	Environment limits:	Operational temperature range: -40 to +105°C standard -40 to +204°C extended
5	Lifetime limits:	10 years when used within the limits shown in graphs above, or 10 million cycles (whichever occurs first)
6	Maintenance requirements:	Refer to I,O & M sheet, S-K025
7	Repair constraints:	Refer to I,O & M sheet, S-K025
8	Hardware fault tolerance:	0 (SPDT variant) 1 (DPDT variant)
9	Highest SIL:	SIL 3
10	Systematic fault tolerance measures:	None other than compliance with user instructions (Table 1 above)
11	Validation records:	Refer to Manufacturers validation documents assessed in Sira report R56A17769A
12	Type A / Type B:	Type A (simple)
13	Proof Test Interval:	Refer to table above
14	Mean Time to Repair (MTTR):	User defined / application dependent
15	Systematic Capability:	SC3
16	Systematic fault avoidance measures:	Refer to the lifecycle and management report 56A24114B
17	Systematic fault tolerance measures:	Refer to the lifecycle and management report 56A24114B

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Conditions of Certification

The validity of the certified data is conditional on the Manufacturer complying with the following conditions:

1. The manufacturer shall analyse failure data from returned products on an on-going basis. Sira Certification Service shall be informed in the event of any indication that the actual failure rates are worse than the certified failure rates. (A process to rate the validity of field data should be used. To this end, the manufacturer should co-operate with users to operate a formal field-experience feedback programme).
2. Sira shall be notified in advance (with an impact analysis report) before any modifications to the certified equipment or the functional safety information in the user documentation is carried out. Sira may need to perform a re-assessment if modifications are judged to affect the product's functional safety certified herein.
3. On-going lifecycle activities associated with this product (e.g., modifications, corrective actions, field failure analysis) shall be subject to surveillance by Sira in accordance with 'Regulations Applicable to the Holders of Sira Certificates'.

Conditions of Safe Use

The validity of the certified data is conditional on the user complying with the following conditions:

1. The user shall comply with the requirements given in the manufacturer's user documentation (referred to in Table 3 above) in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, repair, etc;
2. Selection of this equipment for use in safety functions and the installation, configuration, overall validation, maintenance and repair shall only be carried out by competent personnel, observing all the manufacturer's conditions and recommendations in the user documentation.
3. All information associated with any field failures of this product should be collected under a dependability management process (e.g., IEC 60300-3-2) and reported to the manufacturer.
4. The unit should be tested at regular intervals to identify any malfunctions; in accordance with the safety manual.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in Sira Test & Certification Assessment Report R56A17769A;
2. If certified product or system is found not to comply, Sira Certification Service should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the Sira Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of Sira Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
1. This document remains the property of Sira and shall be returned when requested by the issuer.

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Certificate History

Issue	Date	Document no.	Comment
02	27/06/2017	R70118946A	Certificate reissued as a result of successful recertification.
03	04/09/2018	-	Minor changes to reflect systematic capability.
04	24/06/2022	-	3-month certificate extension for recertification audit.
05	23/09/2022	R80132073A	Certificate renewed following successful recertification audit.

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