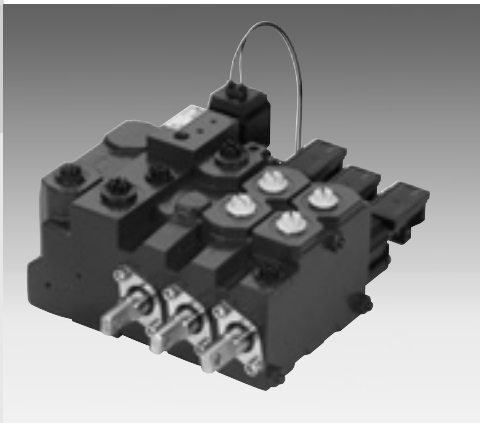
Rexroth
Bosch Group

Load-Sensing Control Block SB12

RE 64 386/02.12
Replaces:
RE 64 386/11.10

SB12-M mechanical actuation
SB12-EM direct operated electromagnetic actuation



Nominal pressure: $p_{nom} = 250$ bar
Flow: $Q_{max} = 100$ l/min

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Operating instructions
- Part 1: General information: RE 64 020-B1
- Part 2: SB12 directional control valves for mobile applications: RE 64 386-B2

Features

System
- "load sensing" system

Design
- plate construction
- up to 10 directional control valve elements

Actuation types
- mechanical
- electromagnetic

Flow
- load-pressure compensated
- high accuracy of repeatability
- low hysteresis

Pressure safeguarding
- port plate for fixed pump

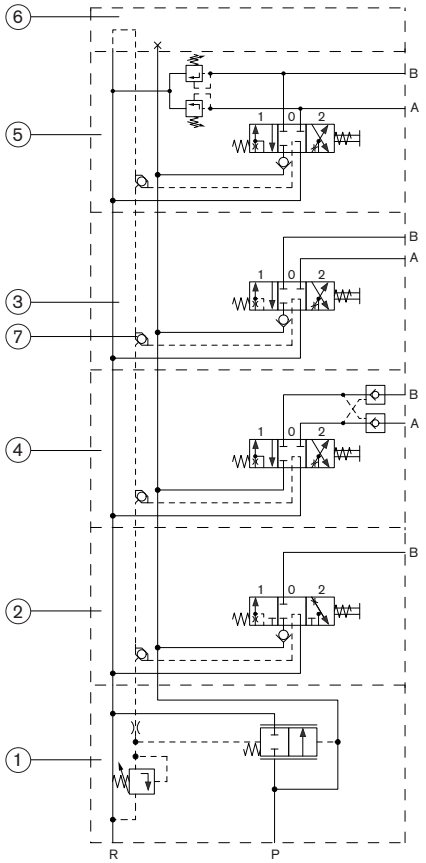
Application areas
- fork lift trucks
- construction machines
- municipal vehicles
- harvesters

Repair instructions
- directional control valve block, series SB12: RDE 64 386-R1

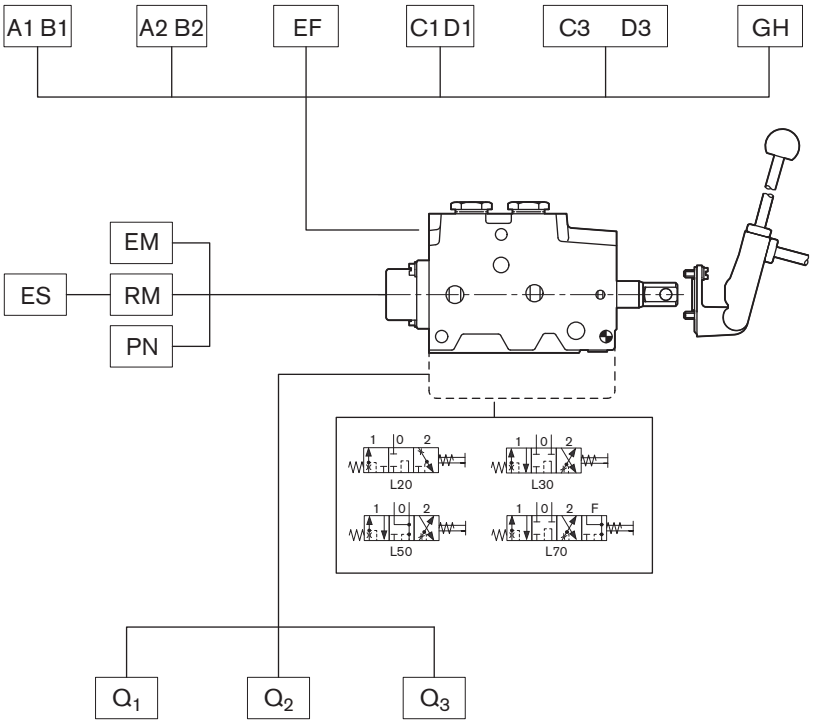
SB12 control block (example)

"Load sensing" system, for minimization of throttle losses and load-independent flow control.

① Port plate with pressure compensator and pressure-relief valve
② Directional control valve, single-acting
③ Directional control valve, double-acting
④ Directional control valve with check valves
⑤ Directional control valve with secondary pressure-relief valve
⑥ End plate
⑦ Shuttle valve for load-pressure selection



Modular system



The desired model variant of a directional control valve is described using this order code.

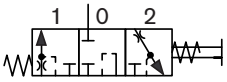
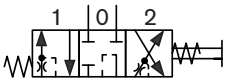
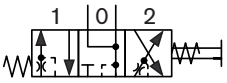
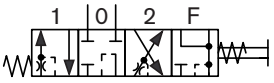
Order code, e.g.

1.	2.	3.	4.	5.	6.	7.
L	30	–	A1 B2	Q1	–	RM

1. Circuit type

L	Load sensing

2. Spool symbol

20	
30	
50	
70	

4. Auxiliary functions in the upper axis

A1 B1	Shock valve	in A in B
A2 B2	Anticavitation valve	in A in B
C1 D1	Check valve, hydr. actuated	in A in B
C3 D3	Check valve, el. actuated	in A in B
E F	Secondary PRV adjustable	in A in B
G H	Pilot pressure insert	in A in B
N	Connection D1 to check valve switching valve contained in subplate.	

