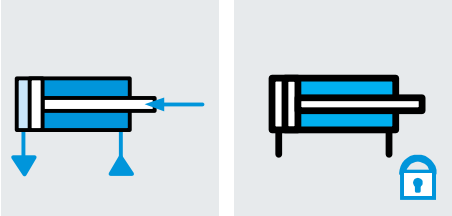
Application Note

Safety Sub-function
SDI Category 1, up to PL c
PUS Category 1, up to PL c



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This document is only suitable for persons with sufficient expertise for machine safety based on EN ISO 12100 and EN ISO 13849. In addition, the following qualifications are required in the project team:

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

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Table of Content

1 Example Circuits

- The circuits specified in this document are principle circuits which cannot be complete due to their clarity and scope.
- The abbreviations used for the safety sub-functions refer to the definitions in VDMA 24584 [1] for pneumatics:
    - SDI: Safe Direction
    - PUS: Prevention unexpected start-up
- Category and PL according EN ISO 13849-1 [2]
- The circuits and the procedure described are recommendations which do not exclude other possibilities.
- Due to the wide variety of possible 5/2 directional control valves, no valve type and part numbers can be given in this document. When selecting valves, make sure that the selected valves have the following characteristics:
    - Valve function: 5/2 monostable
    - Type of actuation: electrical
    - Type of reset: mechanical spring
    - Sealing principle: soft
    - Type of piloting: piloted
    - Pilot air supply: internal or external
    - Duty cycle: 100%.
    - Well-tried components according to EN ISO 13849-1 and the relevant basic and well-tried safety principles have been observed.
    - B10 value required for the calculation of the $MTTF_D$ value must be available.

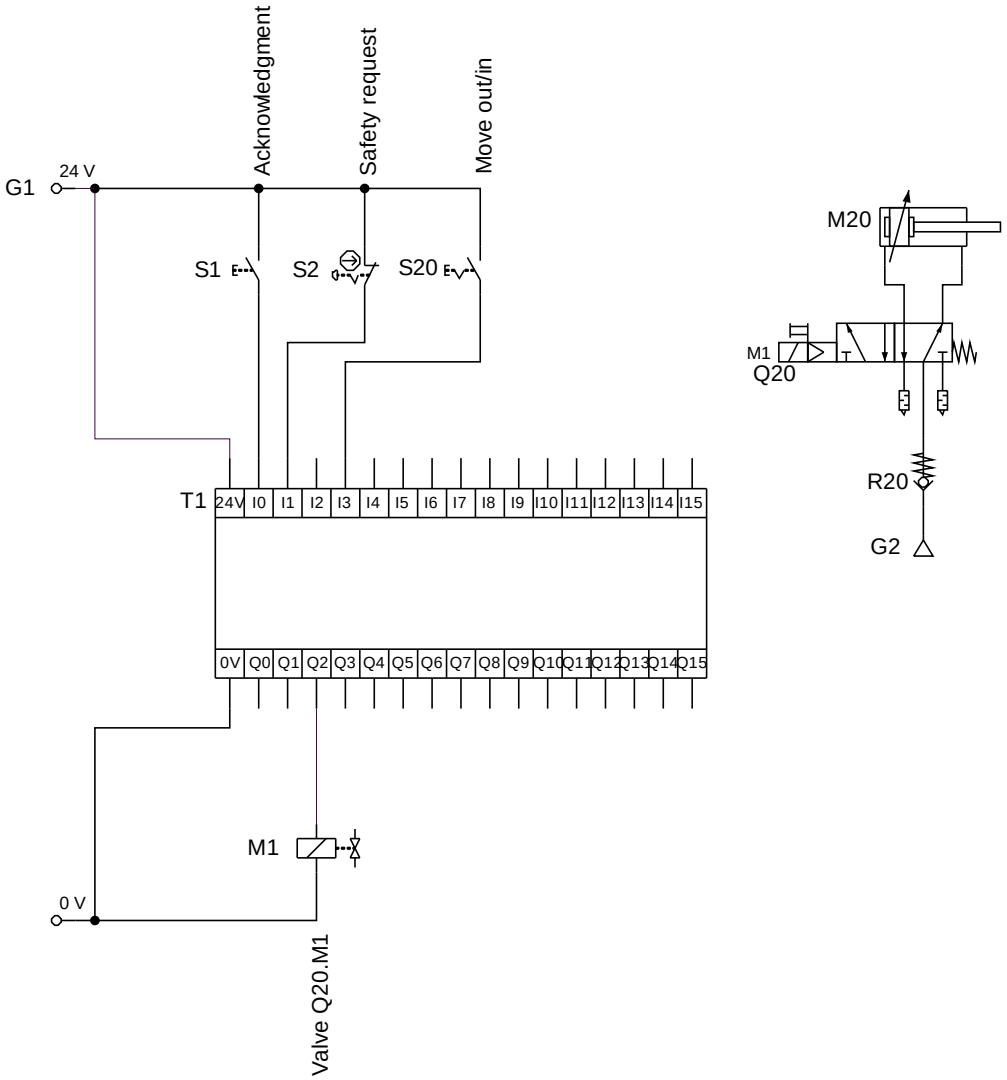
  Important note
    - In addition, further design features and requirements may exist, which must be determined depending on the application.

