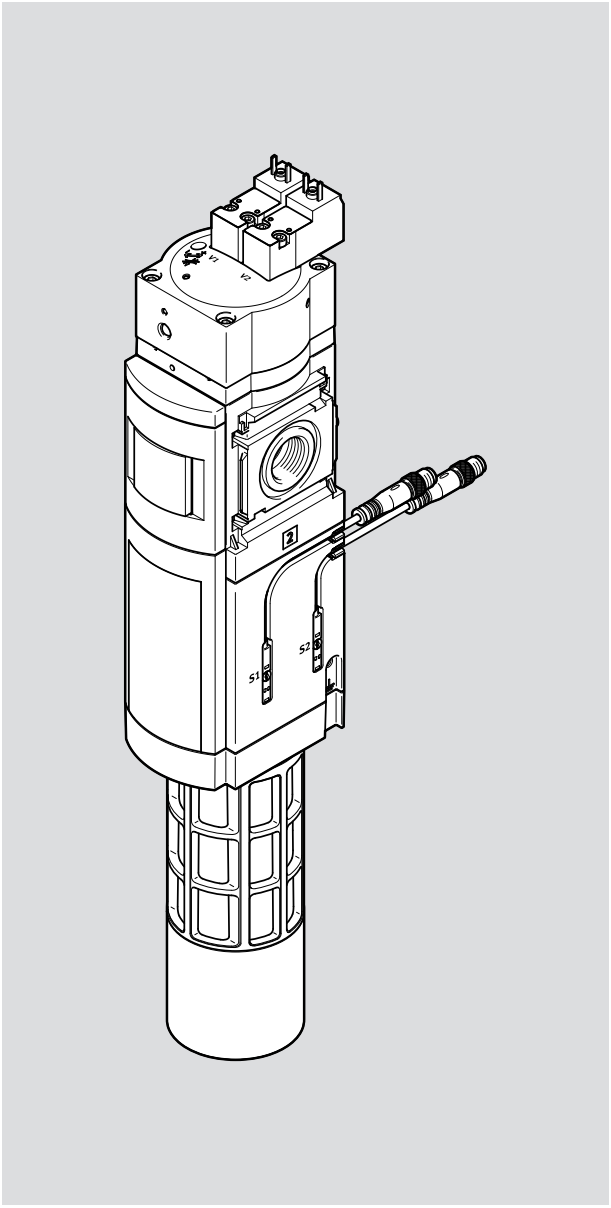
MS6-SV-...-D-10V24

Soft-start/quick exhaust valve



FESTO

Operating instructions

8164008

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2022-06c
[8164010]

Translation of the original instructions

Table of contents

1 About this document

This document describes the use of the soft start/quick exhaust valve.
The document contains additional information for use of the product in safety-related systems (safety handbook in accordance with IEC 61508).

1.1 Applicable documents

All available documents for the product ➔ www.festo.com/sp.

1.2 Target group

The document is targeted towards individuals who mount and operate the product. It is additionally targeted towards individuals who are entrusted with the planning and application of the product in a safety-oriented system.

1.3 Specified standards

Version	
EN ISO 4414:2010-11	EN ISO 13849-2:2012-10
EN ISO 13849-1:2015-12	EN ISO 14118:2018-02

Tab. 1: Standards specified in the document

2 Safety

2.1 Safety instructions

- Only use the product in its original condition without unauthorised modifications.
- Only use the product if it is in perfect technical condition.
- Observe the identifications on the product.
- Take into account the ambient conditions at the location of use.
- Before working on the product, switch off the power supply and secure it against being switched on again.
- Observe the tightening torques. Unless otherwise specified, the tolerance is ± 20%.
- Only use compressed air as an operating medium in accordance with the specification ➔ 12 Technical data.

2.2 Intended use

The product is intended solely for fast and safe venting and for slow pressurisation of pneumatic piping systems and terminals in industry.
The product is intended for installation in machines or automation systems and must be used exclusively as follows:
- in an industrial environment
- within the limits of the product defined by the technical data ➔ 12 Technical data.
- in its original condition, without unauthorised modifications
- in perfect technical condition
- in standard operation, which includes standstill, set-up and service operation, as well as emergency operation

2.3 Foreseeable misuse

The following are examples of foreseeable misuse and are not approved as intended use:
- outdoor operation
- use as a press safety valve
- bypass of safety function
- use in reversible operation with reversal of supply air and exhaust air
- vacuum operation

2.4 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have skills and experience in dealing with electropneumatic (open-loop) control technology.

3 Additional information

- Contact the regional Festo contact if you have technical problems ➔ www.festo.com.
- Accessories and spare parts ➔ www.festo.com/catalogue.