5. Auxiliary functions in the lower axis

Q1	Metering restrictor, inflow	in P
Q2	2-way flow control valve	in P
Q3	2-way pressure compensator	in P

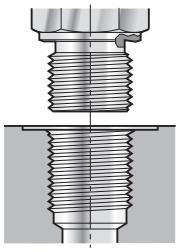
7. Auxiliary function in the main axis

PN	Pneumatic actuation
EM	direct operated electromagnetic actuation
1	Switching
2	Proportional
RM	Detent, mechanical release
ES1	Electrical switch
ES2	Position sensor

Customer ports

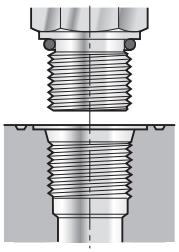
Ports A and B, threaded version
Type I: DIN 3852, part 1
Type III: ISO 6149

Type 1:
DIN 3852-1



Cutting edge,
flat seal ring,
copper ring

Type 3:
ISO 6149-1



O-ring sealing

Operating element

Accessories are to be ordered separately.
See page 13.

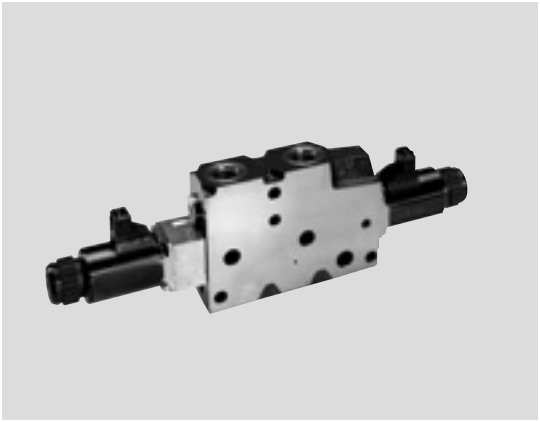
Mechanical actuation – M

Characteristics

General		Valve blocks consisting of: 1 port plate, 1 end plate 1...10 directional control valve elements and shuttle valves 3 tie bolts
Mass		Directional control valve, mechanically actuated: 3.0 kg Directional control valve, electrically actuated: 3.8 kg Port plate: 2.7 kg End plate: 1.8 kg
Fixing		Thread in port plate and end plate (standard: M8)
Line ports		Internal thread, see order details
Installation position		As desired
Port plate configuration		Standard: left-hand version
Ambient temperature		–30 °C...+80 °C
Hydraulic		
Hydraulic fluid		Mineral oil based hydraulic oil acc. to DIN/ISO, other fluids, e.g. environmentally acceptable fluids, on request
Viscosity		10...800 mm^2/s permitted range 20...100 mm^2/s recommended range ...2000 mm^2/s range permitted for start-up
Temperature of hydraulic fluid		In operation +20 °C...+90 °C, for short periods –30 °C...+100 °C
Filtration		Oil contamination class 19/16 acc. to ISO/DIS 4406 or class 10 acc. to NAS 1638, obtained with filter $\beta_{25} \geqq 75$ [1])
Operating pressure at port	P	$p_{max} = 250$ bar (pump side)
	A, B	$p_{max} = 280$ bar (consumer side), in combination with check valves 300 bar
	R	$p_{max} = 20$ bar (return side)
	W	$p_{max} = 250$ bar
Leakage A, B → R at $p = 125$ bar, $\nu = 33$ mm^2/s $\vartheta = 50$ °C		Standard: $Q_L = 18$ cm^3/min with check valve: $Q_L = 2$ cm^3/min with shock valve: $Q_L = 20$ cm^3/min
Nominal flow		see diagram “Operating limits”, page 16
Mechanical		
Spool strokes		Symbol L20: ±8 mm L30, L50: ±6 mm L70: ±6 + 5 mm
Actuating forces		< 200 N in spool axis direction
Type of protection		IP 69 K, with ES1 IP 54, with ES2 IP 64

[1]) Retention rate for dirt particles >25 µm is 1:75, i.e. 98.67 %

Direct operated electromagnetic actuation – EM



Characteristics	Direct operated electromagnetic actuation			
General hydraulic characteristics	See mechanically actuated directional control valves, page 4			
Installation position *)	Spool axis horizontal. Maximum acceleration in spool axis direction 10g			
Ambient temperature	–20 °C...+60 °C			
Temperature of fluid in operation	+20 °C…+80 °C			
Valve type	4/3-, 4/2- and 3/3-way switching / proportional			
Control type	Electromagnetic, direct			
Solenoid working stroke (s)	≈ 3.5 mm			
Actuated time	100 % ED			
Type of protection	IP 65			
Plug connection	AMP Junior Timer, 2-pole			
Characteristics	**EM 1 (switching)**		**EM 2 (proportional)**	
Leakage A, B → R at p = 125 bar, ν = 33 mm²/s ϑ = 50 °C	Standard Q_L ≦ 40 cm³/min (without check valve)		Standard Q_L ≦ 64 cm³/min (without check valve)	
Hysteresis			< 15 %	
Spark suppression	Integrated in solenoid		–	
Solenoid voltage U_{nom}	12V	24V	12V	24V
Solenoid voltage $U_{max\ permitted}$	14V	28V		
Solenoid current min required	2.3 A	1.1 A		
Solenoid current (controlled) I_{max}			2.3 A	1.5 A
Coil resistance (R_L) at 20 °C	3.5 Ω – 3.75 Ω	13.8 Ω – 14.6 Ω	3.5 Ω – 3.75 Ω	9.6 Ω – 10.2 Ω
Coil resistance (R_L) at 80 °C	≦ 4.8 Ω	≦ 18.2 Ω	≦ 4.8 Ω	≦ 12.8 Ω
Inductivity at nominal stroke (50 Hz)			≈ 87 mH	≈ 220 mH
Current – proportional range (A), (B) I_{prop}			0.5 A – 2.3 A	0.25 A – 1.5 A
Dither signal (A), (B)			0.75 A ss ± 0.25 A	0.48 A ss ± 0.2 A
Dither frequency (A), (B)			120 Hz ± 5 Hz	
Dither shape of the current setpoint (A), (B)			Triangular signal	

