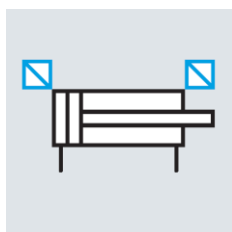


Safety Subfunctions Pneumatic

SCA – Safe Cam

Definition



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Title Safety Subfunctions Pneumatics - Circuit
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Author Festo
Date 2026-10-15

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- Specialist in pneumatics
- Specialist in electrical engineering
- Specialist for the programming of control systems and safety switching devices

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1 General

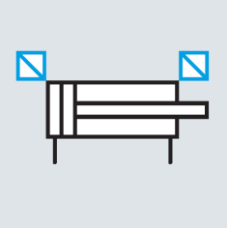
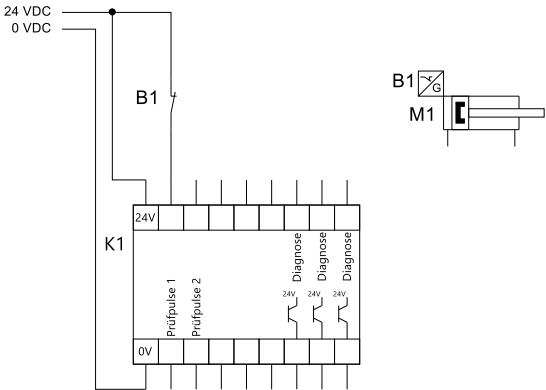
1.1 Objectives of this document

- This document defines the safety subfunction “Safe Cam (SCA)” for pneumatic drives and specifies its safe state. Additional information is then provided for practical implementation, which should be taken into account depending on the application.
- Additional information is provided for the possible diagnostic measures in accordance with ISO 13849-1, Table E.1, explaining how a specific diagnostic coverage can be achieved in one channel of this safety sub-function. For information on how these diagnostic coverage levels can be implemented in two-channel circuits, refer to the Safety Application Notes in the Support Portal; see also Section → “3 References to Example Circuits.”

1.2 General information

- The circuits shown are schematic circuits and cannot be complete due to the need for clarity and the scope of the document. They are recommendations and do not exclude other possibilities.
- The abbreviation used for the SCA safety subfunction is based on the definition in VDMA 24584 for pneumatics.
- The SCA safety subfunction monitors a position or position range. When this position is exited, an appropriate safety subfunction – such as a stopping function or Prevention of Unexpected Start-up (PUS) – is activated to bring the application into a safe state. This stopping function or PUS is not part of the SCA safety subfunction.
- Proximity switches suitable for safety-related circuits, with confirmation of compliance with the relevant safety principles, are used to implement the safety sub-function.
- Safe proximity switches in accordance with IEC 60947-5-3 may also be used. However, these are not considered in this document.

