FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

Planar Motor System – STO
S3 Flyways: S3-AS (240mm × 240mm) and S3-AN (120mm × 480mm)
S4 Flyways: S4-AS (320mm × 320mm) and S4-AN (160mm × 640mm)

manufactured by

Planar Motor
6651 Fraserwood Place, #250
Richmond, British Columbia V6W 1J3
Canada

have been assessed by CSA Group Testing UK Ltd with reference to the CASS methodologies and found to meet the requirements of

IEC 61508-2:2010
Routes 1_H
Systematic Capability (SC2)

in addition to

ISO 13849-1:2023

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

SIL 2 capable with HFT=1 (1oo2)*
& Category 3, PL (d)

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:
David Kilshaw

Initial Certification : 2025-11-03
This certificate re-issued : 2025-11-03
Renewal date : 2030-11-04

UKAS PRODUCT CERTIFICATION
0011

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Product description and scope of certification

Planar Motor System® is a product of Planar Motor Inc. (PMI) based in Richmond BC, Canada. The system functions as a frictionless maglev conveyor machine. Planar Motor System can be subdivided into three major components:

- Flyway – Equivalent to a stator in a conveyor system.
- XBot – Equivalent to a mover in a conveyor system.
- Planar Motor Controller (PMC) – Equivalent to a motion controller in a conveyor system.

Flyways are modularly connected to form configurable working areas. During operation, XBots magnetically levitate on Flyways and are able to individually move with six degrees of freedom as shown in the figure below.
XBots can carry payloads up to 40kg (payload varies based on the XBot model) and are able to move parts from point A to Point B with flexible routing and high precision/accuracy.

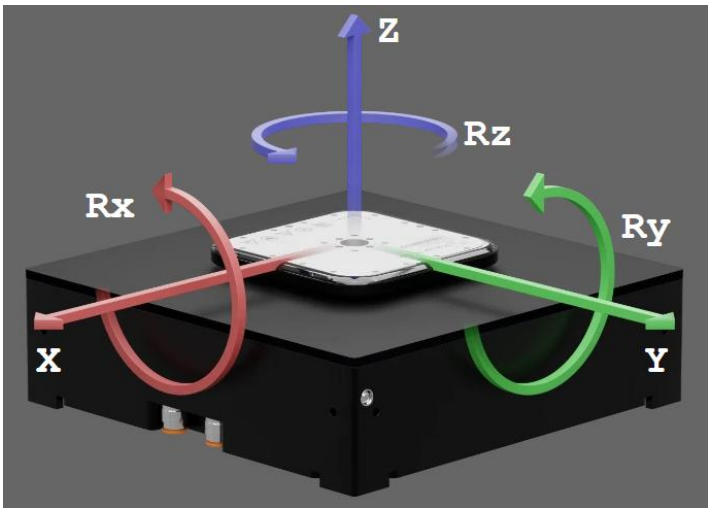

Figure 1: Axes of motion of Planar Motor System

Element Safety Function

The safety function of the certified equipment is:

Planar Motor System - Safe Torque Off (STO)

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.

As part of the product assessment and supporting evidence of conformity in with respect to *'hardware safety integrity'* against the requirements of IEC 61508-2:2010 and ISO 13849-1:2023; Planar Motor has submitted the BOQ and schematics of the STO for FMEA assessment to attain SIL capability. The component failure rates and modes for the STO have been extracted from or calculated using Quanterion Automated Databook, Item Toolkit and Faradip 3.0.

The results in Table 1 summarize the STO FMEA assessment and achieved safety integrity level.

