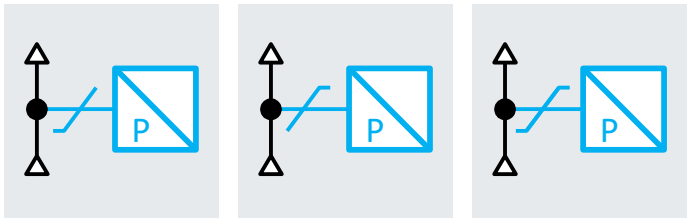
Safety Application Note ISO 13849

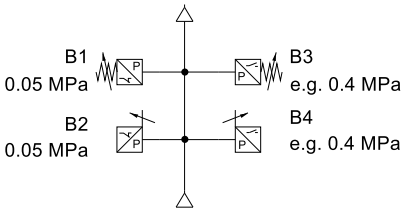
FESTO

Safety Subfunctions Pneumatics

SPM – Safe Pressure Monitoring
Up to Category 3, up to PL e

Circuit





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- 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 shows a possible example circuit for the safety subfunctions Safe Pressure Monitoring lower limit (SPM-l), upper limit (SPM-u), and pressure range (SPR), up to Category 3 and up to PL e.
- For the implementation of the safety sub-function relevant components, the most important features are listed.
- Based on these features, suitable products from Festo are recommended.

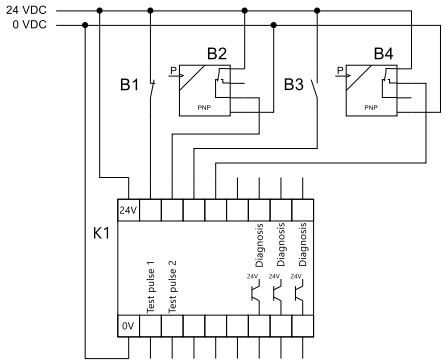
1.2 General Notes

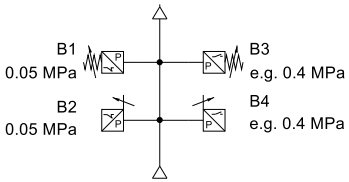
- The given circuit is a principle circuit which cannot be complete due to clarity and scope. It is a recommendation that does not exclude other possibilities.
- The abbreviations used for the safety subfunctions are based on the definitions in VDMA 24584 for pneumatics. The definitions used and important notes are given in the document ↗ 100519 SPM – Safe Pressure Monitoring.
- Whether a recommended product is suitable for a particular application must be checked by the user and confirmed in his technical documentation.
- In the product list included here with recommendations for suitable products, we have checked the specified requirements for the pneumatic circuit. However, if further information is available to us, e.g. through our product observation, this data can be changed on a daily basis. Therefore, these data must be checked in the data sheets available online before final use to see if there has been any change.
- The user must verify whether a recommended product is suitable for a specific application and confirm this in the technical documentation.
- For the Sistema project file of this circuit, the document ↗ 100395 Notes on Sistema project files must be taken into account.

1.3 Notes on safety-related features of the partial circuit

- The safety subfunctions SPM and SPR monitor a defined pressure limit or pressure range. If the defined pressure range is exceeded, a suitable safety subfunction (stop function or PUS) is activated to bring the application into a safe state. This stop function or PUS is not part of the scope of the SPM or SPR safety subfunction.
- For safety-related sub-functions with a two-channel architecture of the safety circuit (in this case, Category 3), a single fault does not lead to failure of the safety-related sub-function.
- The measures for failures due to common cause (CCF) must be assessed depending on the application. Recommendations for possible measures are provided in the document ↗ 100399 Recommendations for Implementing Measures Against Common Cause Failures (CCF).
- For two-channel monitoring, diversity through the use of different technologies is recommended, such as PEV (electromechanical) and SPBA (metal thin-film).
- For electronic proximity switches, an MTTF and B_{10} value should be specified; for electromechanical proximity switches, a B_{10} value should be specified.
- The calculation of the $MTTF_D$ characteristic value from the B_{10} values are included in the Sistema project file. The B_{10} value must be adjusted according to the valves used.
- The pressure limit setting in the switch or sensor must be protected against tampering.

2 Circuit



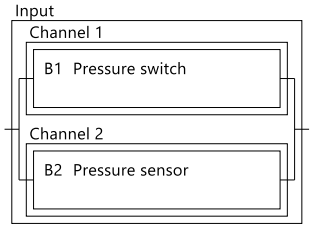


Parts list

Pos...	Identifi...	Description
1	B1	Pressure switch
2	B2	Pressure sensor
3	B3	Pressure switch
4	B4	Pressure sensor
5	K1	Safety switching device

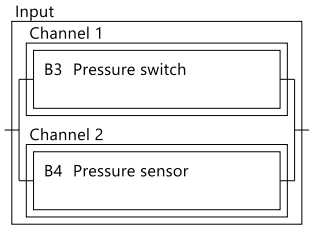
Safety subfunction and Block diagrams

SPM-l - Safe pressure monitor, lower limit — up to category 3, up to PL e can be reached