4 Product overview

4.1 Product design

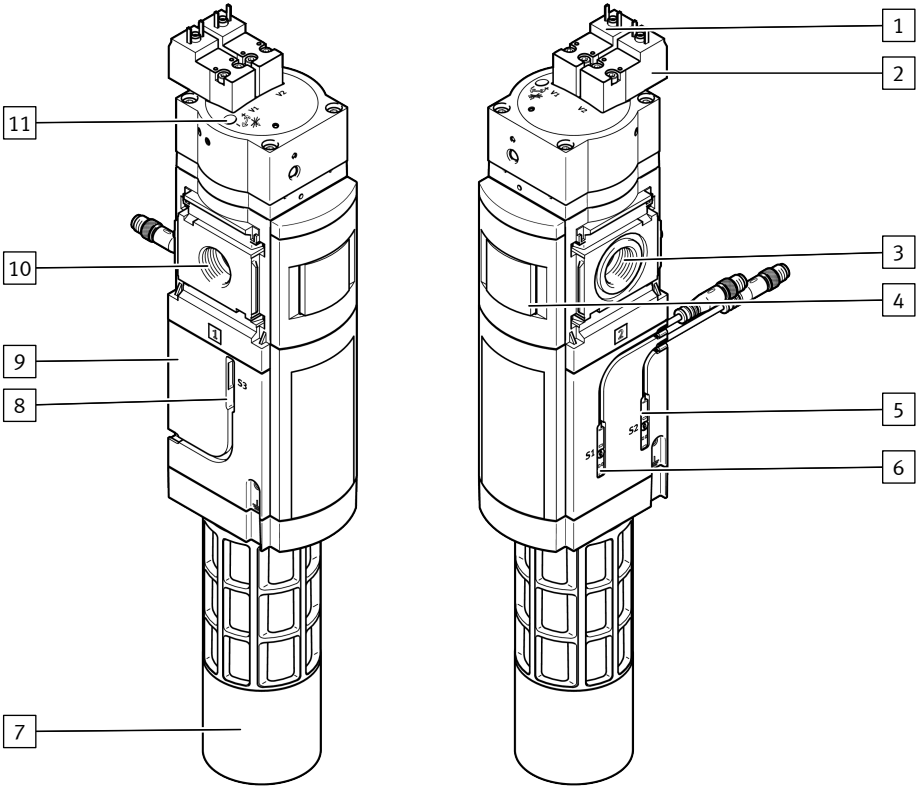


Fig. 1: Operating elements and connections

1 Coil connection pilot valve V1

2 Coil connection pilot valve V2

3 Pneumatic port 2 (output pressure p2)

4 Pressure indicator (optional)

5 Proximity switch S2

6 Proximity switch S1

7 Silencer mounted at pneumatic port 3

8 Slot for proximity switch S3

9 Valve body

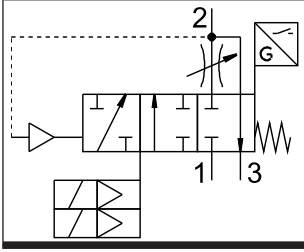
10 Pneumatic port 1 (operating pressure p1)

11 Flow control screw for soft-start function

4.2 Function

The product changes from the normal position to the switching position when both coils are energised simultaneously. The normal position is achieved by switching off both coils.

The product has two safety functions:
– Pressure release
– Protection from unexpected start-up (non-switching)
The product has queries from proximity switches, which are intended for diagnostics of the internal valves. Performance level d/e in category 3 can be achieved by using proximity switches S1 and S2. Performance level e in category 4 can be achieved by using an additional proximity switch S3.

Circuit symbol	Function
	Soft-start/quick exhaust valve, electrically actuated.

Tab. 2: Circuit symbol for the function

Designations

Port	Identifier	Functional principle	Position
Port 1 (operating pressure p1)	1	Pneumatic	➔ 4.1 Product design.
Port 2 (output pressure p2)	2		
Port 3 (exhaust p3)	3		
Coil connection pilot valve V1	V1	Electric	
Coil connection pilot valve V2	V2		
Proximity switch S1	S1	Magnetic	
Proximity switch S2	S2		
Proximity switch S3[1)]	S3		
Flow control valve	DR	Mechanical system	

1) Optional.
Tab. 3: Interfaces

Switching logic
In the normal position (completely exhausted product), the pilot valves V1 and V2 are not actuated. If both pilot valves are actuated, the product switches first to the switching position 1 and then, when the switch-through pressure is reached, automatically into switching position 2 ➔ Fig. 2.