*) Another installation position can be permitted only after positive conclusion of a user validation co-ordinated with Bosch Rexroth

Note

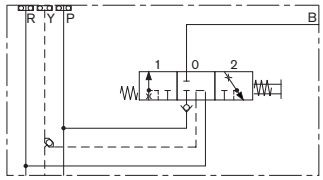
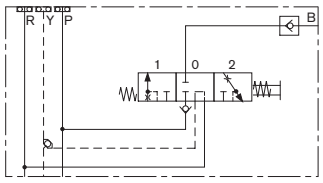
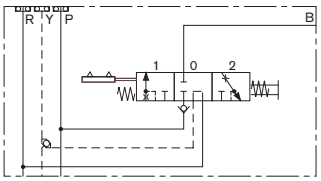
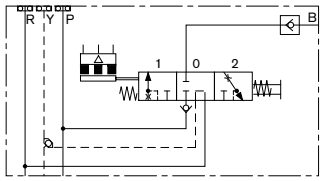
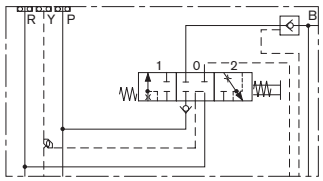
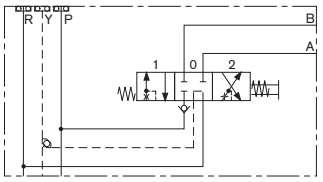
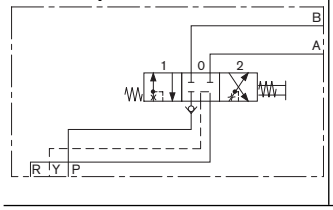
Definition of the proportional range: 0.02 x Q_{nom} to Q_{nom}. Current decay for the specified dither signals via a spark-suppression diode (U_f < 1 V).

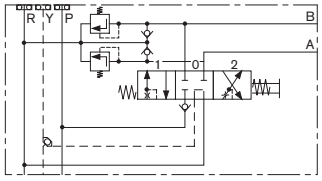
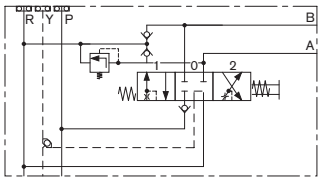
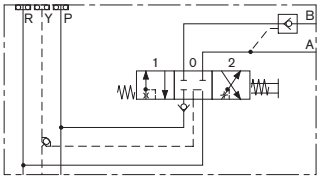
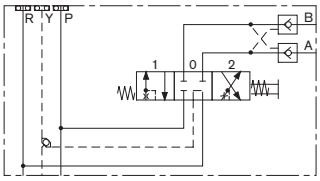
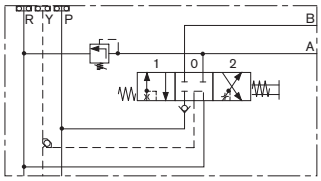
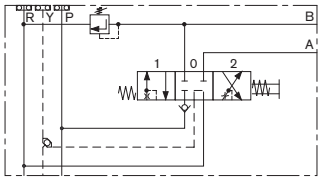
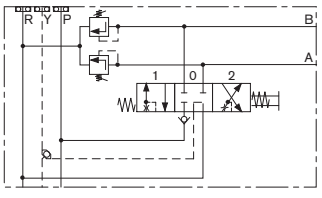
The dither values are to be interpreted as values for minimum hysteresis. All dither data are guide values.

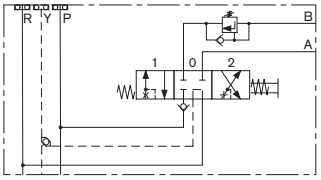
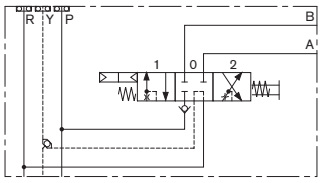
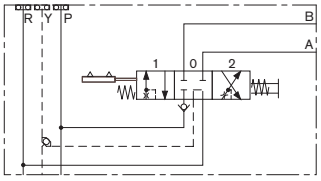
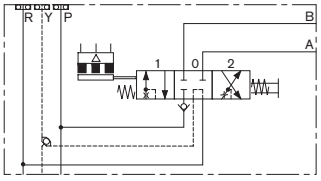
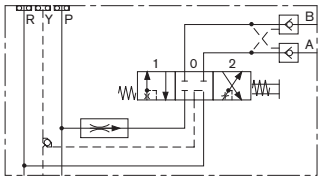
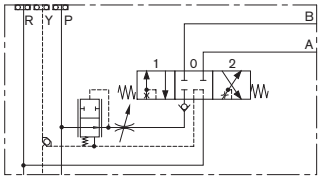
The dither data may need to be examined with respect to the given system and, if necessary, reoptimized.

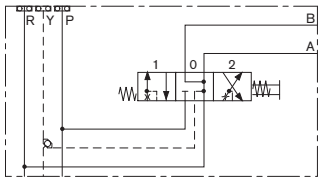
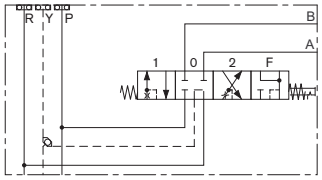
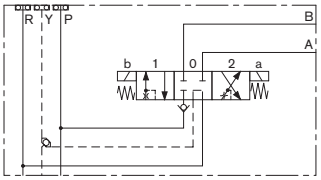
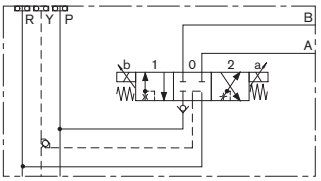
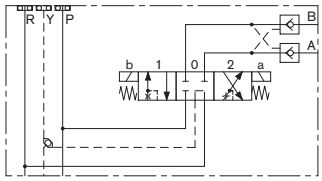
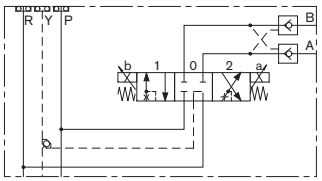
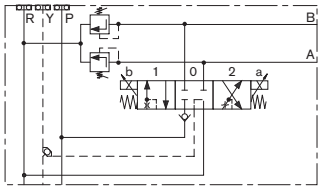
Order details

