

2- and 3-way flow control valves type SF, SD, SK, SKR, SU

Pressure p_{max} = 315 bar
 Flow Q_{max} = 130 lpm

3-way flow control valve for threaded connection



Set-screw



Roller adjustment



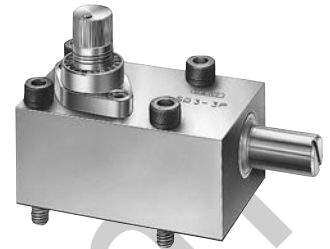
Rotary knob adjustment

2-way flow control valve for threaded connection



Adjustment as shown opposite left

2- and 3-way flow control valve, for manifold mounting



Adjustment as shown in outside left picture

1. General

The type S flow control valves are flow valves (DIN ISO 1219-1) and serve for infinite adjustment of the flow into oil-hydraulic, hydrostatic system. Once set, the flow rate is constantly maintained at a tolerance of approx. $\pm 3\%$, regardless of the pressure within the system and the viscosity of the hydraulic fluid.

It is possible to select electrically between two different flow rates with type SU (see sect. 3.3).

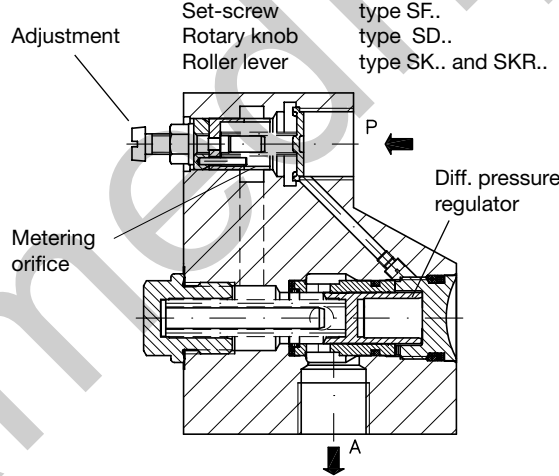
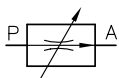
2. Overview

Typical configuration - System functions

Design

Schematic diagram

2-way flow control valve (flow control in serial arrangement, secondary pressure)

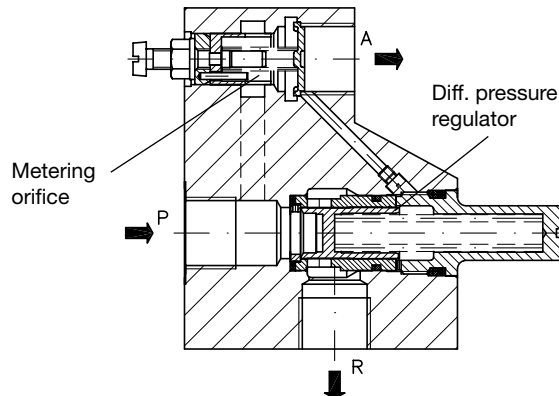
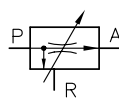


Design and configuration:

Secondary flow control, meaning that the differential pressure regulator (pressure balance) is fitted downstream of the metering orifice to provide a good dynamic damping. A 2-way flow control valve will operate only in conjunction with a pressure relief valve on feed side P, and may therefore be used for both feed and drain control. Observe notes in sect. 3.1 and 6.1!

Versions with by-pass check valve for unhindered return flow or check valve rectifier circuit (enabling flow control for both flow directions) are also available.

3-way flow control valve (flow control valve in parallel)



Design and configuration:

The differential pressure regulator (pressure balance) and metering orifice are arranged in parallel. Contrary to the 2-way flow control valve, the flow is separated in the consumer flow ($\rightarrow A$) and residual flow ($\rightarrow R$), i.e. the 3-way valve can be used for controlling the feed flow only.

The valve acts against the momentary consumer counter-pressure. Additional control functions for pressure limitation or idle circulation may be integrated via directly mounted piloting valves or remote control via control port Z.

3. Types available, main data

3.1 2-way flow control valve

Order examples:

SD 2 - 3/15 R

SF 2 - 4/90 P

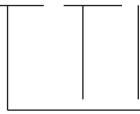


Table 1: Basic type and actuation

Set-screw	Rotary knob adjustment	Roller adjustment	
SF 2	SD 2	Non-shielded version	Shielded version
with lock nut for fixed setting	with fine setting by 3.8 rotations	with mechanical operation via cam	
	Marking rings for counting the number of rotations		

Table 2: Size and flow

Size	Nominal flow deenergized open ²⁾										Ports P and A Pipe connection ISO 228/1 (BSPP) Manifold mounting		
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130			
	Nominal flow deenergized blocked ²⁾												
	-	/6F	/15F	/30F	/36F	/50F							
Adjustment range $Q_{A \text{ min}} \dots Q_{A \text{ max}}$ (lpm)													
		0.3 to 6	0.3 to 15	0.3 to 30	0.3 to 36	0.3 to 50 ³⁾	0.3 to 60 ³⁾	0.3 to 70	0.3 to 90	1 to 130			
3	•	•	•	•	•	•	•					G 1/2	See dimensional drawing in sect. 5.2
4								•	•			G 3/4	
5										•		G 1	

Table 3: Connection pattern, symbols and auxiliary valves

Type of connection	Basic version		With auxiliary valve	
			Bypass check valve for free reflow A → P	Check valve rectifier circuit (only for pipe connection), flow control in both directions, see also footnote ³⁾ above
Pipe connection	(no coding)		R	B
Manifold mounting	P		PR	

- 1) Suited for out door use, but not available for manifold mounting valves.
- 2) To ensure optimum control, the flow at port P must always exceed the consumer flow in operation in order to build up an internal control pressure drop for activating the pressure balance.
- 3) When used with auxiliary valve B, the flow range is 0.3 to 40 lpm
- 4) Actuation symbol is omitted with type SF 2