V1	V2	S1	S2	S3	MS6-SV-...-D
Voltage [V]		Switching position			Status
0	0	1	1	1	Normal position Port 1 blocked, passage from port 2 to 3 opened.
24	0	0	1	1	Normal position, optional testing condition ➔ Tab. 6 Recommendation for actuation and diagnostics. Port 1 blocked, passage from port 2 to 3 opened.
0	24	1	0	1	Normal position, optional testing condition ➔ Tab. 6 Recommendation for actuation and diagnostics. Reduced flow rate via flow control valve from port 1 to 2, passage from port 2 to 3 opened.
24	24	0	0	1	Switching position 1. Reduced flow rate over flow control valve from port 1 to 2, passage from port 2 to 3 blocked.
24	24	0	0	0	Switching position 2. Full flow rate from port 1 to 2, passage from port 2 to 3 closed.

Tab. 4: Switching logic

Switching characteristics

Switching behaviour of the product's internal valves. The normally exhausted position is sensed by the proximity switch. Switching logic ➔ Tab. 4 Switching logic.

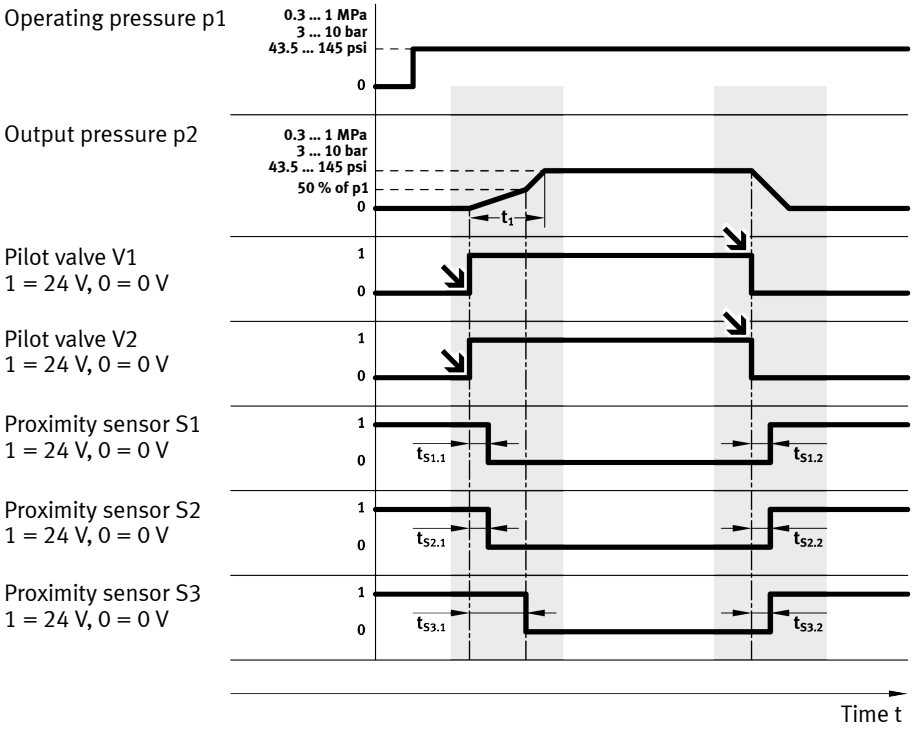


Fig. 2: Input and output switching behaviour in normal status

Proximity switch reaction times[1)]			
Switching on		Switching off	
t_1	Depending on p1, flow control valve setting and system volume at p2.		
$t_{S1.1}$	Maximum of 4 s after signal at V1.	$t_{S1.2}$	Maximum of 4 s after signal drop at V1.
$t_{S2.1}$	Maximum of 4 s after signal at V2.	$t_{S2.2}$	Maximum of 4 s after signal drop at V2.
$t_{S3.1}$	After signal at V1 and V2. Depending on p1, flow control valve setting and system volume at p2.	$t_{S3.2}$	Maximum of 5 s after signal drop at V1 and V2. Depending on system volume at p2.

1) After the reaction time, the signals are applied statically. The maximum specified reaction times must be considered in the diagnostics. These reaction times are normally shorter.

Tab. 5: Proximity switch reaction times

Switch-through pressure

There is a flow control screw in the cover of the product. The flow control screw can be used to generate a gradual pressure build-up of output pressure p2 ➔ 12.5 Filling flow.

The flow rate and thus the pressure rise can be adjusted by turning the flow control screw. When output pressure p2 reaches about 50% of operating pressure p1, the maximum flow rate performance is enabled.