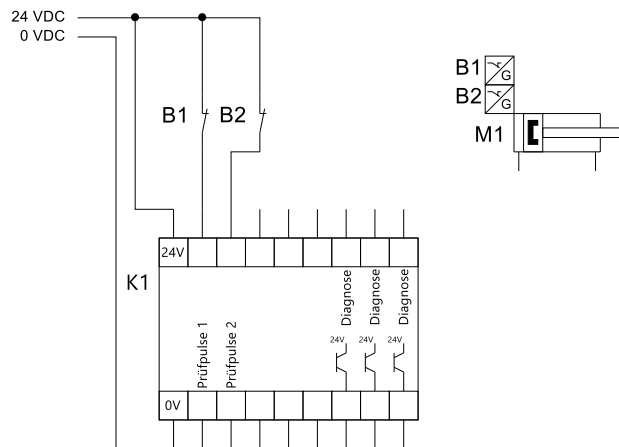
2 SCA – Safe Cam for Pneumatic Drives

Abbreviation	SCA
Designation	Safe Cam for pneumatic drives
Symbol	
Schematic circuit	
Monitoring function	The SCA safety sub-function outputs a safe output signal when the pneumatic drive is within a defined position or angular range.
Output	• If the pneumatic drive is within the safe position or angular range, a signal of 24 VDC is output. • If the pneumatic drive is outside the safe position or angular range, no signal of 0 VDC is output. • The output signal can be processed by a safety switching device.
Warnings	ATTENTION  • No magnets may enter the sensing range of the proximity switches used; otherwise, the safety subfunction can no longer be guaranteed. • The proximity switches must be securely mounted. A tool must be required for removal. • Mechanical loads, vibrations, or temperature changes must not cause the mounting to loosen by itself or change the installation position. • The mounting should be positively locked and protected against tampering. For this purpose, the SAMH-S mounting kit, for example, may be used. • The proximity switches should be accessible for maintenance and inspection. • The proximity switches must be protected against external influences that could cause damage. • The SCA monitoring function detects a hazardous condition. To address this, an appropriate response of the safety control system must be defined, for example, bringing all pneumatic functions to a safe state by means of STO (Safe Torque Off) or SDE (Safe Dynamic Exhaust). • The position range of pneumatic drives is monitored using a magnet on the piston.

	Monitoring is performed at the piston of the pneumatic drive. To enable monitoring at the load as well, fault exclusions for “failure of the piston-to-piston – rod connection” and “failure of the piston – rod-to-load connection” are required.
Notes	- When designing the SCA safety subfunction, the switching times and hysteresis of the proximity switches, as well as the processing time of the safety switching device, must be taken into account. - The cable length to the proximity switch must be taken into account during the design. The cable resistance may increase the total resistance to such an extent that the signal is no longer detected by the safety input. The permissible cable lengths for connection to the safety input must be verified. - Electronic proximity switches often have a high internal resistance. This resistance may be high enough that the switching of the proximity switch’s electronic output is no longer detected by the safety input. It must be verified how high the internal resistance of a proximity switch may be while still allowing the safety input to process the signal. - Connecting the proximity switches in series is not permitted because individual faults may be masked. See also ISO 14119, Annex J. - EMC measures in accordance with ISO 13849-1, Annex L, and IEC 60204-1, Annex H, must be implemented. Recommendations are provided in the application notes ↗ 100513 and ↗ 100565. - Short-circuit and cross-circuit detection can only be performed by the safety switching device. If test pulses are used, it must be verified for electronic outputs that these test pulses do not affect the proximity switch. - For two-channel monitoring, diversity through different technologies is recommended, such as SMT (magneto-resistive) and SME (reed switch). - If two proximity switches are used, the discrepancy time – the time difference between the two signals – must be taken into account for all switching operations. For example, if a proximity switch becomes detached, this can be detected by discrepancy-time monitoring. - This safety subfunction corresponds to SCA according to VDMA 24584 for pneumatics.

Diagnostic Coverage DC = 90%

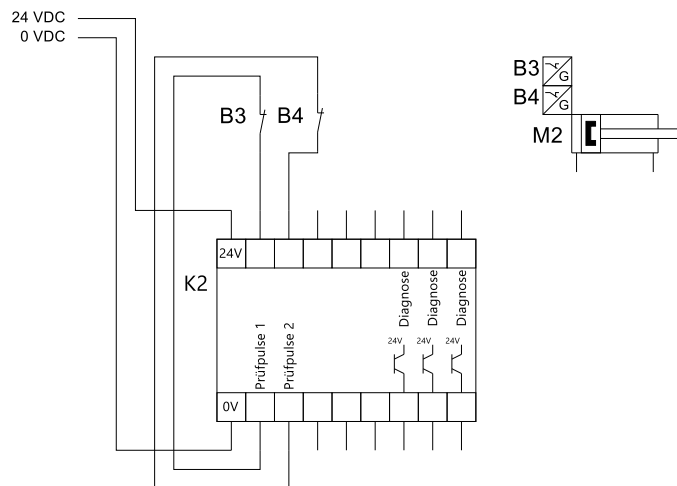
To achieve a diagnostic coverage of DC = 90% for the SCA safety subfunction, the diagnostic measure “Cross-monitoring of input signals, whereby short circuits and cross-circuits cannot be detected” can be applied.