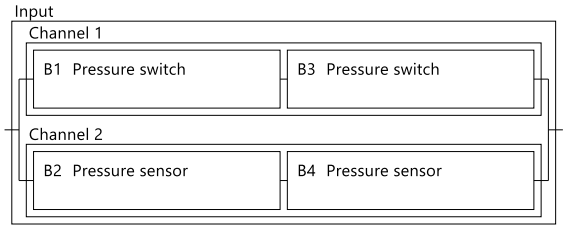
B1, B2
Pressure switch, Pressure sensor
Diagnostic coverage DC=90%
Cross-monitoring of input signals with dynamic testing
Short circuits may go undetected.
(estimate according ISO 13849-1, table E.1)

SPM-u - Safe pressure monitor, upper limit — up to category 3, up to PL e can be reached



B3, B4
Pressure switch, Pressure sensor
Diagnostic coverage DC=90%
Cross-monitoring of input signals with dynamic testing
Short circuits may go undetected.
(estimate according ISO 13849-1, table E.1)

SPR - Safe pressure range — up to category 3, up to PL e can be reached



B1, B2, B3, B4
Pressure switch, Pressure sensor
Diagnostic coverage DC=90%
Cross-monitoring of input signals with dynamic testing
Short circuits may go undetected.
(estimate according ISO 13849-1, table E.1)

3 Suitable Products for Pressure Switches B1, B2 (SPM-l, Minimum Pressure)

- Based on the following features, other suitable proximity or position sensors from Festo can also be selected using the features in the data sheets available online.
- Depending on the application, it must be evaluated whether this list of features needs to be added.

Feature	Value
Product category	Pressure switch
Measured variable	Relative pressure
Switching element function	NC (normally closed)
Operational pressure	Pressure range according to the application
B_{10} value	Specified
Relevant basic safety principles	Confirmed
Relevant well-tried safety principles	Confirmed

Other values for the features may be possible and must be considered separately.

Note: These pressure switches were selected as examples from different configurations.

No.	Material	Designation/Type (Sorting ↑)	Link Data Sheet	Link Datasheet Product Reliability
1.	10773	Pressure switch PEV-1/4-B **Notes** • The PEV pressure switches do not contain embedded software. • The PEV pressure switches are suitable for power supplies with test pulses.	↗	↗
2.	8000210	Pressure switch SPBA-P2R-G18-2P-M12-0,25X **Notes** • The SPBA pressure switches use embedded software. • The SPBA pressure switch is not suitable for power supplies with test pulses.	↗	↗

4 Suitable Products for Pressure Switches B3, B4 (SPM-u, Maximum Pressure)

- Based on the following features, other suitable proximity or position sensors from Festo can also be selected using the features in the data sheets available online.
- Depending on the application, it must be evaluated whether this list of features needs to be added.

Feature	Value
Product category	Pressure switch
Measured variable	Relative pressure
Switching element function	NO (normally open)
Operational pressure	Pressure range according to the application
B_{10} value	Specified
Relevant basic safety principles	Confirmed
Relevant well-tried safety principles	Confirmed

Other values for the features may be possible and must be considered separately.

Note: These pressure switches were selected as examples from different configurations.

No.	Material	Designation/Type (Sorting ↑)	Link Data Sheet	Link Datasheet Product Reliability
1.	10773	Pressure switch PEV-1/4-B **Notes** • The PEV pressure switches do not contain embedded software. • The PEV pressure switches are suitable for power supplies with test pulses.	↗	↗
2.	8000210	Pressure switch SPBA-P2R-G18-2P-M12-0,25X **Notes** • The SPBA pressure switches use embedded software. • The SPBA pressure switch is not suitable for power supplies with test pulses.	↗	↗

5 Used Literature

5.1 Cited Documents from Festo

[1] 100395 Notes on Sistema project files
[2] 100519 SPM – Safe Pressure Monitoring

5.2 Standards

[3] 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
[4] ISO 5598:2020-01 – Fluid power systems and components - Vocabulary
[5] 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
[6] 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
[7] 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
[8] VDMA 24584:2022-06 – Safety functions of regulated and unregulated (fluid) mechanical systems; German Version
[9] DIN EN 61508:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508:2010); German version EN 61508:2010
[10] 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
[11] DIN EN 61511:2019-02 - Functional safety - Safety instrumented systems for the process industry sector - (IEC 61511:2016); German version EN 61511:2017
[12] 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

5.3 Legal Regulations

[13] 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)
[14] 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

6 Information about the Document

6.1 General Information

Document Number	**100570**
Safety Subfunction	SPM – Safe Pressure Monitoring SPR – Safe Pressure Range
Category	Up to Category 3
PL	Up to PL e

6.2 Revision History

Ver.	**Date**	**Ed.**	**Chapter**	**Description of Change/Impact**
1.10	2026-11-19	JKHL	All	Creation of document

6.3 Approval/Release of the Document

Role	**Signature**
Release	Jürgen Kühnle 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: 2026-11-19 09:39+01:00

6.4 Period of Validity

Document is valid until 2031-11-19 or until one of the documents used or the required relevant base are changed.



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