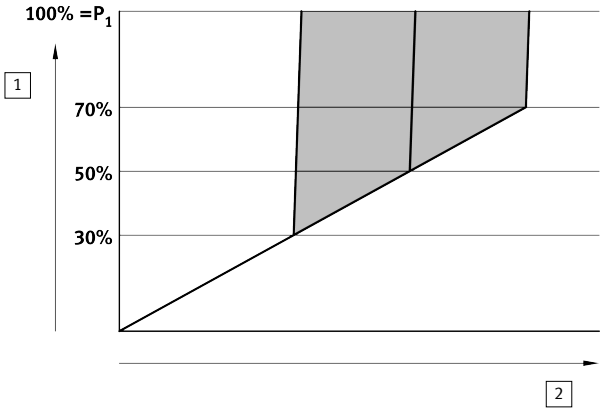


Fig. 3: Switch-through pressure tolerance field

1 Ratio of p2 to p1 [%]

2 Filling time t

Actuation and diagnostics

If the results of actuation and the sensor signals S1, S2 and S3 are not plausible, carry out the following measures:

1. Switch off voltage to pilot valves V1 and V2.
2. Output error message.
3. Prevent new switching.

Sequence	Activity	Status and status transitions
Diagnostics at each switching operation		
1.	Apply voltage to pilot valves V1 and V2.	V1 = 1; V2 = 1
2.	Record edge change at proximity switches S1 and S2.	S1 = 1 → 0; S2 = 1 → 0
Optional, when using a third proximity switch S3		
3.	Record edge change at proximity switch S3.	S3 = 1 → 0
Corresponding reaction times ➔ Fig. 2.		

Sequence	Activity	Status and status transitions
Diagnostics at every reset to the normal position		
1.	Switch off voltage to pilot valves V1 and V2.	V1 = 0; V2 = 0
2.	Record edge change at proximity switches S1 and S2.	S1 = 0 → 1; S2 = 0 → 1
Optional, when using a third proximity switch S3		
3.	Record edge change at proximity switch S3.	S3 = 0 → 1
Corresponding reaction times ➔ Fig. 2.		
Diagnostics in normal position		
Pay attention to forced switch on/off ➔ 12.1 Safety data.		
1.	Apply voltage to pilot valve V1.	V1 = 1
2.	Record edge change at proximity switch S1.	S1 = 1 → 0
3.	Switch off voltage to pilot valve V1.	V1 = 0
4.	Record edge change at proximity switch S1.	S1 = 0 → 1
5.	Apply voltage to pilot valve V2.	V2 = 1
6.	Record edge change at proximity switch S2.	S2 = 1 → 0
7.	Switch off voltage to pilot valve V2.	V2 = 0
8.	Record edge change at proximity switch S2.	S2 = 0 → 1
Corresponding reaction times ➔ Fig. 2.		

Tab. 6: Recommendation for actuation and diagnostics

4.3 Information on functional safety

4.3.1 Safety function in accordance with EN ISO 13849

The product achieves a performance level for the following safety functions:
- safe venting
- Protection against unexpected start-up (pressurisation) after EN ISO 14118

NOTICE

Loss of the safety function

Common cause failures (CCF) cause the failure of the safety function, since in this case both channels in a two-channel system fail simultaneously.
If measures to control the CCFs are not observed, the safety function of the soft-start/quick exhaust valve can be impaired.
- Make sure that the described measures are observed ➔ Failures due to a common cause (Common Cause Failure – CCF).
  ➔ 12.1 Safety data

NOTICE

Loss of the safety function

Non-compliance with the technical data can lead to loss of the safety function.
- Observe the technical data ➔ 12 Technical data.

Failures due to a common cause (Common Cause Failure – CCF)

To achieve the desired performance level, the applicable measures against CCF must be implemented in accordance with the specifications of EN ISO 13849-2.

PFH_d value

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The PFH_d value depends on the model of the product and the annual actuation rate (n_{op}).