1.1 SDI at Stopping and PUS with 5/2 Directional Control Valve, Category 1, up to PL c

SDI and PUS according VDMA 24584 [1] and category 1, up to PL c according EN ISO 13849-1 [2].

1.1.1 Circuit Diagram

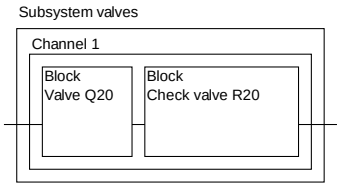
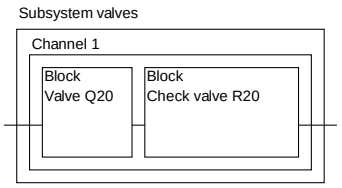
According to EN ISO 14118 enclosed pressurized air shall be marked and shall be provided with a possibility for manual pressure release.



1.1.2 Components

Component	Type	Description / Part Number / Remarks	Qty.	Mssr.
M20		Pneumatic drive	1	Festo
Q20		5/2 directional control valve, bistable	1	Festo
		Silencer, if necessary	2	Festo
R20	H-...-B; H-QS-...; HA-...-QS-...; HB-...-QS-...	Check valve	1	Festo
S1		Acknowledge push button	1	
S2		Safety commanding device, e.g. emergency stop switch	1	
S20		Switch functional control	1	
T1		Safety switching device	1	

1.1.3 Description

Application	Double acting pneumatic drive
Triggering event	Safety request, e.g. by emergency stop switch, safety gate
Reaction (Safety Sub-function)	**Safe Direction (SDI) at stopping, category 1, PL c**  **Prevention of unexpected start-up, category 1, PL c** 
Safe state	One chamber of the pneumatic drive is supplied with compressed air and the other chamber is exhausted. This can cause a movement in the direction in which there is no additional risk. The pneumatic drive will come to a standstill in the corresponding end position and will be kept in this end position. It is assumed that this may be a safe condition. The circuit diagram shows the safe direction of movement during stopping as retraction. This circuit must be checked for its applicability to the specific application and adapted if necessary. If the operating pressure supply (G2) is exhausted, actuating the valve (Q20) can cause the pneumatic drive (M20) to be exhausted. Notes: • The non-return valve (R20) is used to maintain the operating pressure when the compressed air supply is switched off or fails. After switching off or after failure of the operating pressure, a movement may occur due to the leakage which cannot be stopped. • The non-return valve (R20) is not necessary if there is no hazard after switching off or failure of the compressed air supply. • The use of a soft-start valve is recommended in order to be able to approach an end position in a controlled manner when the compressed air supply is switched on.
Function	The safety requirement (S2): 1. Interrupts the input circuit of the safety switching device (T1). 2. Switch off the safe outputs of the safety switching device (T1). 3. The solenoids of the valve (Q20) are no longer controlled. 4. The valve (Q20) switches to the normal position, exhausts one chamber and connects the compressed air supply to the other chamber of the pneumatic drive (M20). This controls the pneumatic drive (M20) in one direction and stops it in the end position.
Manual reset function	1. After resetting the safety request (S2), e.g. by mechanically unlocking the emergency stop switch or closing the safety guard, the start or restart can be made possible by pressing the acknowledge push button (S1). 2. The safety switching device (T1) can then allow the solenoid of the valve (Q20) to be controlled so that normal operation is possible.

1.1.4 Safety Considerations

Input	Safety considerations must be carried out in accordance with the selected safety commanding device (S2).
Logic	Safety considerations must be carried out in accordance with the selected safety switching device (T1).
Output	The valve (Q20, R20) are well-tried components according to EN ISO 13849-1 and the relevant basic and well-tried safety principles have been observed. B10 value required for the calculation of the $MTTF_D$ must be available.

2 Literature

[1] VDMA 24584:2016-08 - Safety functions of regulated and unregulated (fluid) mechanical systems (German edition)

[2] DIN EN ISO 13849-1:2016-06 - Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015); German version EN ISO 13849-1:2015