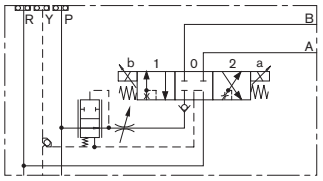
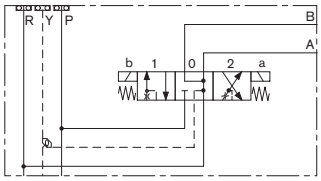
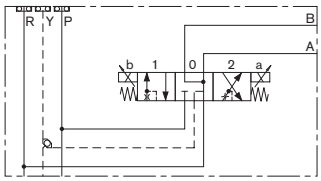
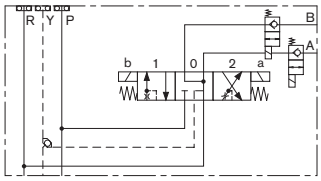
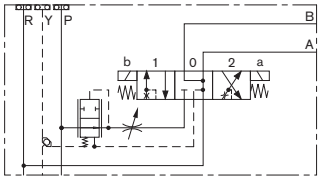
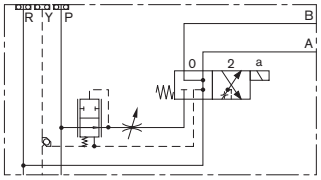
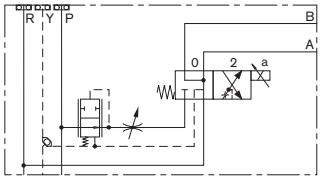
Directional control valves

Symbol	Comments	Port A	Port B	Q_{nom} with AP Δp [l/min / bar]	Order number
L 20 		M18 x 1.5 / 1 without	M18 x 1.5 / 1 M22 x 1.5 / 1	50 / 3 50 / 3	**0 521 608 004** **0 521 608 073**
L 20 D1 		without without	G1/2 / 1 M22 x 1.5 / 3	70 / 3 70 / 3	**0 521 608 028** **R 917 005 371**
L20 ES1 	with switch hub and spare parts set E-switch incl.	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 024**
L20 D1 ES2 		without without	M22 x 1.5 / 1 M22 x 1.5 / 3	120 / 8.4 100 / 6	**R 917 003 192** **R 917 004 505**
L20 D1 N 	for connection of the subplate with cut-out function	without	M22 x 1.5 / 3	70 / 3	**R 917 005 356**
L30 		M18 x 1.5 / 1 M22 x 1.5 / 1 M18 x 1.5 / 3	M18 x 1.5 / 1 M22 x 1.5 / 1 M18 x 1.5 / 3	50 / 3 50 / 3 50 / 3	**0 521 608 003** **0 521 608 034** **R 917 005 358**
L30 end plate valve unit 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**R 917 004 171**

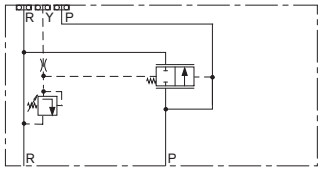
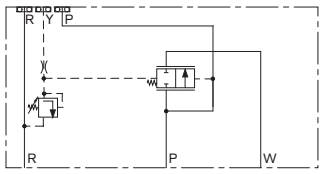
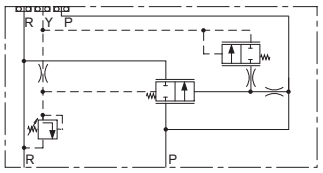
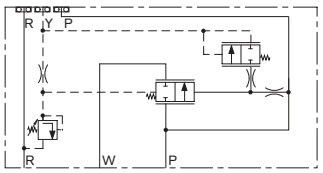
Symbol	Comments	Port A	Port B	Q_{nom} with AP Δp [l/min / bar]	Order number
L30 A1 B1 	A1 B1 p = 300 bar	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 008**
	A1 p = 250 bar	M22 x 1.5 / 1	M22 x 1.5 / 1	50 / 3	**0 521 608 032**
	B1 p = 125 bar				
L30 A1 B2 	A1 p = 300 bar	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 009**
	A1 p = 90 bar	M22 x 1.5 / 1	M22 x 1.5 / 1	50 / 3	**0 521 608 043**
L30 D1 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 006**
L30 C1D1 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 005**
L30 E 	E p = 120 bar (100...150 bar)	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 022**
L30 F 	F p = 120 bar (100...150 bar)	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 023**
L30 EF 	E F p = 175 bar (150...230 bar)	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 011**
	E F p = 175 bar (150...230 bar)	M22 x 1.5 / 1	M22 x 1.5 / 1	50 / 3	**0 521 608 069**

Symbol	Comments	Port A	Port B	Q_{nom} with AP Δp [l/min / bar]	Order number
L30 H 	H p = 125 bar	M18 x 1.5 / 3	M18 x 1.5 / 3	50 / 3	**R 917 005 357**
L30 PN 	$p_{N\ max}$ = 4 bar *) $_{min}$ = 1 bar *) proportional control	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 066**
L30 ES1 	with switch hub and spare parts set E-switch incl.	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 025**
L30 ES2 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**R 917 003 194**
L30 C1D1 Q2 	Q = 34 l/min (2...34)	M18 x 1.5 / 1	M18 x 1.5 / 1	34 / 3	**0 521 608 071**
L30 Q3 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 079**

