FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

FS Series and ES Series Proximity Switches

manufactured by

Longvale Ltd.
Lancaster Park
Needwood
Burton upon Trent
Staffordshire
DE13 9PD

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

IEC 61508:2010
Routes 1_H & 1_S
Systematic Capability (SC3)

as an element/subsystem suitable for use in safety related systems performing safety functions up to and including

SIL 2 capable with HFT=0 (1oo1)*

when used in accordance with the scope and conditions of this certificate.

* This certificate does not waive the need for further functional safety verification to establish the achieved Safety Integrity Level (SIL) of the safety related system

Certification Manager:
Wayne Thomas

Initial Certification	: 20/07/2018
This certificate re-issued	: 23/07/2018
Renewal date	: 19/07/2023

Sira Certification Service
Part of CSA Group UK
Unit 6 Hawarden Industrial Park,
Hawarden, CH5 3US, United Kingdom.
Tel: +44 (0) 1244 670900
Email: ukinfo@csagroup.org
Web: www.csagroupuk.org

Product description and scope of certification

The FS Series proximity switches use an array of internal magnets to provide extremely reliable and accurate sensing in hazardous and arduous environments. They are able to sense ferrous material, such as carbon steel and 400 series stainless steel at up to 2.5mm and are reliable through millions of operations. This assessment report covers both the SPDT and DPDT versions of the FS series switches.
This assessment also covers the SPDT ES Series proximity switches. The ES series require external magnetic actuation utilising reed switch technology. These switches are hermetically sealed for use in hazardous locations.

Figure 1: Typical Assembly of the FS Series & ES Series Proximity Switch

Element Safety Function

Each of the different types of proximity switch has two separate safety functions; the target entering the sensing range, and the target leaving the sensing range. The specific safety function must be taken into account when using these proximity switches.

The element safety functions of the FS Series and ES Series Proximity Switches are defined as follows:

- **FS-Series SPDT Proximity Switch**
    1. *To provide the correct N/O output as required upon a ferrous target entering the sensing range. (single & both contact monitoring)*
    2. *To provide the correct N/C output as required upon a ferrous target leaving the sensing range. (both contact monitoring)*
- **FS-Series DPDT Proximity Switch**
    1. *To provide the correct N/O output on either switch as required upon a ferrous target entering the sensing range. (single & both contact monitoring)*
    2. *To provide the correct N/C output on either switch as required upon a ferrous target leaving the sensing range. (both contact monitoring)*
- **ES-Series Reed Proximity Switch**
    1. *To provide the correct N/O output as required upon a magnetic target entering the sensing range. (both contact monitoring)*
    2. *To provide the correct N/C output as required upon a magnetic target leaving the sensing range. (both contact monitoring)*

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Certified Data in support of use in safety functions

The assessment has been carried out with reference to the *Conformity Assessment of Safety-related Systems* (CASS) methodology using the Route 1_H approach.

Each type of product shown below (FS SPDT, FS DPDT and ES series) has two alternative safety functions. The first is to provide a N/O output upon the target entering the sensing area, the second is to provide a NC signal when the target leaves the sensing area. These safety functions must be taken into account when using this product for the SIL to be valid. The safety function used will determine which of the two columns of failure rates, SFF, PFD etc. is to be used in the application.

Note. Only one out of the two safety functions shall be used for each proximity sensor.

Table 1: FMEA Summary for the FS Series SPDT Proximity Switch in Single Mode (HFT = 0, 1oo1) – monitoring both contacts.

Safety Function: **FS-Series SPDT Proximity Switch** 1. *To provide the correct N/O output as required upon a ferrous target **entering** the sensing range.* 2. *To provide the correct N/C output as required upon a ferrous target **leaving** the sensing range.*			
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		FS-Series SPDT (Target **entering** sensing area)	FS-Series SPDT (Target **leaving** sensing area)
Architectural constraints & Type of product A/B		HFT = 0 Type A	HFT = 0 Type A
Safe Failure Fraction (SFF)		73%	60%
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 8.35E-08	0.00E-00 1.24E-07
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 2.28E-07	0.00E-00 1.88-07
Diagnostic coverage (DC)		0%	0%
PFD @ PTI = 8760 Hrs. MTTR = 24 Hrs.		3.68E-04	5.44E-04
Hardware safety integrity compliance		Route 1_H	Route 1_H
Systematic safety integrity compliance		Route 1_S	Route 1_S
Systematic Capability (SC1, SC2, SC3, SC4)		SC 3	SC 3
Hardware safety integrity achieved		**SIL 2**	**SIL 2**

UKAS PRODUCT CERTIFICATION 011

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Table 2: FMEA Summary for the FS Series SPDT Proximity Switch in Single Mode (HFT = 0, 1oo1) – <u>monitoring one contact only</u>.