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Table 1: Summary for the Planar Motor System - Safe Torque Off (STO) in redundant mode (1oo2)

Safety Function: **Safe Torque Off (STO) – "To de-energize the system in the event of an accident or emergency upon request."**				
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		**Safe Torque Off (STO)**		
Architectural constraints & Type of product A/B		HFT = 1 TYPE A		
Safe Failure Fraction (SFF)		96.78%		
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	3.64E-08 4.04E-09		
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 8.52E-08		
Diagnostic coverage (DC)		90%		
PFD @ PTI = 8760 Hrs. MTTR = 8 Hrs.		1.80E-05		
PFH		4.04E-10		
Hardware safety integrity compliance		Route 1_H		
Systematic safety integrity compliance		Route 1_S See report R80235623B		
Systematic Capability (SC1, SC2, SC3, SC4)		**SC 2**		
Summary assessment against ISO 13849:2023		**$MTTF_D$**	**DCavg**	**PL**
$MTTF_D$ (yr) & DCavg		100	90%	d
Denotation of each channel		High	Medium	-
Hardware safety integrity achieved		**SIL 2**		
PL achieved		**Cat 3 PL (d)**		

Note: Safety Integrity Level is limited to SIL 2 based on Systematic Capability.

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.

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Table 2: Base information for the Safe Torque Off (STO)

1	Product identification:	Planar Motor System - STO
2	Functional specification:	STO – Safe Torque Off
3-5	Random hardware failure rates:	Refer to table 1 of this certificate.
6	Environment limits:	Operating temperature: -40 to +60 ºC ambient
7	Lifetime/replacement limits:	Refer to safety manual - FSM – PMI-STO-SFM.
8	Proof Test requirements:	Refer to safety manual - FSM – PMI-STO-SFM.
9	Maintenance requirements:	Refer to safety manual - FSM – PMI-STO-SFM.
10	Diagnostic coverage:	90% diagnostic coverage.
11	Diagnostic test interval:	Refer to safety manual - FSM – PMI-STO-SFM.
12	Repair constraints:	Refer to safety manual - FSM – PMI-STO-SFM.
13	Safe Failure Fraction:	96.78%
14	Hardware fault tolerance (HFT):	See Table 1 above
15	Highest SIL (architecture/type A/B):	Type A, SIL 2.
16	Systematic failure constraints:	The hardware safety integrity assessment was based on a proof test interval of 1 year. For further information refer to safety manual - PMI-STO-SFM.
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 R80235623B.
21	Systematic capability (SC1, SC2, SC3)	SC2 - See systematic report R80235623B.
22	Systematic fault avoidance measures:	Compliance with techniques and measures from IEC 61508-2 Annex B to SIL 2 - See systematic report R56A26205B.
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 R80235623A.
24	Validation records:	All documents that have been used in support of the hardware have been documented in section 5.24 of report R80235623A; this includes the FMEA document and insertion tests.

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 R80235623B.

Identification of certified equipment

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

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Table 3: Certified documents

CSA ID	Document no.	Rev	Date	Document description
FS01	Schematic-S3P-AN-R3.1_TOP.pdf	R3.1	2025-10-07	S3-AN Power Entry Board Schematics
FS02	Schematic-S3P-AS-R3.2_TOP.pdf	R3.2	2025-10-07	S3-AS Power Entry Board Schematics
FS03	Schematic-S4P-AN-R1.0_TOP.pdf	R1.0	2025-10-07	S4-AN Power Entry Board Schematics
FS04	Schematic-S4P-AS-R3.1_TOP.pdf	R3.1	2025-10-07	S4-AS Power Entry Board Schematics
FS05	BOM-STO-FLYWAY-P-R1.1.xlsx	R1.1	2025-10-07	Power Entry Board STO Subsystem Components Rev 1.1
FS06	PMI-STO-SFM	4.0	2025-10-15	Safety Manual for STO
FS07	PMI-STO-DRS	0.1	2025-07-24	Design Requirement Specification
FS08	PMI-STO-SRS	0.1	2025-07-24	Functional Safety Specification

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. CSA 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. CSA 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. CSA 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 CSA in accordance with 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd 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.

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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 CSA Test & Certification Assessment Report R80235623A and any further reports referenced (R80235623B).
2. If the certified product or system is found not to comply, CSA Group Testing UK Ltd should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the CSA Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
4. This document remains the property of CSA 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	17th October 2025	R80235623A R80235623B	The release of prime certificate.

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