Symbol	Comments	Port A	Port B	Q_{nom} with AP Δp [l/min / bar]	Order number
L50 		M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 012**
L70 RM 	detent engagement in F	M18 x 1.5 / 1	M18 x 1.5 / 1	50 / 3	**0 521 608 013**
L30 EM1 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 833**
L30 EM2 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 827**
L30 C1D1 EM1 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 834**
L30 C1D1 EM2 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	7 / 3	**0 521 608 841**
L30 EF EM2 	12 V Jet E F p = 230 bar (150...230 bar)	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**R 917 002 484**

Symbol	Comments	Port A	Port B	Q_{nom} with AP Δp [l/min / bar]	Order number
L30 Q3 EM2 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 859**
L50 EM1 	24 V Jet 12 V Jet	M18 x 1.5 / 1 M18 x 1.5 / 1	M18 x 1.5 / 1 M18 x 1.5 / 1	30 / 3 30 / 3	**0 521 608 831** **0 521 608 847**
L50 EM2 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	10 / 3	**R 917 001 607**
L50 C3 D3 EM1 	12 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 821**
L50 Q3 EM1 	12 V Jet	M22 x 1.5 / 1	M22 x 1.5 / 1	30 / 3	**0 521 608 829**
L50.2 Q3 EM1 	12 V Jet	M22 x 1.5 / 1	M22 x 1.5 / 1	36 / 3	**0 521 608 830**
L50.2 Q3 EM2 	24 V Jet	M18 x 1.5 / 1	M18 x 1.5 / 1	30 / 3	**0 521 608 837**

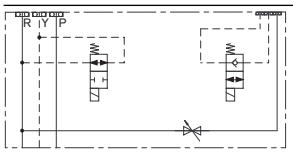
Port plates

Symbol	Δp bar	Q_{max} l/min	Ports P, R, W, Y, S	Order number
A1 	3	50	P: M18 x 1.5 R: M22 x 1.5	**1 525 503 390**
	3	50	P: M18 x 1.5 R: plugged	**1 525 503 524**
	6	75	P: M18 x 1.5 R: M22 x 1.5	**1 525 503 528**
	3	50	P: M18 x 1.5 R: M22 x 1.5 Y: G1/4	**1 525 503 503**
A3 	3	50	P: M18 x 1.5 R: M22 x 1.5 W: M18 x 1.5	**1 525 503 394**
A6 		100	P: M22 x 1.5 R: M26 x 1.5 Y: M12 x 1.5	**1 525 503 779**
A2 	2.5/7	80	P: M22 x 1.5 R: M26 x 1.5	**1 525 503 392**
	3/8.4	90	P: M22 x 1.5 R: M26 x 1.5	**1 525 503 525**
	3/11	95	P: M22 x 1.5 R: M26 x 1.5	**1 525 503 531**
	6/16	100	P: M22 x 1.5 R: M26 x 1.5	**1 525 503 505**
A4 	2.5/7	80	P: M22 x 1.5 R: M26 x 1.5 W: M22 x 1.5	**1 525 503 396**

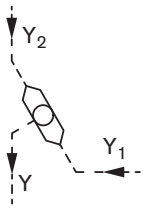
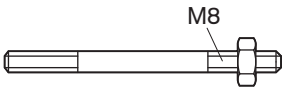
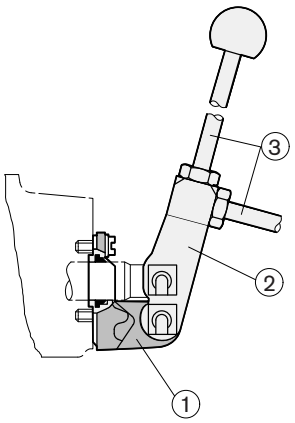
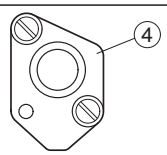
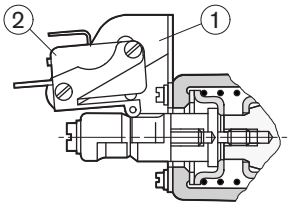
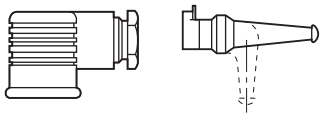
End plates

E2 			S: M22 x 1.5 plugged	**1 525 503 474**
			S: M22 x 1.5	**1 525 503 475**
E8 			W: M18 x 1.5 Y: M12 x 1.5 S: M22 x 1.5	**R 917 000 886**

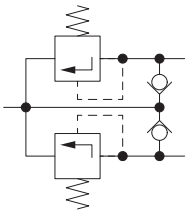
Subplate

	LS switching valve – Connection of load sensing to return flow. Check valve switching valve – prevents / allows relief of check valve of the bordering directional control valve L20 D1 N. Manual lowering function.	**R 917 003 111**

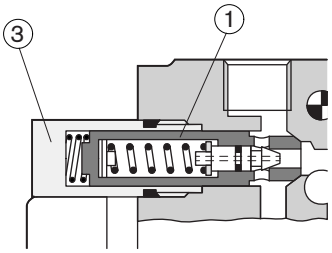
Accessories

	Shuttle valve for load tap (left-hand version)				**1 527 419 006**
	Tie bolt (1 tie bolt with nut)	Number of directional control valves (port plate and end plate are taken into account)		mm	
			1	115	**1 523 502 075**
			2	155	**1 523 502 076**
			3	195	**1 523 502 077**
			4	235	**1 523 502 078**
			5	275	**1 523 502 079**
			6	315	**1 523 502 080**
			7	355	**1 523 502 081**
			8	395	**1 523 502 082**
			9	435	**1 523 502 083**
			10	475	**1 523 502 084**
	Operating element and bracket			Pos. ① + ②	**1 527 000 097**
	Bracket with wiping ring			①	**1 527 000 098**
	Hand lever			③	**1 522 027 306**
	Cover plate with wiping ring			④	**1 527 010 326**
	Electrical switch, retrofit kit, complete				**1 527 010 332**
	Service part Fixing clip with electrical switch			① + ②	**1 527 010 293**
DIN/ISO Jet 	Plug connector 2-pin, EM	DIN/ISO			**1 834 484 057**
		Jet			**1 834 484 094**
		+ individual wire seals			**R 900 313 533**
					1 834 484 095
	Plug connector 4-pin, EHS	Jet			**R 917 002 006**