Safety Function: **FS-Series SPDT Proximity Switch** 1. *To provide the correct N/O output as required upon a ferrous target **entering** the sensing range.*		
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		FS-Series SPDT (Target **entering** sensing area)
Architectural constraints & Type of product A/B		HFT = 0 Type A
Safe Failure Fraction (SFF)		62%
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 1.14E-07
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 1.83E-07
Diagnostic coverage (DC)		0%
PFD @ PTI = 8760 Hrs. MTTR = 24 Hrs.		5.02E-04
Hardware safety integrity compliance		Route 1_H
Systematic safety integrity compliance		Route 1_S
Systematic Capability (SC1, SC2, SC3, SC4)		SC 3
Hardware safety integrity achieved		**SIL 2**

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Table 3: FMEA Summary for the FS Series DPDT Proximity Switch in Single Mode (HFT = 0, 1oo1) – <u>monitoring both contacts.</u>

Safety Function: **FS-Series DPDT Proximity Switch** 1. *To provide the correct N/O output on **either** switch as required upon a ferrous target **entering** the sensing range.* 2. *To provide the correct N/C output on **either** switch as required upon a ferrous target **leaving** the sensing range.*			
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		FS-Series DPDT (Target **entering** sensing area)	FS-Series DPDT (Target **leaving** sensing area)
Architectural constraints & Type of product A/B		HFT = 0 Type A	HFT = 0 Type A
Safe Failure Fraction (SFF)		87%	74%
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 4.00E-08	0.00E-00 8.00E-08
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 2.62E-07	0.00E-00 2.22E-07
Diagnostic coverage (DC)		0%	0%
PFD @ PTI = 8760 Hrs. MTTR = 24 Hrs.		1.76E-04	3.52E-04
Hardware safety integrity compliance		Route 1_H	Route 1_H
Systematic safety integrity compliance		Route 1_S	Route 1_S
Systematic Capability (SC1, SC2, SC3, SC4)		SC 3	SC 3
Hardware safety integrity achieved		**SIL 2**	**SIL 2**

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Table 4: FMEA Summary for the FS Series DPDT Proximity Switch in Single Mode (HFT = 0, 1oo1) – <u>monitoring one contact only.</u>

Safety Function: **FS-Series DPDT Proximity Switch** 1. *To provide the correct N/O output on **either** switch as required upon a ferrous target **entering** the sensing range.*		
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		FS-Series DPDT (Target **entering** sensing area)
Architectural constraints & Type of product A/B		HFT = 0 Type A
Safe Failure Fraction (SFF)		85%
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 4.00E-08
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 2.30E-07
Diagnostic coverage (DC)		0%
PFD @ PTI = 8760 Hrs. MTTR = 24 Hrs.		1.76E-04
Hardware safety integrity compliance		Route 1_H
Systematic safety integrity compliance		Route 1_S
Systematic Capability (SC1, SC2, SC3, SC4)		SC 3
Hardware safety integrity achieved		**SIL 2**

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Table 5: FMEA Summary for the ES Series Reed Switch in Single Mode (HFT = 0, 1oo1) – monitoring both contacts.

Safety Function: **ES-Series Reed Proximity Switch** 1. *To provide the correct N/O output as required upon a magnetic target **entering** the sensing range.* 2. *To provide the correct N/C output as required upon a magnetic target **leaving** the sensing range.*			
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		ES-Series (Target **entering** sensing area)	ES-Series (Target **leaving** sensing area)
Architectural constraints & Type of product A/B		HFT = 0 Type A	HFT = 0 Type A
Safe Failure Fraction (SFF)		64%	64%
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 1.57E-07	0.00E-00 1.57E-07
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 2.85E-07	0.00E-00 2.85E-07
Diagnostic coverage (DC)		0%	0%
PFD @ PTI = 8760 Hrs. MTTR = 24 Hrs.		6.92E-04	6.92E-04
Hardware safety integrity compliance		Route 1_H	Route 1_H
Systematic safety integrity compliance		Route 1_S	Route 1_S
Systematic Capability (SC1, SC2, SC3, SC4)		SC 3	SC 3
Hardware safety integrity achieved		**SIL 2**	**SIL 2**

The failure data above is supported by the base information given in Table 6 below.