PFH_d value MS6-SV-...-D

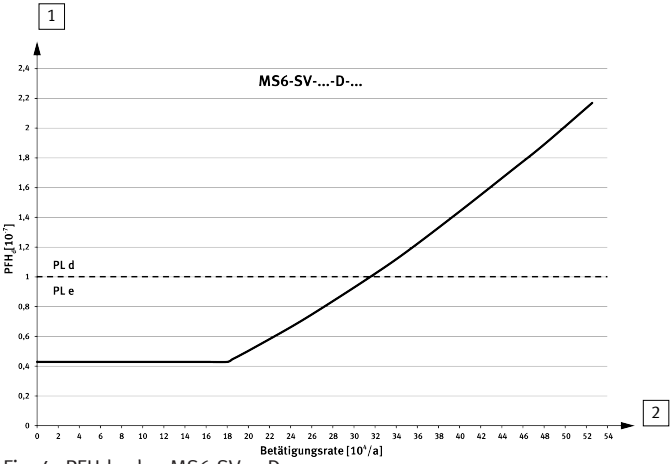

Fig. 4: PFHd value MS6-SV-...-D

1 PFHd [10 -7]

2 Actuation rate (nop) [10 4/a]

PFH_d value MS6-SV-...-D-S3

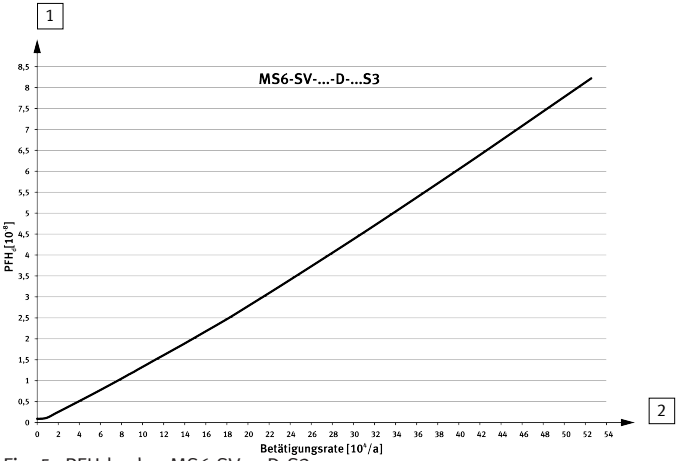

Fig. 5: PFHd value MS6-SV-...-D-S3

1 PFHd [10 -8]

2 Actuation rate (nop) [10 4/a]

5 Assembly

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Information about mounting the module connector, connecting plate and mounting bracket can be found in the instruction manual enclosed with the relevant accessories.

5.1 Mounting clearances

NOTICE

Loss of the safety function

Failure to comply with the minimum distance of 15 mm between the silencer and base can result in the loss of the safety function.

- Observe the minimum distance of 15 mm below the silencer ➔ Fig. 6.
  The free space ensures the exhaust can escape.

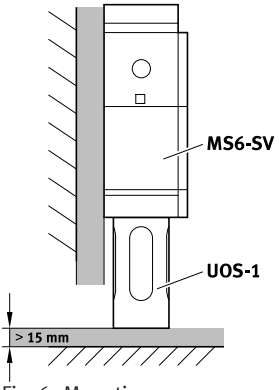

Fig. 6: Mounting

5.2 Preparation

- Observe the flow direction from port 1 to port 2. Numbers 1 and 2 on the housing ➔ Fig. 7 are provided for orientation.

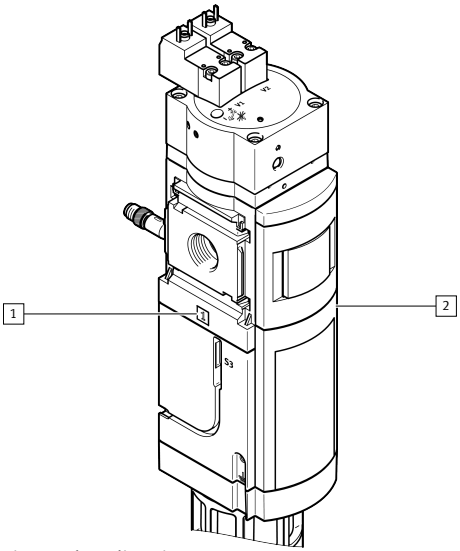

Fig. 7: Flow direction

5.3 Assembly with MS-series service unit components

⚠ WARNING

Loss of the safety function

If devices that impair the exhaust are placed behind the pneumatic connection 2 of the soft start/quick exhaust valve, this can result in loss of the safety function.

- Only place devices that do not impair the exhaust downstream of pneumatic connection 2.