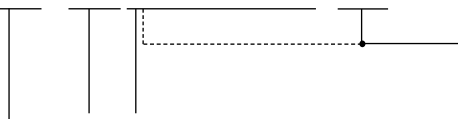
3.2 3-way flow control valve

Order examples:

SF 3 - 3/15 P

SD 3 - 4/70 S - 100

SD 3 - 3/15 S - WN1F - G12 - 120



Pressure specification in bar, max. 315
(only in connection with auxiliary valve, coding S)

Table 4: Basic type and actuation

Set screw	Rotary knob adjustment	Roller adjustment	
SF 3	SD 3	Non-shielded version	Shielded version
with lock nut for fixed setting 	with fine setting by 3.8 rotations Marking rings for counting the number of rotations 	with mechanical operation via cam 	

Table 5: Size and flow

Size	Nominal flow deenergized open ²⁾										Ports P and A		
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130	Pipe connection ISO 228/1 (BSPP)	Manifold mounting	
	Nominal flow deenergized blocked ²⁾												
	-	/6F	/15F	/30F	/36F	50F							
Adjustment range $Q_{A \text{ min}} \dots Q_{A \text{ max}}$ (lpm)													
		0.3 to 6	0.3 to 15	0.3 to 30	0.3 to 36	0.3 to 50	0.3 to 60	0.3 to 70	0.3 to 90	1 to 130	P, R, A	Z ³⁾	P, R, A Z ³⁾
3	●	●	●	●	●	●	●				G 1/2	G 1/4	See dimensional drawing in sect. 5.3
4								●	●		G 3/4	G 1/4	
5										●	G 1	G 1/4	

Table 6: Connection pattern, flow pattern symbols and auxiliary valves

Type of connection	Basic version	With auxiliary valve		Nominal voltage U_N	
		Pressure limiting valve	Pressure limiting valve with directly mounted 2-way direct. seated valve acc. to D 7470 A/1		
Pipe connection	(no coding) 	S 	S-WN 1 F-... S-WN 1 D-... Circulation setting (circulation pressure 6...10 bar) S-WN 1 F S-WN 1 D 	G 12	12V DC
				G 24	24V DC
				WG 110	110V AC 50 / 60 Hz
				WG 230	230V AC 50 / 60 Hz
		See sect. 4.2 for main electrical data! For further data, see D 7470 A/1.			
Manifold mounting	P 				

- 1) Suited for out-door use, but not available for manifold mounting valves.
- 2) To ensure optimum control, the flow at port P must always exceed the consumer flow in operation in order to built up an internal control pressure drop for activating the pressure balance.

³⁾ Z = Control port with type S.3-3(4.5)/...S... and ...-3(4.5)/...P(PS)
It is used when an arbitrary idle pump circulation P→R is intended via an externally connected 2/2-way directional valve e.g. type WN1D(F)-1/4-.. acc. to D 7470 A/1 (see symbols above)

⁴⁾ Actuation symbol is omitted with type SF 2

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3.3 2- and 3-way flow control valve type SU

Flow control valve where two constant flow rates can be selected electrically.

These flow control valves feature an additional solenoid as actuation, contrary to the versions specified in sect. 3.1 and 3.2. This way, plus a corresponding metering orifice, two different (constant) flow rates can be remotely activated by energizing or deenergizing the solenoid. This can be employed for e.g. creeping or rapid traverse. It also may make prop. flow control valves (e.g. type SE or SEH acc. to D 7557/1) and respective prop. amplifiers superfluous.

With some types (e.g. SU 2-3-0/40-G24) it is even possible to block the connection to the consumer ($Q_A = 0$) when required.

Order examples:

SU 2-3 - 4/ 16 - G 24

SU 3-3 - 25/10 S - WG 230 - 100



Pressure specification in bar, max. 315
(only in connection with auxiliary valve, coding **S**)

Table 7: Basic type with actuation (only size 3!)

Coding	Design	Only tapped ports for direct pipe connection ISO 228/1 (BSP) P, R, A Z 1)	
SU 2-3	2-way flow control valve	G 1/2	---
SU 3-3	3-way flow control valve	G 1/2	G 1/4

Table 8: Flow (= Effective consumer flow Q_A in lpm)
Combinations are possible, dep. on requirement

0 2)	0,4	0,6	1	2,5	4	6	10	16	25	40	50
4 / 16											
First coding = Usable consumer flow Q_A with deenergized solenoid Second coding = Usable consumer flow Q_A with energized solenoid											

Table 9: Flow pattern symbols and auxiliary valves

Basic version	Pipe connection (no coding)	With auxiliary valve	
		Bypass check valve R	Pressure limiting valve S
2-way flow control valve			
3-way flow control valve			

Table 10: Operating voltage for the actuation solenoid

Coding	Nominal voltage U_N
G 12	12V DC
G 24	24V DC
WG 110	110V AC 50 and
WG 230	230V AC 60 Hz

For more detailed electrical data, see sect. 4.2

1) Z = control connection. To be used only if operation is to be switched at random to P→R pump circulation via an externally connected 2/2-way valve, e.g. WN 1D(F) - 1/4-.. according to D 7470 A/1; see symbol

2) Usable consumer flow $Q_A = 0$ lpm (spool valve characteristic)

4. Further data

4.1 General and hydraulic data

Installation position Any

Ports P = Inlet
A and B = Consumer side
R = Return
Z = External control port, see ³⁾ in sect. 3.2

Surface Valve body gas nitrided, other parts zinc galvanized
Solenoid (with type ...S-WN1.. and SU..) zinc galvanized and olive passivated

Direction of flow Only in direction of arrow from P→A(R);
opposite direction A→P only possible with by-pass check valve.
With flow control valve in rectifier circuit A→B or B→A.

