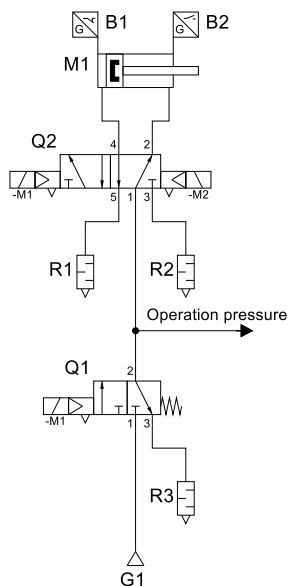


Circuit

Safety Subfunctions Pneumatic

PUS – Prevention unexpected startup – up to Cat. 2, up to PL d



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100588

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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 shows a possible example circuit for the safety sub-function PUS (Prevention of Unexpected Startup) with up to category 2, up to PL d.
- 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 [↗ 100405 Safety subfunctions pneumatics – PUS](#).
- The requirements for the valve are only considered in the context of the pneumatic circuit. Suggestions for the electrical wiring of individual valves or valve terminals have not been considered in this document.
 - For single valves, the document [↗ 100393 Safe electrical switch-off of individually controlled valves](#) should be considered.
 - For valve terminals, the document [↗ 100394 Safe electrical switch-off of valve terminals](#) should be considered.
- 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.
- Whether a recommended product is suitable for a particular application must be checked by the user and confirmed in his 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

- For safety sub-functions with 1-channel architecture with testing of the safety circuit (here category 2), the occurrence of a failure can lead to the loss of the safety-subfunction between the tests. The loss of the safety subfunction is detected by the test. The test or diagnosis can detect some faults (diagnostic coverage 60%).
- The consideration of measures for failures due to common cause (CCF) are to be evaluated depending on the application. Recommendations on possible measures are contained in the document [↗ 100399 Recommendations for the implementation of measures against common cause failures \(CCF\)](#).
- The calculation of the MTTF₀ characteristic from the B₁₀ values are included in the Sistema project file. The B₁₀ value must be adjusted according to the valves used.
- In order to estimate a diagnostic coverage for valve Q2, a suitable plausibility and positioning time monitoring of the control signals up to the signal change of sensors B1, B2 should be implemented.
- The testing is carried out automatically by the diagnostic measure positioning time monitoring of drive M1. The function of valve Q2 is monitored with every movement of the pneumatic drive.
- In the event of a failure, the drive will move out of its end position until the failure response interrupts and exhausts the working-pressure air supply. This shall not create any hazard.



3 Suitable Products for Limit Switches B1, B2

- 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	Proximity sensor
Measured variable	Position
Switching output	Contact OR contactless OR PNP OR NPN/PNP switchable
Switching element function	NO OR NC/NO switchable
Operational voltage range DC	The maximum permissible operating voltage must be ≥ 30 V
Relevant basic safety principles	Yes
Relevant well-tried safety principles	Yes

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

Note: These proximity sensors were selected as examples from different series and sizes.

No.	Material	★	Designation/Type (Sorting ↑)	Link Data Sheet	Link Data Sheet Product Reliability
1.	543863		Proximity sensor SME-8M-DS-24V-K-5,0-OE	↗	↗
2.	543872		Proximity sensor SME-8M-ZS-24V-K-2,5-OE	↗	↗

★ Core product range

4 Suitable Products for Valve Q1

4.1 Soft-Start/Quick Exhaust Valve

- Based on the following features, other suitable pressure 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.
- Additional information on these features can be found in the document [↗ 100396 Notes on features of directional control valves](#).

Feature	Value
Product category	Soft-Start/Quick Exhaust Valve
Valve function	3/2-way, closed, monostable, soft-start function
Type of actuation	Electric
Type of piloting	Pilot actuated
Type of reset	Mechanical spring
Duty cycle	100 %
Service-life value B ₁₀	Specified
Performance Level (PL)	PL c

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

Note: These soft-start and quick exhaust valves were selected as examples from different series and sizes.

No.	Material	Designation/Type (Sorting ↑)	Link Data Sheet	Link Data Sheet Product Reliability
1.	8001469	Soft-start / quick exhaust valve MS6-SV-1/2-C-10V24-S	↗	↗
2.	570737	Soft-start / quick exhaust valve MS9-SV-G-C-V24-S-VS	↗	↗

Note

- Soft-start and quick exhaust valves with category 3, PL d and category 4, PL e can also be used in the service unit if this is required in the application.

4.2 On-Off Valves

- Based on the following features, other suitable valves 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.
- Additional information on these features can be found in the document [↗ 100396 Notes on features of directional control valves.](#)

Feature	Value
Product category	On-off Valves
Valve function	3/2-way, closed, monostable
Type of actuation	Electric
Type of piloting	Pilot actuated
Type of reset	Mechanical spring
Duty cycle	100 %
Service-life value B ₁₀	Specified
Relevant basic safety principles	Yes
Relevant well-tried safety principles	Yes

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

Note: These on-off valves were selected as examples from different series and sizes.