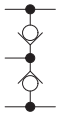
Retrofitting kits for A1, B1, A2, B2, E, F



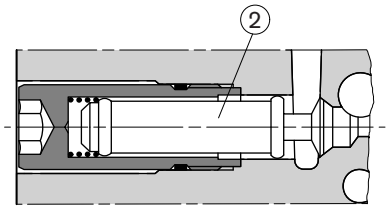
Shock valve A1 B1



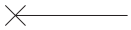
p [bar]	Pos. ①
30	**1 527 410 084**
50	**1 527 410 082**
80	**1 527 410 079**
90	**1 527 410 078**
100	**1 527 410 081**
120	**1 527 410 083**
140	**1 527 410 077**
160	**1 527 410 080**
180	**1 527 410 076**
200	**1 527 410 070**
220	**1 527 410 073**
250	**1 527 410 076**
280	**1 527 410 072**
300	**1 527 410 061**



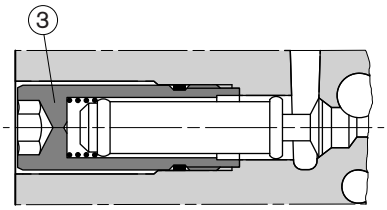
Anticavitation valve A2 B2



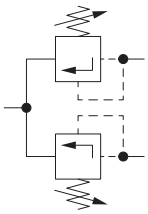
Pos. ②
1 523 105 083



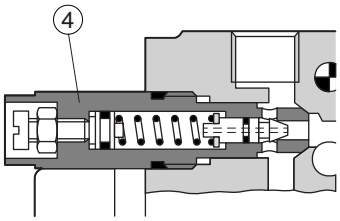
Spare parts set: locking screw for A1 B1 A2 B2



Pos. ③
1 527 010 355

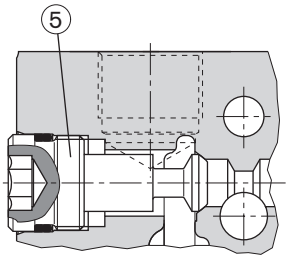


Secondary PRV, adjustable E F



p [bar]	Pos. ④
25... 60	**1 527 410 089**
60...100	**1 527 410 123**
100...150	**1 527 410 069**
150...230	**1 527 410 063**

Spare parts set, leakage dummy plug, no function

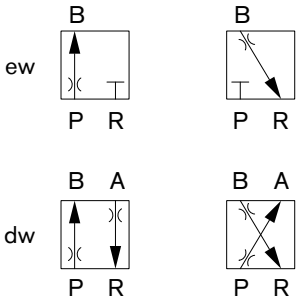


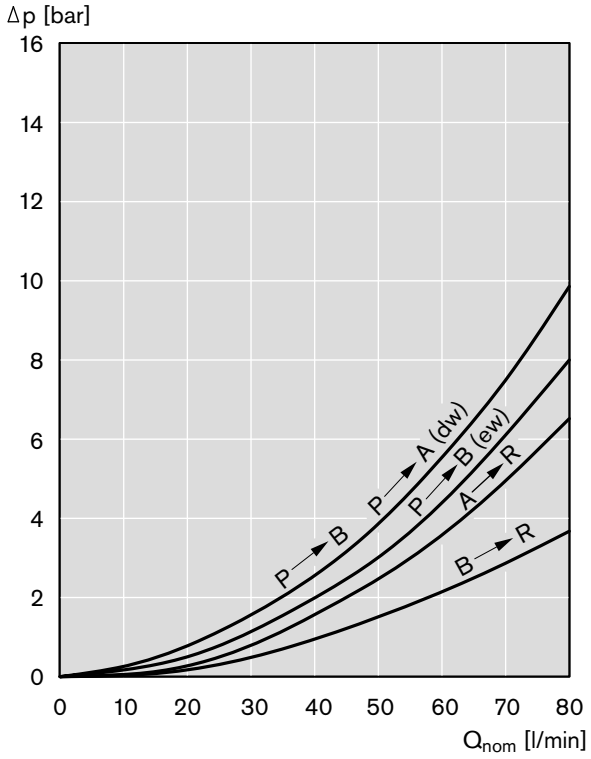
Pos. ⑤
1 527 010 356

Characteristics, directional control valves

$\nu = 35\ mm^2/s$, $\vartheta = 50\,°C$

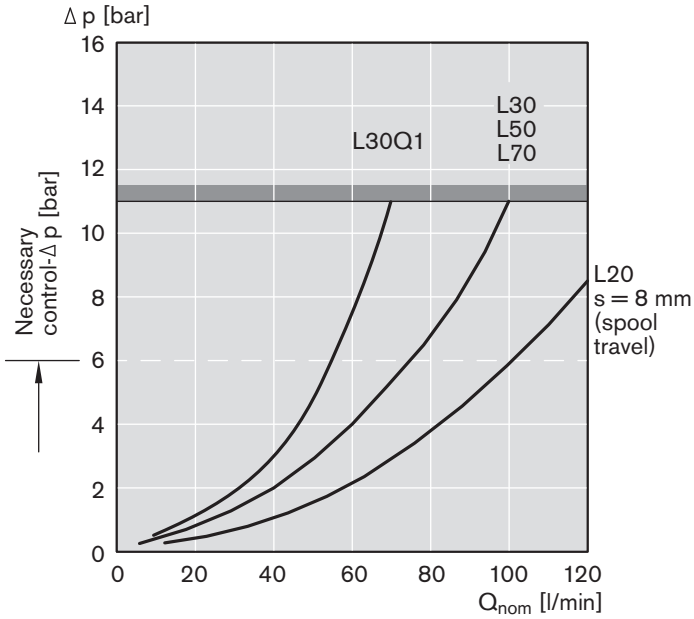
Flow resistance for fully open directional control valve
(characteristic curve)





Operating limits Mechanical actuation

$\Delta p \geqq 6$ bar only with
Δp switchover
Control Δp on pressure compensator