Table 6: Base information for the FS and ES Series Proximity Switches

1	Product identification:	FS Series and ES Series Proximity Switches
2	Functional specification:	**FS-Series SPDT Proximity Switch** 1. To provide the correct N/O output as required upon a ferrous target entering the sensing range. (single & both contact monitoring) 2. To provide the correct N/C output as required upon a ferrous target leaving the sensing range. (both contact monitoring) **FS-Series DPDT Proximity Switch** 1. To provide the correct N/O output on either switch as required upon a ferrous target entering the sensing range. (single & both contact monitoring) 2. To provide the correct N/C output on either switch as required upon a ferrous target leaving the sensing range. (both contact monitoring) **ES-Series Reed Proximity Switch** 1. To provide the correct N/O output as required upon a magnetic target entering the sensing range. (both contact monitoring)

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		2. To provide the correct N/C output as required upon a magnetic target leaving the sensing range. (both contact monitoring)
3-5	Random hardware failure rates:	Refer to Table 1 to Table 5 of this certificate.
6	Environment limits:	Operating temperature: -60 to +120 ºC.
7	Lifetime/replacement limits:	20 years
8	Proof Test requirements:	Refer to safety manual - LV-065-06
9	Maintenance requirements:	Refer to safety manual - LV-065-06
10	Diagnostic coverage:	0% diagnostic coverage.
11	Diagnostic test interval:	Refer to safety manual - LV-065-06
12	Repair constraints:	Refer to safety manual - LV-065-06
13	Safe Failure Fraction:	Refer to Table 1 to Table 5 of this certificate.
14	Hardware fault tolerance (HFT):	Refer to Table 1 to Table 5 of this certificate.
15	Highest SIL (architecture/type A/B):	Type A, SIL2.
16	Systematic failure constraints:	Refer to the product safety manual – LV-065-06
17	Evidence of similar conditions in previous use:	Not applicable.
18	Evidence supporting the application under different conditions of use:	Not applicable.
19	Evidence of period of operational use:	Not applicable.
20	Statement of restrictions on functionality:	See systematic report R70158996B.
21	Systematic capability (SC1, SC2, SC3)	SC3 - See systematic report R70158996B.
22	Systematic fault avoidance measures:	Compliance with techniques and measures from IEC 61508-2 Annex B to SIL 2 - See systematic report R70158996B.
23	Systematic fault tolerance measures:	Compliance with techniques and measures from IEC 61508-2 Annex A to support the SFF achieved – see hardware safety integrity report R70158996A.
24	Validation records:	All documents that have been used in support of the hardware have been documented in section 5.26 of report R70158996A; this includes the FMEA document.

Management of functional safety

The assessment has demonstrated that the product is supported by an appropriate functional safety management system that meets the relevant requirements of IEC 61508-1:2010 clause 6, see report R70158996B.

Identification of certified equipment

The certified equipment and it's safe use is defined in the manufacturer's documentation listed in Table 7 below.

Table 7: Certified Documents

Document no.	Rev	Date	Document description
70-000	A	16/07/2010	FS Series SPDT Proximity Switch GA Drawing
90-000	B	09/05/2017	FS Series DPDT Proximity Switch GA Drawing
HSRS 1	4	08/01/2014	Reed Switch for ES1000(D), 5000(D) & BZ18 and ESI-M12, M18 & 8000 Series.
HSRS 2	4	08/01/2014	Reed Switch for ES2000, 4000, 6000, 1000-B, 3000-B, 5000-B & ESI-M12PCR-K40, M18PCR-K40, 201-D & V3-CR.

Conditions of Certification

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

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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 base data in any specific user application 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 in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, and repair.
2. Selection of this product for use in safety function 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. A proof test interval of 1 year.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in Sira Test & Certification Assessment Report R70158996A and any further reports referenced (R70158996B).
2. If the 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'.
4. This document remains the property of Sira and shall be returned when requested by the issuer.
5. No part of the Functional safety related aspects stated in the instruction manual shall be changed without approval of the certification body.
6. This certificate will remain valid subject to completion of two surveillance audits within the five year certification cycle, and upon receipt of acceptable response to any findings raised during this period. This certificate can be withdrawn if the manufacturer no longer satisfies scheme requirements.

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Certificate History

Issue	Date	Report no.	Comment
0	20th July 2018	R70158996A R70158996B	The release of prime certificate.
1	23rd July 2018	-	Update to reflect new version of SIL safety manual LV-065-06.

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