No.	Material	★	Designation/Type (Sorting ↑)	Link Data Sheet	Link Data Sheet Product Reliability
1.	542602	★	On-off valve MS6-EE-1/2-10V24-S	↗	↗

★ Core product range

4.3 Single Valves

- Based on the following features, suitable valves from Festo can 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 extended.
- Additional information on these features can be found in the document [↗ 100396 Notes on features of directional control valves](#).

Feature	Value
Product category	Electrically actuated valves
Valve function	3/2 closed monostable
Type of actuation	Electric
Type of piloting	Pilot actuated
Pilot air supply	Internal or external
Type of reset	Mechanical spring
Duty cycle	100 % OR 100 % with holding current reduction
Service-life value B10	Specified
Relevant basic safety principles	Yes
Relevant well-tried safety principles	Yes

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

Note: These valves were selected as examples from different series and sizes.

No.	Material		Designation/Type (Sorting ↑)	Link Data Sheet	Link Data Sheet Product Reliability
			<i>Single valves</i>		
1.	574348		Solenoid valve VUVG-L10-T32C-MT-M5-1P3	↗	↗
2.	574352		Solenoid valve VUVG-L10-T32C-MZT-M5-1P3	↗	↗
3.	575274	★	Solenoid valve VUVS-L20-M32C-MD-G18-F7-1C1	↗	↗
4.	575273	★	Solenoid valve VUVS-L20-M32C-MZD-G18-F7-1C1	↗	↗

★ Core product range

5 Suitable Products for Valve Q2

- Based on the following features, suitable valves from Festo can 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 extended.
- Additional information on these features can be found in the document ➔ [100396 Notes on features of directional control valves](#).

Feature	Value
Product category	Electrically actuated valves
Valve function	5/2 bistable
Type of actuation	Electric
Type of piloting	pilot actuated
Pilot air supply	Internal or external
Duty cycle	100 % OR 100 % with holding current reduction
Service-life value B ₁₀	Specified
Relevant basic safety principles	Yes
Relevant well-tried safety principles	Yes
Fault exclusion	Spontaneous change of the initial switching position of the main stage without an input signal. The control signal at piloted valves consists of the electrical control signal for the valve magnet and the pneumatic signal (pilot air supply) of the pilot valve. Note If the fault exclusion is not specified in the Product Reliability Data Sheet, it can also be stated in the ➔ Technical Report TR-300004 .

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

Note: These valves were selected as examples from different series and sizes.

No.	Material	★	Designation/Type (Sorting ↑)	Code ¹	Link Data Sheet	Link Data Sheet Product Reliability
<i>Single valves</i>						
1.	547074		Solenoid valve VSVA-B-B52-ZH-A1-1C1		↗	↗
2.	566467		Solenoid valve VUVG-L10-B52-ZT-M5-1P3		↗	↗
3.	575683	★	Solenoid valve VUVS-L20-B52-ZD-G18-F7-1C1		↗	↗
<i>Valve for valve terminals</i>						
4.	533343		Solenoid valve VMPA1-M1H-J-PI	J	↗	↗
5.	8033042		Solenoid valve VSVA-B-B52-ZH-A1-1T1L	J	↗	↗
6.	573418		Solenoid valve VUVG-B10-B52-ZT-F-1T1L	J	↗	↗

★ Core product range

¹ Code of the valve for the configurator or in the order code of the valve terminal.

6 Used Literature

6.1 Cited Documents from Festo

- [1] 100393 Safe electrical switch-off of individually controlled valves
- [2] 100394 Safe electrical switch-off of valve terminals
- [3] 100395 Notes on Sistema project files
- [4] 100396 Notes on features of directional control valves
- [5] 100399 Recommendations for the implementation of measures against common cause failures (CCF)
- [6] 100405 Safety subfunctions pneumatics – PUS
- [7] TR-300004 – Festo AG & Co. KG bistable valves for safety-related applications

6.2 Standards

- [8] 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
- [9] ISO 5598:2020-01 – Fluid power systems and components - Vocabulary
- [10] 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
- [11] 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
- [12] 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
- [13] VDMA 24584:2022-06 - Sicherheitsfunktionen geregelter und nicht geregelter (fluid-) mechanischer Systeme.
- [14] DIN EN 61508:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508:2010); German version EN 61508:2010
- [15] 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
- [16] DIN EN 61511:2019-02 - Functional safety - Safety instrumented systems for the process industry sector - (IEC 61511:2016); German version EN 61511:2017
- [17] DIN EN IEC 62061:2023-02 - Sicherheit von Maschinen - Funktionale Sicherheit sicherheitsbezogener Steuerungssysteme (IEC 62061:2021); Deutsche Fassung EN IEC 62061:2021

6.3 Legal regulations

- [18] 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)
- [19] 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

7 Information about the Document

7.1 General Information

Document Number	100588
Safety Subfunction	PUS
Category	up to category 2 can be reached
PL	up to PL d can be reached

7.2 Revision History

Ver.	Date	Ed.	Chapter	Description of Change/Impact
1.10	2024-08-21	JKHL	All	Creation of the document
1.20	2026-07-24	JKHL	All	Update Layout
			5	Note to Technical Report 5 added
			6	Machinery Regulation (EU) 2023/1230 added

7.3 Approval/Release of the Document

Role	Signature
Release	

7.4 Period of Validity

Document is valid until 2031-07-24 or until one of the documents used or the required relevant base are changed.



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