Inflow The pump delivery on the inlet side must exceed $Q_{A\max}$ by 10% when the full range will be exploited.

Mass (weight) approx. kg	Size	Basic valve	With directly mounted 2-way directional seated valve acc. to D 7470 A/1
		3	1.4 (2.0) ¹⁾
	4	2.1	2.7
	5	3.1	3.7

1) Figures in brackets apply to SU 2(3)-3

Operating pressure $p_{\max} = 315$ bar; $p_{\min} = 10...20$ bar, depending on flow rate pressure required for opening pressure balance approx. 6 bar. Counter-pressure at drain port R at 3-way flow control valves must always be lower than the feed pressure applied at port A (min. diff. 8 bar)

Pressure fluid Hydraulic oil conforming DIN 51524 part 1 to 3: ISO VG 10 to 68 conforming DIN 51519.
Viscosity limits: min. approx. 4, max. approx. 1500 mm²/sec;
opt. operation: approx. 10... 500 mm²/sec
Also suitable are biologically degradable pressure fluids types HEPG (Polyalkylenglycol) and HEES (Synth. Ester) at service temperatures up to approx. +70°C.

Temperature Ambient: approx. -40 ... +80°C
Fluid: -25 ... +80°C. Note the viscosity range!
Permissible temperature during start: -40°C (observe start-viscosity!), as long as the service temperature is at least 20K (Kelvin) higher for the following operation.
Biologically degradable pressure fluids: Observe manufacturer's specifications. By consideration of the compatibility with seal material not over +70°C.

Attention: Observe the restrictions in sect. 4.2 regarding the perm. duty cycles of the solenoids!

Setting curves (basic values)

Type SF..

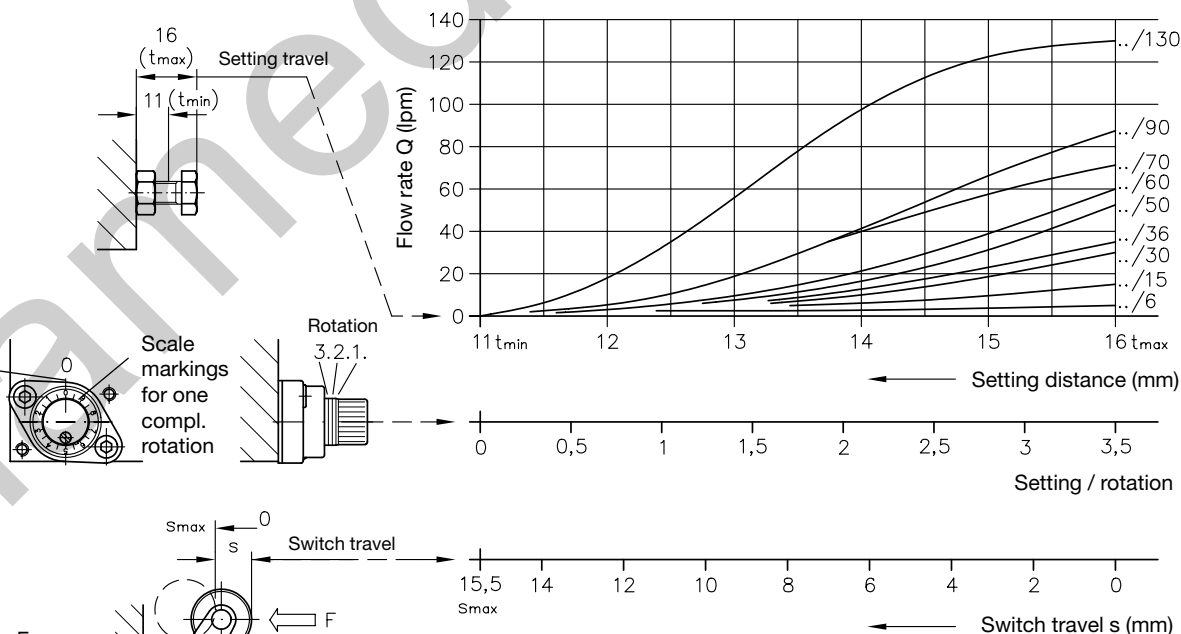
Type SD..

Notch for marking position 0

Type SK..
SKR..

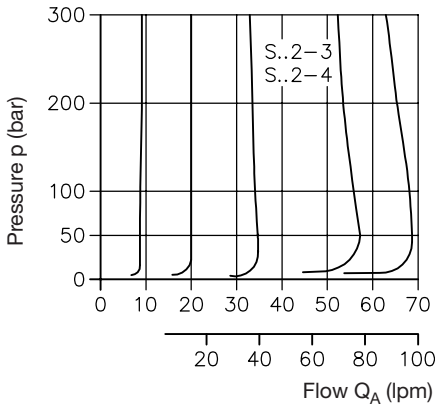
Operating force F (basic values) at
0 bar ... approx. 30 N
100 bar ... approx. 44 N
200 bar ... approx. 56 N
300 bar ... approx. 70 N