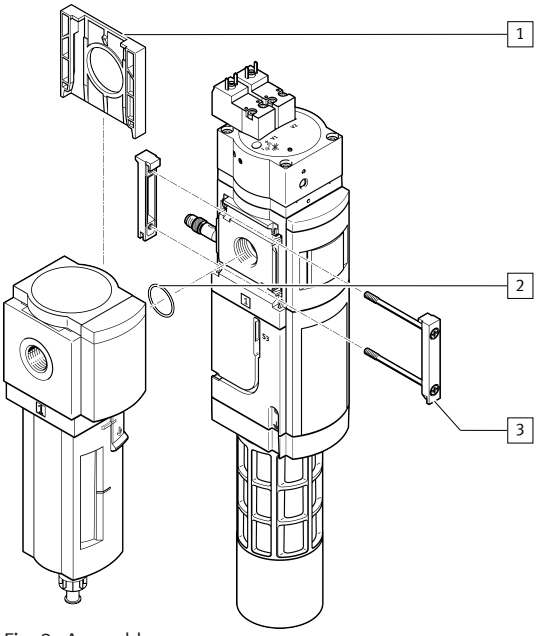

Fig. 8: Assembly

1. Slide the cover cap MS6-END [1] upwards and remove it.
2. Insert a seal [2] between the separate devices (module connector in scope of delivery).
3. Place the module connector [2] in the slots of the separate devices.
4. Fasten the module connector with two screws (module connector in scope of delivery).
   Tightening torque: maximum 1.2 Nm

6 Installation

6.1 Safety

⚠ WARNING

Risk of injury from compressed air.

- Before carrying out installation and maintenance work, switch off the compressed air supply.

6.2 Pneumatic installation

Port 1 and 2

If using screw connectors:

1. Note the screw-in depth of the connector thread: 10 mm.
2. Make sure that the compressed air lines are connected correctly.
3. Screw the fittings into the pneumatic ports using a suitable sealing material.

Port 3

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Exhausting a system using the product results in high noise levels.

- Recommendation: use silencer ➔ www.festo.com/catalogue.

1. Screw the silencer into pneumatic port 3.
2. Make sure that the exhaust is unrestricted. Neither the silencer nor port 3 may be blocked.

6.3 Electrical installation

⚠ WARNING

Risk of injury due to electric shock.

- For the electrical power supply with extra-low voltages, use only PELV circuits that guarantee a reinforced isolation from the mains network.
- Observe IEC 60204-1/EN 60204-1.

Connecting the product

- Connect pilot valves and proximity switches.

Example of circuits

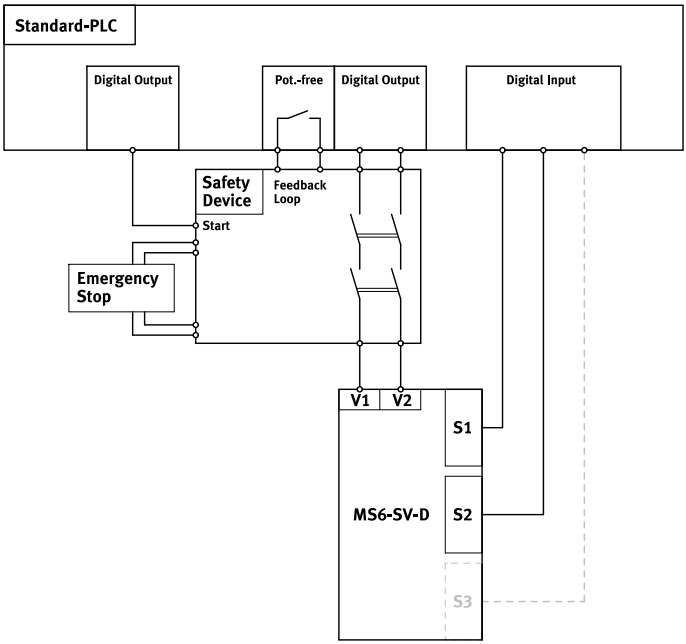

Fig. 9: Example of circuits

Designations	
S1	Proximity switch S1
S2	Proximity switch S2
S3	Proximity switch S3
V1	Pilot valve 1
V2	Pilot valve 2
Pot.-free	Potential-free contact
Emergency Stop	Emergency stop (input circuit)
Feedback Loop	Feedback circuit
Safety Device	Safety relay unit or safety PLC
Digital Output	Digital output
Digital Input	Digital input
Standard PLC	Programmable logic controller

Tab. 7: Designations in circuit examples

7 Commissioning

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The product does not have its own control logic and must therefore be integrated into the control system through appropriate measures.

Graphic representation of the switching behaviour ➔ Fig. 2.
Proceed as follows to commission the product:

- Apply operating pressure p1.
  - The product is now ready for operation and can be actuated.
    The filling speed of the pneumatic system can be adjusted with the flow control valve ➔ Fig. 1.

8 Operation

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Perform a forced switch-off at least once a month if the process-related switching frequency is lower.

9 Maintenance

9.1 Maintenance work

A dirty silencer can extend the time needed for exhausting the system and thus restrict the safety function.

- Check the silencer regularly and replace if necessary.

9.2 Cleaning

1. Switch off energy sources:
   - Operating voltage
   - Compressed air
2. If necessary, clean the product on the outside. Soap suds (max. +50 °C), petroleum ether and all non-abrasive cleaning agents may be used.