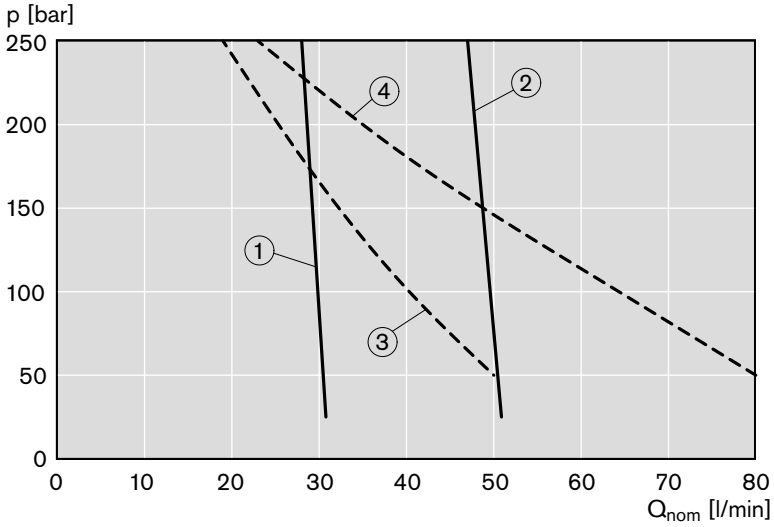
Operating limits direct operated electromagnetic actuation

① Braking load,
i.e. lifting or pressing at control $\Delta p = 3$ bar

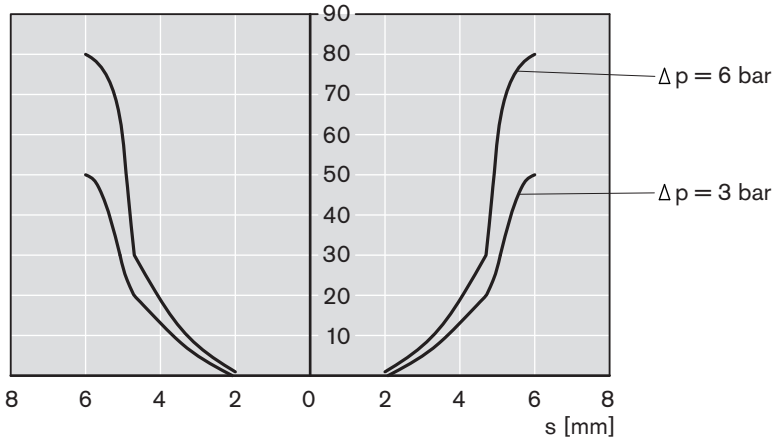
② Braking load,
i.e. lifting or pressing at control $\Delta p = 8.4$ bar

③ Driving load,
i.e. lowering or pulling,
A → R

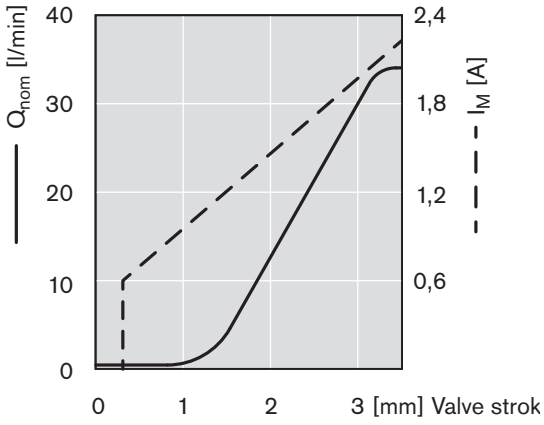
④ Driving load,
i.e. lowering or pulling,
B → R



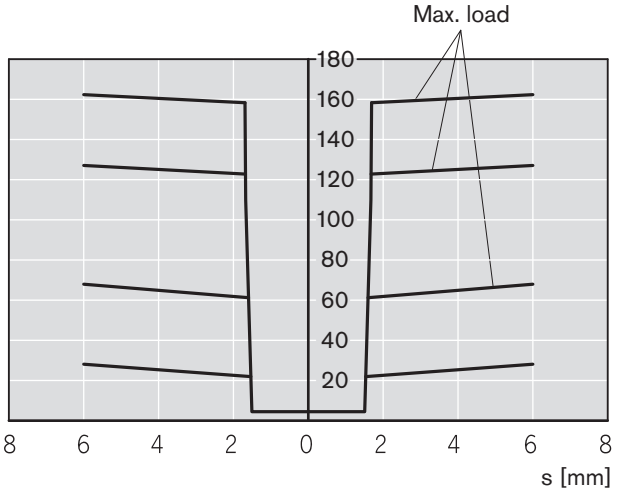
Flow versus spool travel
(characteristic curve)



Flow Q and solenoid current I versus spool travel
(characteristic curve)



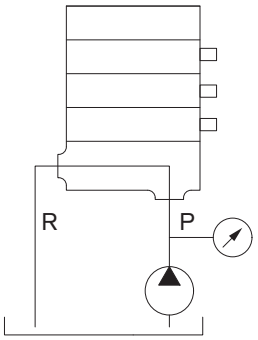
Pressure build-up versus spool travel
(characteristic curve)