Type SU.. two fixed figures corresponding to the type coding

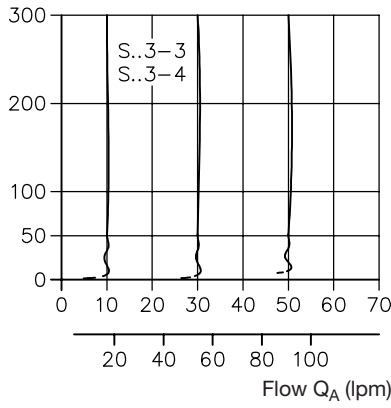


Δp -Q - curves

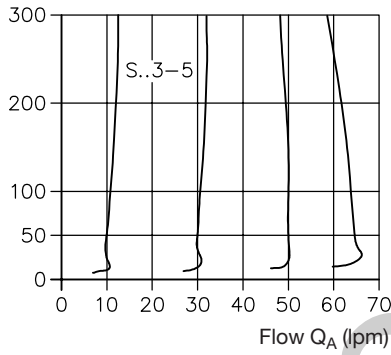
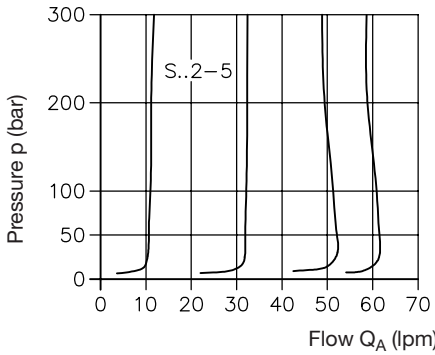
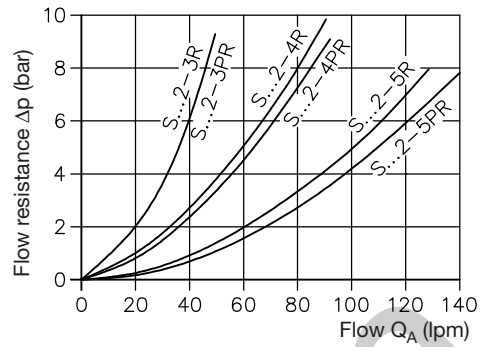
2-way flow control



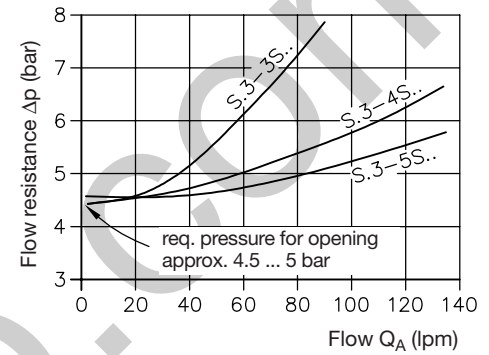
3-way flow control



2-way flow control with bypass relief valve, flow direction A → P



Circulation back pressure with relieved flow controller



Oil viscosity during measurement approx. 35 mm²/sec

4.2 Electrical data

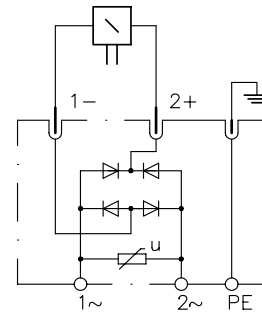
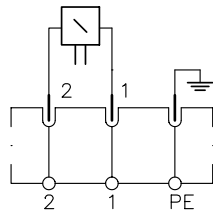
of the solenoid valve with type S..3-3 (4, 5) as specified in sect. 3.2 or 3.3

Solenoid Built and tested acc. to DIN VDE 0580, wet armature sealed to outside
Basic rating at P_N nom. output ≈ 24.4 W ± 6% depending on nom. voltage U_N and manufacturer

Coding	G 12	G 24	WG 110	WG 230	
Nom. voltage U _N	12V DC	24V DC	110V AC	230V AC	Other voltages on enquiry
				50/60 Hz	
Nom. current I ₂₀	2A	1A	0.22A	0.14A	

Plug (connection and circuitry) DC-voltage coding G.. AC-voltage coding WG..

All plugs with cable glands



Relative duty cycle	100% ED Stamped on the solenoid body	Service:	At ambient temperature (°C)		
			< 40	60	< 80
			Duty cycle (%)		
			100	approx. 60	approx. 40

Protection class IP 65 conf. DIN EN 60529 / IEC 60529 (in properly assembled state)

Insulation material class F

Surface temperature approx. 85°C at ambient temperature 20°

Mounting The solenoid can be easily exchanged in case of an electrical defect. Simply pull-off the solenoid after removing the 4 mounting screws and put on a new one.

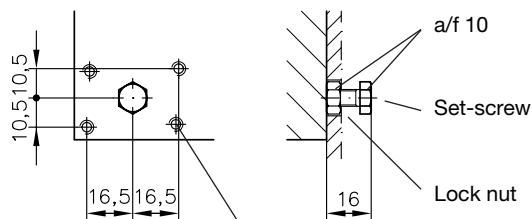
5. Dimensions

All dimensions are in mm, subject to change without notice !

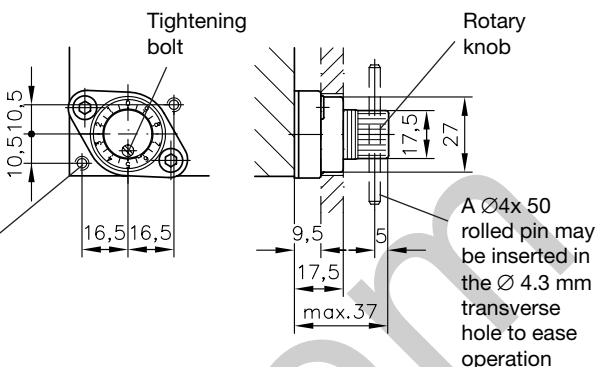
In the interest of simplicity, different drawings are provided for the adjustment versions and the valves. Just combine the individual drawings in order to obtain an drawing for the entire valve system. (See also photo on page 1).

5.1 Adjustment versions

Type SF..