10 Malfunctions

10.1 Fault clearance

- Check compressed air supply
- Check power supply
- Check installation of the signal lines
- Start device ➔ 7 Commissioning.
- Implement possible remedies ➔ Tab. 8 Fault clearance.
- If the fault occurs again: contact Festo service ➔ www.festo.com.

Malfunction	Possible cause	Remedy
Product does not switch	Power supply is insufficient	– provide sufficient power supply.
	Pressure supply interrupted	– Restore compressed air supply.
	Malfunction due to electrical or electromagnetic effects (EMC measures not in compliance).	– note maximum length of the signal lines. – Run the control and power lines separately. – use screened cables. – Provide low-impedance paths to earth.
Pressure p1 collapses briefly at every switching operation	The cross-section of the MS6-SV-...-D pressure supply is too small.	– Tighten flow control screw a little. – Attach reservoir in front of input p1. – Modify the compressed air supply, e.g. increase cross-section of the power supply cable.

Tab. 8: Fault clearance

11 Dismantling

1. Switch off the energy sources
   - Operating voltage
   - Compressed air
2. Disconnect the applicable connections from the product.

12 Technical data

12.1 Safety data

Safety characteristics	MS6-SV-...-D
Safety function	Safe venting and protection against unexpected pressurisation
Service-life value B_{10}	0.9 mill. switching cycles
Service life [years]	20
Achievable performance level (PL) in accordance with EN ISO 13849-1	
With sensing of S1 and S2	Category 3, PL d or category 3, PL e[1)]
With sensing of S1, S2 and S3	Category 4, PL e
Probability of dangerous failure per hour	
PFH_d value MS6-SV-...-D	➔ Fig. 4.
PFH_d value MS6-SV-...-D-S3	➔ Fig. 5.
CCF measures	Relevant requirements EN ISO 13849-2 ➔ Failures due to a common cause (Common Cause Failure – CCF).
Note on forced checking procedure	Switching frequency min. 1/month

1) Depending on the average number of actuations per year (nop).

Tab. 9: Safety data

MS6-SV-...-D	
Certificates, declaration of conformity	➔ www.festo.com/sp

Tab. 10: Product conformity

12.2 Technical data, mechanical

MS6-SV-...-D	
Type of mounting	In-line installation With accessories
Design	Piston seat has no underlap
Position sensing principle	Piston magnet principle
Reset method	Mechanical spring
Mounting position	Any
Sound pressure level [dB(A)]	75 with silencer UOS-1
Environmental conditions	
Shock resistance	Shock test with severity level 2 in accordance with FN 942017-5 and EN 60068-2-27
Vibration resistance	Transport application test with severity level 2 in accordance with FN 942017-4 and EN 60068-2-6
Degree of protection	
Degree of protection	IP65 (fully mounted and connected)
Protection class	III
Materials	
Housing	Die-cast aluminium
Seal	NBR

Tab. 11: Technical data, mechanical

Type of severity level (SL)					
Vibration load					
Frequency range [Hz]		Acceleration [m/s²]		Deflection [mm]	
SL1	SL2	SL1	SG2	SL1	SL2
2 … 8	2 … 8	–	–	±3.5	±3.5
8 … 27	8 … 27	10	10	–	–
27 … 58	27 … 60	–	–	±0.15	±0.35
58 … 160	60 … 160	20	50	–	–
160 … 200	160 … 200	10	10	–	–
Shock load					
Acceleration [m/s²]		Duration [ms]		Shocks per direction	
SL1	SL2	SL1	SL2	SL1	SL2
±150	±300	11	11	5	5

Type of severity level (SL)		
Continuous shock load		
Acceleration [m/s²]	Duration [ms]	Shocks per direction
±150	6	1000

Tab. 12: Type of severity level (SL)

12.3 Technical data, pneumatic

MS6-SV-...-D		
Pneumatic port 1, 2		G 1/2
Pneumatic port 3		G 1
Pilot air supply		Internal
Exhaust function		Cannot be throttled
Manual override		None
Type of control		Pilot-controlled
Valve function		3/2-way valve, single solenoid, closed Soft-start function
Medium		
Operating medium		Compressed air to ISO 8573-1:2010 [7:4:4] and inert gases
Note		Lubricated operation possible, in which case lubricated operation will always be required
Temperature		
Medium	[°C]	–10 ... +50
Environment	[°C]	–10 ... +50
Bearing	[°C]	–10 ... +50
Operating pressure		
Operating pressure	[MPa]	0.35 ... 1
	[bar]	3.5 ... 10
	[psi]	50.75 ... 145
Residual pressure in normal operation	[MPa] [bar] [psi]	0 (no residual pressure)
Residual pressure in the event of error	[MPa]	≤ 0.04; at p1 = 1 MPa and flow control valve fully open
	[bar]	≤ 0.4; at p1 = 10 bar and flow control valve fully open