Proximity switches B1 and B2 monitor the retracted end position of the pneumatic drive. Since short circuits and cross-circuits cannot be detected directly, the diagnostic coverage is limited to 90%.

Diagnostic Coverage DC = 99%

To achieve a diagnostic coverage of DC = 99%, the diagnostic measure “Cross-monitoring of input signals and intermediate results in the logic (L), as well as temporal and logical program-sequence monitoring and detection of static failures and short circuits (for multiple inputs/outputs)” is used.



3 References to Example Circuits

Safety Application Notes with a possible assessment based on ISO 13849 are available in the Support Portal for the following categories and Performance Levels.

SCA	Channel 1 diagnosis	Channel 2 diagnosis	Link
Up to Category 1, up to PL c	Proximity switch	-	↗ 100624
Up to Category 3, up to PL e	Proximity switch Cross-monitoring; short circuits/cross-circuits are not detected	Proximity switch Cross-monitoring; short circuits/cross-circuits are not detected	↗ 100625
Up to Category 4, up to PL e	Proximity switch Cross-monitoring; short circuits/cross-circuits are detected	Proximity switch Cross-monitoring; short circuits/cross-circuits are detected partially	↗ 100626

4 Used Literature

4.1 Cited Documents from Festo

- [1] [100624 Safety Subfunction SCA – Circuit – up to Category 1, up to PL c](#)
- [2] [100625 Safety Subfunction SCA – Circuit – up to Category 3, up to PL e](#)
- [3] [100626 Safety Subfunction SCA – Circuit – up to Category 4, up to PL e](#)

4.2 Standards

- [4] DIN EN ISO 4414:2011-04 – Pneumatic fluid power - General rules and safety requirements for systems and their components (ISO 4414:2010); German version EN ISO 4414:2010
- [5] ISO 5598:2020-01 – Fluid power systems and components - Vocabulary
- [6] DIN EN ISO 12100:2011-03 - Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010); German version EN ISO 12100:2010
- [7] DIN EN ISO 13849-1:2023-12 – Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023); German version EN ISO 13849-1:2023
- [8] DIN EN ISO 13849-2:2013-02 – Safety of machinery - Safety-related parts of control systems - Part 2: Validation (ISO 13849-2:2012); German version EN ISO 13849-2:2012
- [9] DIN EN ISO 14119:2025-09 - Safety of machinery - Interlocking devices associated with guards - Principles for design and selection (ISO 14119:2024); German version EN ISO 14119:2025
- [10] VDMA 24584:2022-06 – Safety functions of regulated and unregulated (fluid) mechanical systems; German Version
- [11] DIN EN 60204-1:2026-06 - Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2016, modified + AMD1:2021); German version EN 60204-1:2018 + A1:2025
- [12] DIN EN 61508:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508:2010); German version EN 61508:2010
- [13] DIN EN 61508-4:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations (IEC 61508-4:2010); German version EN 61508-4:2010
- [14] DIN EN 61511:2019-02 - Functional safety - Safety instrumented systems for the process industry sector - (IEC 61511:2016); German version EN 61511:2017
- [15] DIN EN IEC 62061:2023-02 - Safety of machinery - Functional safety of safety-related control systems (IEC 62061:2021); German version EN IEC 62061:2021

4.3 Legal Regulations

- [16] Machinery Directive: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
- [17] Machinery Regulation: Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC

5 Information about the Document

5.1 General Information

Document Number	100586
Definition	SCA – Safe Cam for Pneumatic Drives

5.2 Revision History

Ver.	Date	Ed.	Chapter	Description of Change/Impact
1.10	2026-10-15	JKHL	All	Creation of the document

5.3 Approval/Release of the Document

Role	Signature
Release	 Digital signiert von Jürgen Kühnle DN: cn=Jürgen Kühnle, gn=Jürgen Kühnle, c=DE, Germany, l=DE, Germany, o=Festo SE & Co. KG, ou=SC-OTP e=juergen.kuehnle@festo.com Grund: Freigabe dieses Dokuments Ort: Esslingen Datum: 2026-10-15 10:51:02+00

5.4 Period of Validity

Document is valid until 2031-10-15 or until one of the documents used or the required relevant base are changed.



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