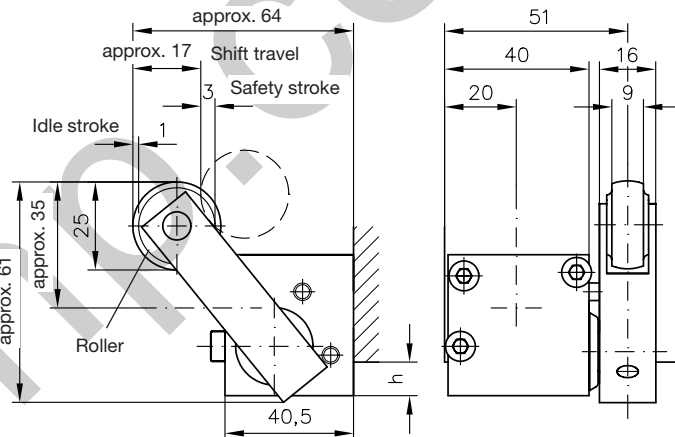
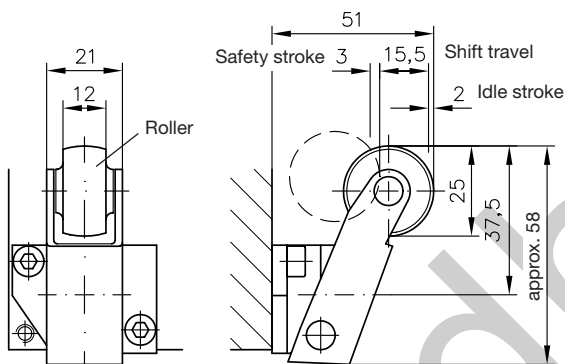
Type SD..



M5, 4 deep fastening thread for installing at an instrument console. Version for instrument console installation not possible with type S..2 - 3 B and with all types for manifold mounting.

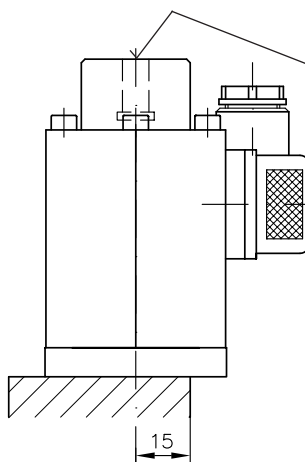
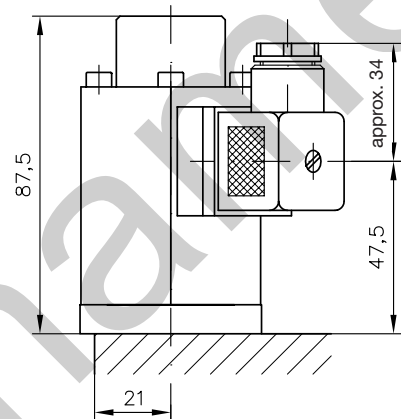
Type SKR..

Type SK..



h = 9.5 (Size 3)
13.5 (Size 4)
2.5 (Size 5)

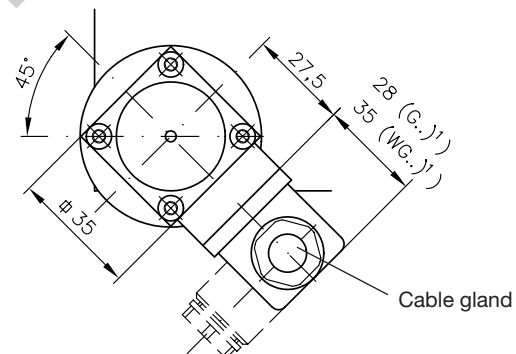
Type SU..



Manual emergency actuation:

Push down the pin with an actuation aid (not sharp edged) when required. Actuation force ≤ 10 N.

Solenoid and plug may be fitted rotated by $3 \times 90^\circ$



1) This dimension is depending on the manufacturer and can be max. 40 mm acc. to DIN EN 175 301-803.

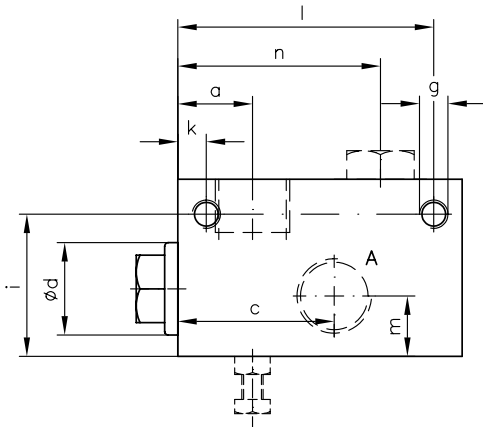
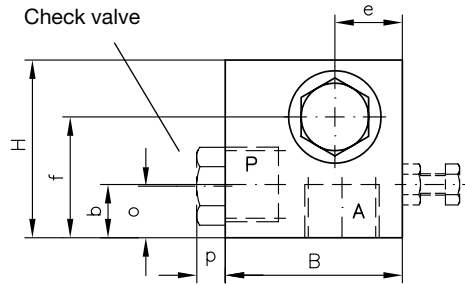
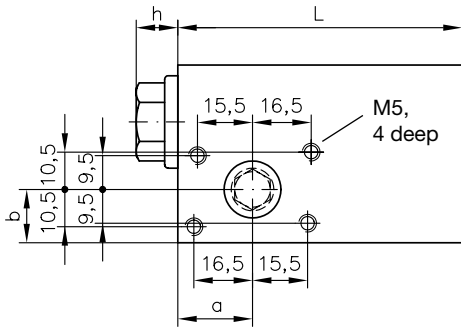
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5.2 2-way flow control valve