MS6-SV-...-D		
	[psi]	≤ 5.8; at p1 = 145 psi and flow control valve fully open
Characteristic flow rate values		
Standard nominal flow rate 1 ⟶ 2	[l/min]	4300; at p1 = 0.6 MPa and p2 = 5 bar (at p1 = 6 bar and p2 = 5 bar, at p1 = 87 psi and p2 = 72.5 psi)
Standard flow rate 2 ⟶ 3	[l/min]	9000; at p1 = 0.6 MPa (p1 = 6 bar, p1 = 87 psi)
Standard flow rate 2 ⟶ 3 in the event of a critical fault	[l/min]	≥ 6000; at p1 = 0.6 MPa (at p1 = 6 bar, at p1 = 87 psi)
Switch-through point		Approx. 50% of p1
Filling flow		Adjustable by flow control valve
minimum pause time after exhaust	[s]	≥ 1

Tab. 13: Technical data, pneumatic

12.4 Technical data, electrical

MS6-SV-...-D	
Actuation type	Electric
Protection against electric shock (protection against direct and indirect contact to EN/IEC 60204-1)	By PELV fixed power supply
Pilot valves	
Nominal operating voltage DC [V]	24
permissible voltage fluctuations [%]	±10
Duty cycle [%]	100
Nominal power per solenoid coil [W]	1.8 (at 24 V DC)
Proximity switch SMT-8M-A-PS-24V-E	
Nominal operating voltage [V]	24
permissible voltage fluctuations [%]	±10
Switching element function	N/O contact
Measurement principle	Magneto-resistive
Switching status display	LED
Switching output	PNP

Tab. 14: Technical data, electrical

12.5 Filling flow

Throttle flow rate qn, as a function of the number of revolutions n of the flow control screw

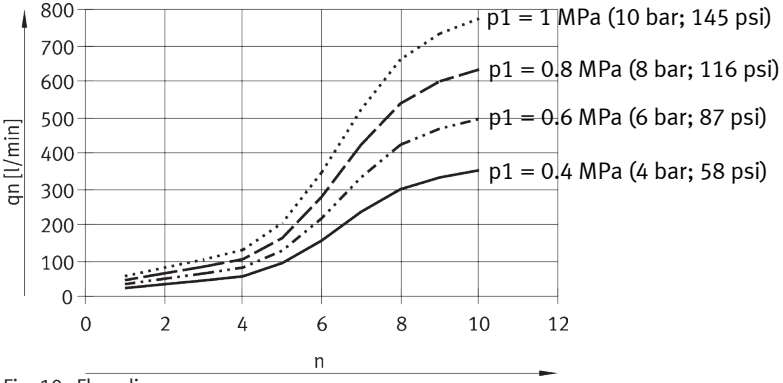

Fig. 10: Flow diagram

12.6 Exhaust time

The following table shows the exhaust time in normal operation (N) and in the event of a fault (F) for different volumes and operating pressures.

NOTICE

In the case of a fault (F) the worst possible fault in the valve's interior is assumed (worst case).

Normal operation (N) Fault F			**Exhaust time [s]**					
Operating pressure	[MPa]		0.35		0.6		1	
	[bar]		3.5		6		10	
	[psi]		50.75		87		145	
Exhaust to	[MPa]		0.1	0.05	0.1	0.05	0.1	0.05
	[bar]		1.0	0.5	1.0	0.5	1.0	0.5
	[psi]		14.5	7.25	14.5	7.25	14.5	7.25
Volume [l]	2	N	0.1	0.2	0.24	0.3	0.3	0.4
		(F)	(0.16)	(0.22)	(0.28)	(0.35)	(0.36)	(0.52)
	10	N	0.3	0.45	0.55	0.7	0.7	0.9
		(F)	(0.4)	(0.6)	(0.8)	(1.1)	(1.2)	(1.9)
	20	N	0.5	0.85	1.0	1.3	1.4	1.7
		(F)	(0.8)	(1.25)	(1.5)	(2.2)	(2.4)	(3.9)
	40	N	1.2	1.9	2.2	3.0	3.0	3.9
		(F)	(1.7)	(2.8)	(3.4)	(5.3)	(5.1)	(8.1)
	150	N	3.2	5.0	6.0	8.2	11.0	12.8
		(F)	(4.8)	(8.2)	(9.8)	(15.4)	(16.2)	(29.0)

Tab. 15: Exhaust time

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