



FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

Variable reluctance speed sensors series 4016xx-xx
401631-70, 401633-30, 401633-10, 401633-40, 401692-40, 401635-00

manufactured by

Magnetic sensors corporation

1365 N McCan St
Anaheim
California
92806
United States

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

IEC 61508-2:2010
Routes 1_H

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

SIL 2 capable with HFT=0
SIL 3 capable with HFT=1

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 Decision:

James Lynskey

Initial Certification : 19 January 2022
This certificate re-issued : 31 January 2024
Renewal date : 18 January 2027

This certificate may only be reproduced in its entirety, without any change.



Product description and scope of certification

Magnetic Sensors Corporation's CSA/ATEX Series of Variable Reluctance Speed Sensors are designed specifically for use in hazardous location applications. The sensors have threads for fitting to ½-14 NPT conduits and are thereby sealed for protection against corrosion, water, dust, and oil.

The variable reluctance speed sensors automatically generate a low-energy electrical signal that has a frequency directly proportional to wheel speed. The amplitude of this signal is also proportional to wheel speed. The sensors do not require any operational action.

Element Safety Function

The element safety functions of the Variable Reluctance Speed Sensors are defined as follows:

To provide a voltage output of frequency proportional to the turbine shaft speed

Certified Data in support of use in safety functions

As part of the product assessment and supporting evidence of conformity in with respect to 'hardware safety integrity' against the requirements of IEC 61508-2; Magnetic Sensors Corporation have submitted the Variable reluctance speed sensors for FMEA assessment to attain SIL capability. The component failure rates and modes for the Variable reluctance speed sensors have been extracted from or calculated using Quanterion Automated Databook. Table 1 summarises the FMEA assessment for the Variable reluctance speed sensors.



Table 1: FMEA Summary for the Variable reluctance speed sensors

| <i>Safety Function:</i> | | | |
|---|------------------------------------|----------------------------------|----------------------------------|
| <i>To provide a voltage output of frequency proportional to the turbine shaft speed.</i> | | | |
| Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4 | Variable reluctance speed sensors | | |
| Architectural constraints & Type of product A/B | HFT = 0 (1oo1) Type A | HFT = 1 (1oo2) Type A | HFT = 1 (2oo3) Type A |
| Safe Failure Fraction (SFF) | 60% | 90% | 90% |
| Random hardware failures: λ_{DD} λ_{DU} [h ⁻¹] | 3.81E-08 2.54E-08 | 5.72E-08 6.35E-09 | 5.72E-08 6.35E-09 |
| Random hardware failures: λ_{SD} λ_{SU} [h ⁻¹] | 0.00E-00 0.00E-00 | 0.00E-00 0.00E-00 | 0.00E-00 0.00E-00 |
| Diagnostic coverage (DC) | 60% | 90% | 90% |
| PFD @ PTI = 8760 Hrs. MTTR = 8 Hrs. | 1.13E-04 | 5.62E-06 | 5.62E-06 |
| Probability of Dangerous failure (High Demand - PFH) [h ⁻¹] | 2.54E-08 | 1.27E-09 | 1.27E-09 |
| Hardware safety integrity compliance | Route 1 _H | Route 1 _H | Route 1 _H |
| Systematic safety integrity compliance | SC3 – See report R80070273B | | |
| Systematic Capability (SC1, SC2, SC3, SC4) | SC3 – See report R80070273B | | |
| Hardware safety integrity achieved | SIL 2 | SIL 3 | SIL 3 |

Note 1: The failure data:

- 1) The PFD_{AVG} figure shown is for illustration only assuming a proof test interval of 8760 hours and MTTR of 8 hours. Refer to IEC 61508-6 for guidance on PFD_{AVG} calculations from the failure data.
- 2) The verified failure rates used in the safe failure fraction and diagnostic coverage do not include (λ no parts or no effect) failures in the calculation.

The failure data above is supported by the base information given in Table 2 below.

Table 2: Base information for the Variable reluctance speed sensors

| | | |
|-----|--|---|
| 1 | Product identification: | Variable reluctance speed sensors |
| 2 | Functional specification: | <i>To provide a voltage output of frequency proportional to the turbine shaft speed.</i> |
| 3-5 | Random hardware failure rates: | Refer to table 1 of this certificate. |
| 6 | Environment limits: | Operating temperature: -40 to +125°C. |
| 7 | Lifetime/replacement limits: | 20 years |
| 8 | Proof Test requirements: | Proof test required to be carried out at 8760 hours to meet the PFD stated in this certificate. Any deviation from this proof test interval will require re-calculation of the PFD. |
| 9 | Maintenance requirements: | N/A for this component – this needs to be decided at system level. |
| 10 | Diagnostic coverage: | See Table 1 above |
| 11 | Diagnostic test interval: | N/A for this component – this needs to be decided at system level. |
| 12 | Repair constraints: | N/A for this component – this needs to be decided at system level. |
| 13 | Safe Failure Fraction: | See Table 1 above |
| 14 | Hardware fault tolerance (HFT): | See Table 1 above |
| 15 | Highest SIL (architecture/type A/B): | Type A, SIL3. |
| 16 | Systematic failure constraints: | The hardware safety integrity assessment was based on a proof test interval of 1 year. |
| 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: | Not applicable. |
| 21 | Systematic capability (SC1, SC2, SC3) | See systematic report R80070273B |
| 22 | Systematic fault avoidance measures: | Compliance with techniques and measures from IEC 61508-2 Annex B to SIL 3 - See systematic report R80070273B. |
| 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 R80070273A. |
| 24 | Validation records: | All documents that have been used in support of the hardware have been documented in section 5.24 of report R80070273A; this includes the FMEA document and insertion tests. |

Management of functional safety

The Functional Safety management assessment will be reviewed as part of project R80070273B, and the certificate will be updated accordingly once it is completed.

Identification of certified equipment

The certified equipment and its safe use is defined in the manufacturer's documentation listed in Table 3 below.

Table 3: Certified documents

| Sira ID | Document no. | Rev | Date | Document description |
|-----------|--------------|-----|------------|--------------------------------------|
| 02500-68 | 1 | T | 08/07/2021 | Installation and safety instructions |
| 40103171 | 1 | T | 29/03/2021 | Schematic drawing |
| 401031-70 | 1 | U | 21/10/2019 | Bill of Materials (BOM) |



Conditions of Certification

The validity of the certified base 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 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. The safety device is to have an independent power supply, it must not share the same power supply as non-safety devices that may cause a fault to the safety device.
5. 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 R80070273A and any further reports referenced (R80070273B).
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.

Certificate History

| Issue | Date | Report no. | Comment |
|-------|-------------|------------|--|
| 0 | 19 Jan 2022 | R80070273A | The release of prime certificate. |
| 1 | 31 Jan 2024 | 80195249 | Certificate updated to include specific model numbers. |