Version with tapped ports

Type S.. 2-3(4, 5) and S.. 2-3(4, 5)...R acc. to sect. 3.1

Type SU 2-3...(R) acc. to sect. 3.3

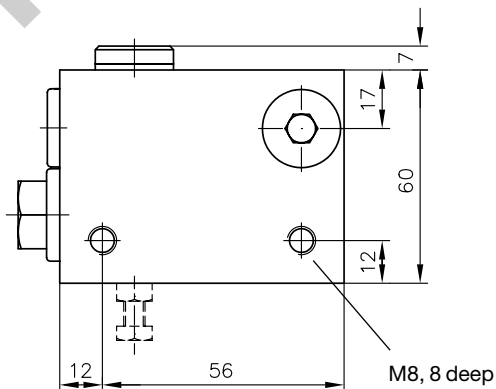
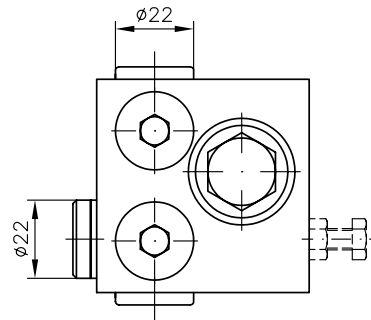
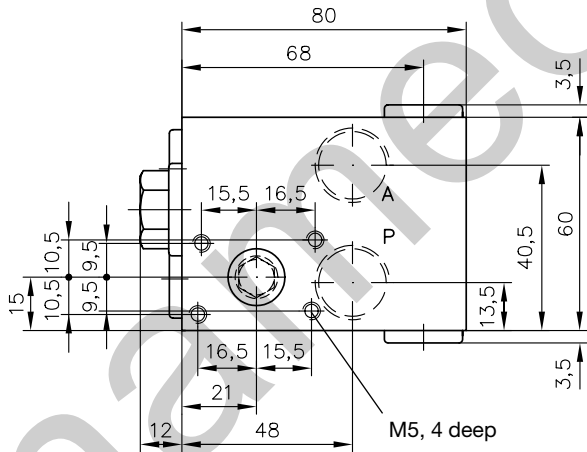


Size	Ports P and A ISO 228/1 (BSP)									
		L	B	H	a	b	c	d	e	f
3	G 1/2	80	50	50	21	15	44	26	19	34
4	G 3/4	85	60	60	25	19	53	32	21	41
5	G 1	100	70	70	27	24	60	39	23	47

Size									
	g	h	i	k	l	m	n	o	p
3	M8, 8 deep	12	40	8	72	17	57	14.5	5.5
4	M8, 10 deep	14	48	10	75	21	68	18	5.5
5	M10, 12 deep	16	52	20	80	23	80	21	11

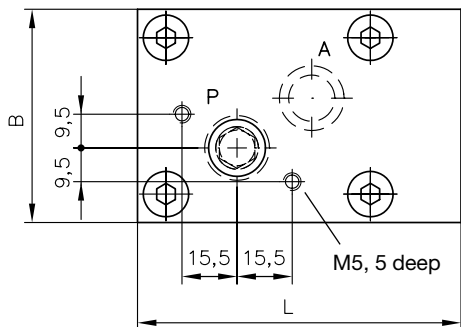
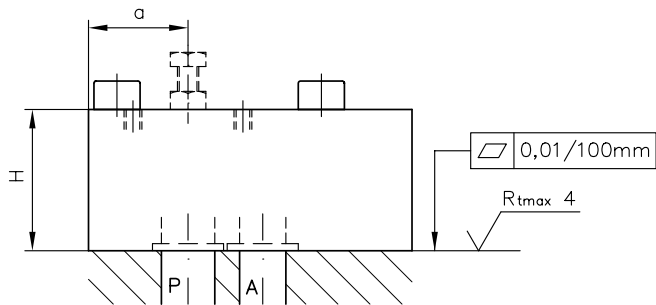
Version with tapped ports and rectifier circuit

Type S.. 2-3...B acc. to sect. 3.1 (not with type SU 2-3)



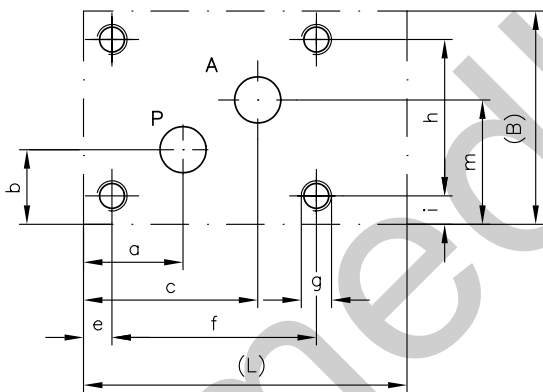
Tel: 02133988511

Manifold mounting version
Type S.. 2-3(4, 5)..P and S.. 2-3(4, 5)..PR (not with type SU 2-3)



Size	L	B	H	a	b	c	e	f	g
3	93	60	40	28	21	49	8	57.5	M8, 10 deep
4	100	70	50	35	26	57	16	57	M10, 10 deep
5	106	80	50	33	28	65	9	88	M10, 10 deep

Hole pattern of the manifold (top view)



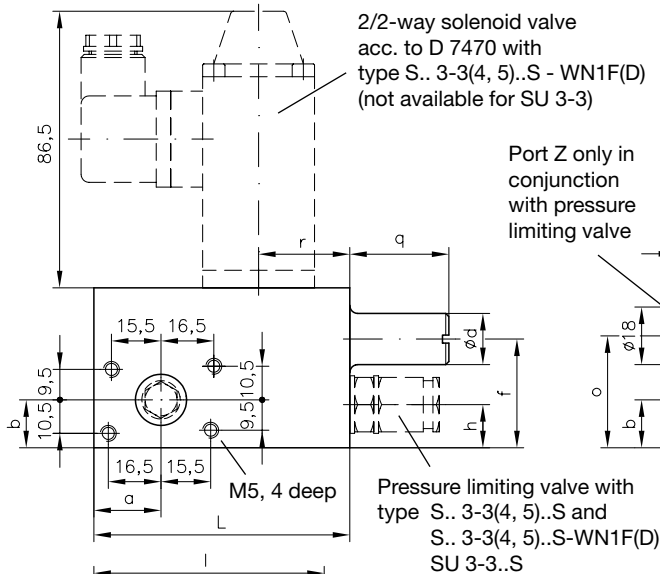
Size	Port Ø			Seals (O-ring NBR 90 Sh)			
	h	i	m	P	A		
3	44	8	35	14	12	15x2.5	
4	52	9	42	17	17	18.75x2.62	
5	64	8	48	17	17	26x3	18.75x2.62

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5.3 3-way flow control valve

Version with tapped ports

Type S.. 3-3(4, 5); S.. 3-3(4, 5)...S; S.. 3-3(4, 5)...S - WN 1 F(D) acc. to sect. 3.2 and type SU 3-3...(S) acc. to sect. 3.3



Adjustment of the pressure limiting valve

Pressure range	Travel f_{max} (mm)	Δp (bar) per turn
(0) ... 200 bar	4	90
200 ... 315 bar	4	150

Ports ISO 228/1 (BSPP):

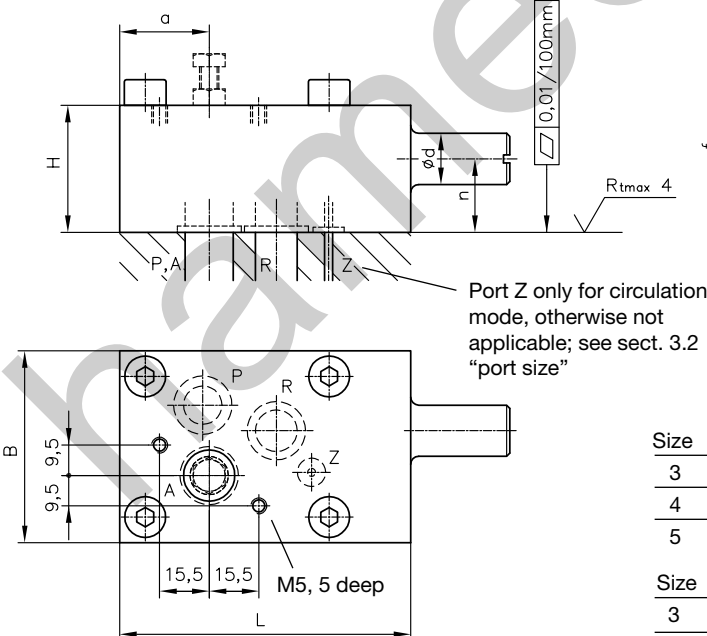
Size	P, R, A	Z
3	G 1/2	G 1/4
4	G 3/4	
5	G 1	

Size	L	B	H	a	b	c	d	e	f	g
3	80	50	50	21	15	44	16.5	19	34	M8, 8 deep
4	85	60	60	25	19	53	16.5	21	41	M8, 10 deep
5	100	70	70	27	24	60	24	23	47	M10, 12 deep

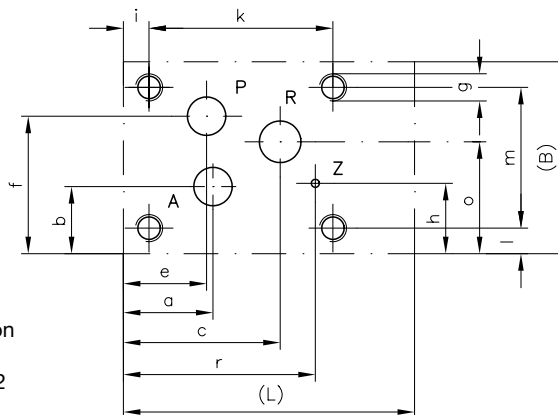
Size	h	i	k	l	m	n	o	p	q	r	s
3	13.5	40	8	72	40	60	35	17	31	28.5	19
4	23	48	10	75	46	55	41	21	31	28.5	21
5	22	52	20	80	55	70	47	23	30	29.5	23

Manifold mounting version

Type S.. 3-3(4, 5)...P and S.. 3-3(4, 5)...PS acc. to sect. 3.2 (not with type SU 3-3)



Hole pattern of the manifold (top view)



Size	L	B	H	a	b	c	d	e	f	g
3	93	60	40	28	21	49	16.5	26	43	M8, 10 deep
4	100	70	50	35	26	57	16.5	33.5	53	M10, 10 deep
5	106	80	50	33	28	65	24	33	62	M10, 10 deep

Size	h	i	k	l	m	n	o	p	r
3	22	8	57.5	8	44	23	35	31	60
4	21	16	57	9	52	29	42	31	55
5	40	9	88	8	64	27	48	30	87

Adjustment of the pressure limiting valve

Pressure range	Travel f_{max} (mm)	Δp (bar) per turn
(0) ... 200 bar	6.3	40
200 ... 315 bar	4.5	95

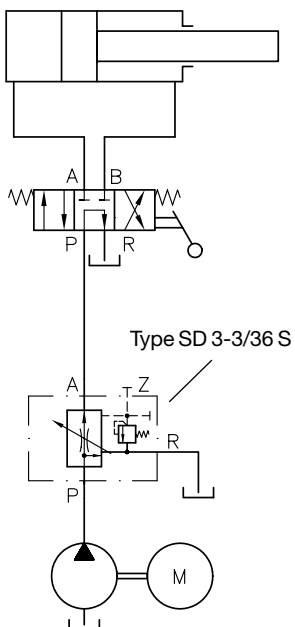
Size	Port \varnothing				Seals (O-ring NBR 90 Sh)		
	P, R	A	Z	P and R	A	Z	
3	12	14	4	15x2.5		6x2	
4	17		4	18.75x2.62		6x2	
5	17		4	18.75x2.62	26x3	6x2	

6. Appendix

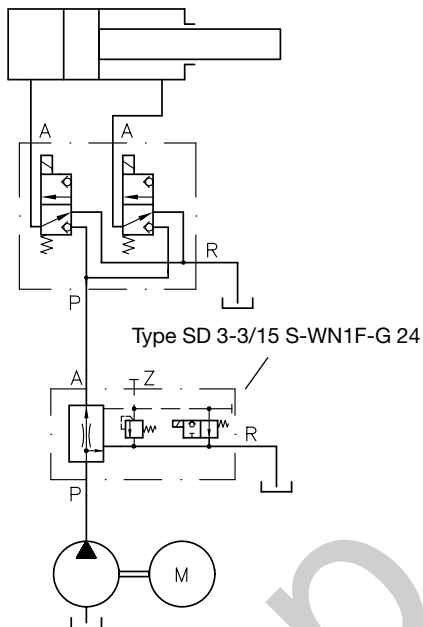
6.1 Typical circuitry

Feed control with 3-way flow control valve

Feed control with simultaneous pressure control

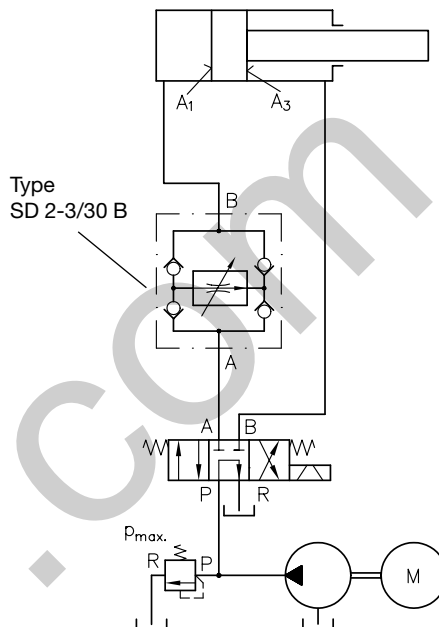


Feed control with simultaneous pressure control and idle circulation mode

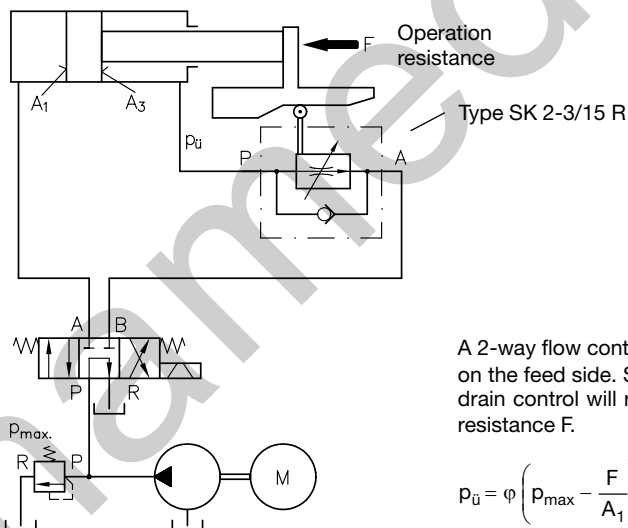


Speed control in both directions by rectifier circuit

Forward and reverse velocity are equal. Attention: The pressure may be geared up when the flow control valve is connected to the rod side.



Control of flow out via a 2-way flow control valve



A 2-way flow control valve operates only in conjunction with a pressure relief valve on the feed side. Should the area ratio $\varphi = A1/A3$ (see wiring diagram) be unequal, drain control will result in a pressure transmission factor depending on operating resistance F.

$$p_{\ddot{u}} = \varphi \left(P_{max} - \frac{F}{A_1} \right)$$

It follows that the pressure transmission factor may be excessive when running without load.

7. Type over view

Order examples:

SD 2 - 3 / 15 P

SKR 3 - 4 / 70 S-WN1F - G 12 - 120

SU 2 - 3 - 25/10 - G 24

Pressure specification for the pressure limiting valve (bar)

Nom. voltage of the solenoid
G 12, G 24, WG 110 and WG 230

Connection pattern and ancillary valve
Without Version for pipe connection
P Manifold mounting valve, not with type SU
R, PR Valve with bypass check valve (2-way flow control valve)
B Rectifier circuit via check valves (2-way flow control valve)
S Pressure limiting valve (3-way flow control valve)
S-WN1F, S-WN1D Pressure limiting and idle circulation valve (3-way flow control valve, not with type SU)

Flow
/3, /6, /15, /30, /36, /50, /60 size 3 (deenergized open)
/6F, /15F, /30F, /36F, /50F size 3 (deenergized blocked)
/70, /90 size 4
/130 size 5
-0/50..., -4/25..., -50/0 size 3, only type SU

Size
3, 4, 5 (Type SU only in size 3)

Version
2 2- way flow control
3 3- way flow control

Basic type and adjustment mode

SF - Tool adjustable, with lock nut

SD - Via rotary knob adjustment

SK - Via roller (unshielded version)

SKR - Via roller (shielded version, not available for manifold mounting)

SU - Solenoid actuation, activating one of two fixed settings (only available for size 3 and pipe connection)