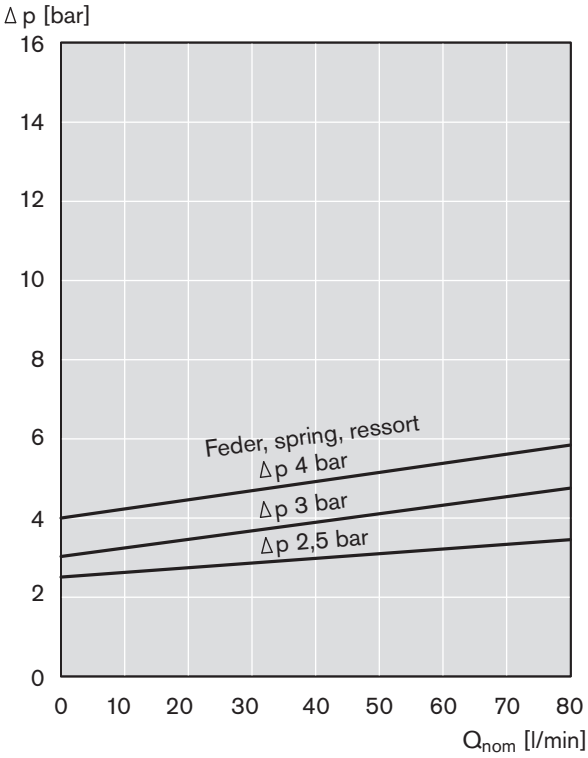


Characteristics, port plates

Open center pump control P → R

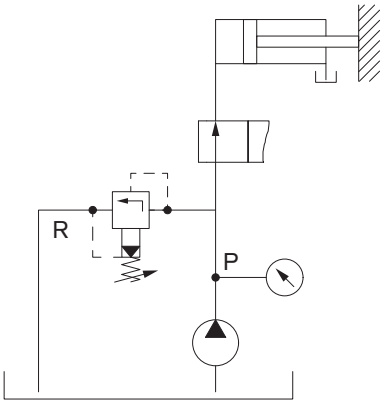
(characteristic curve)

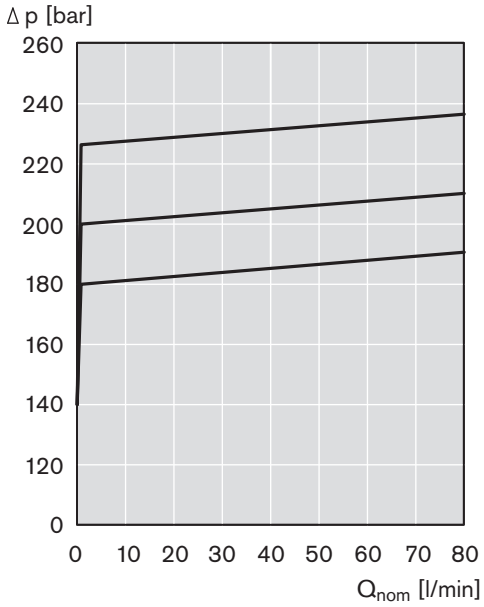




Pressure-relief valve

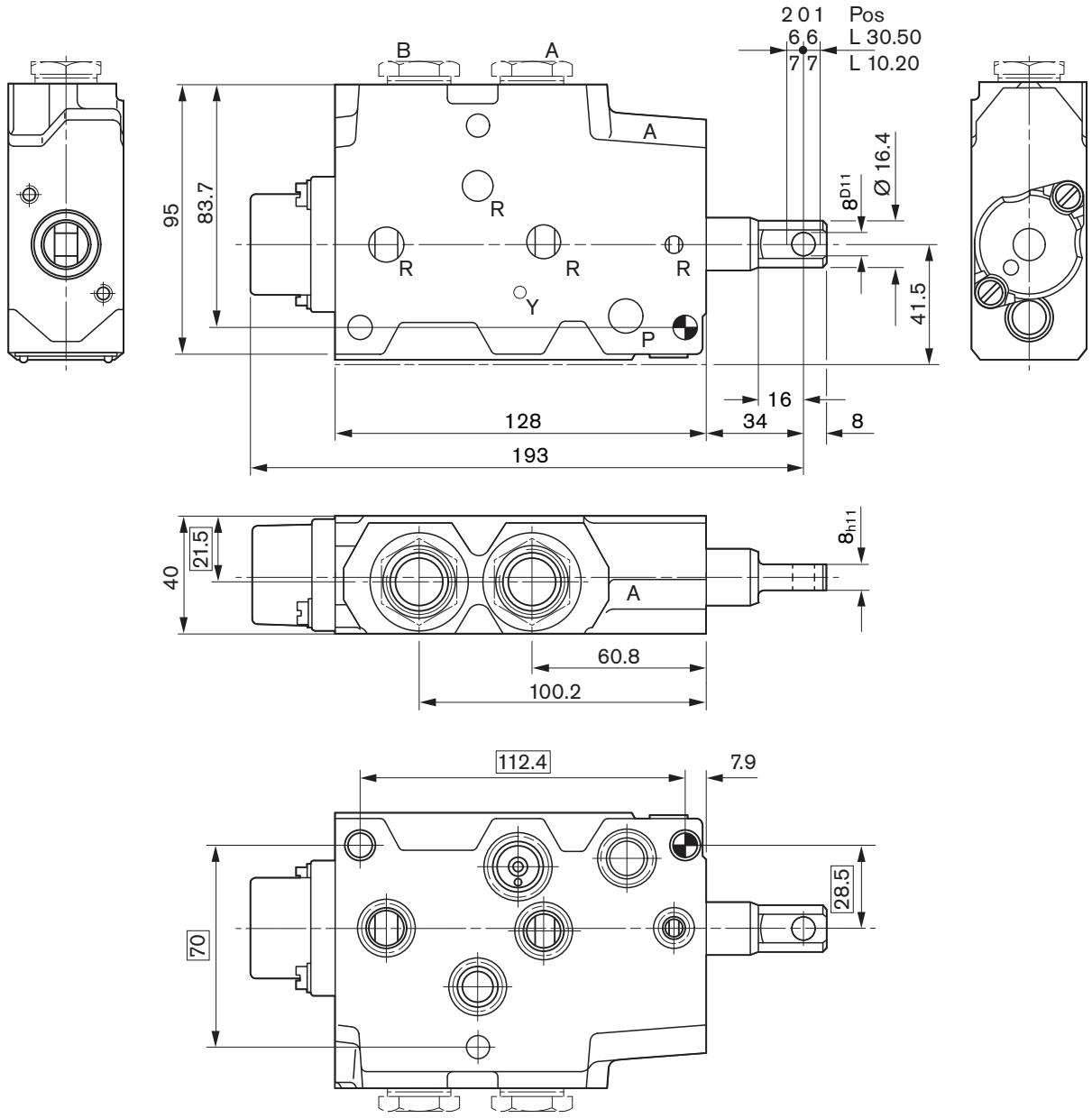
(characteristic curve)



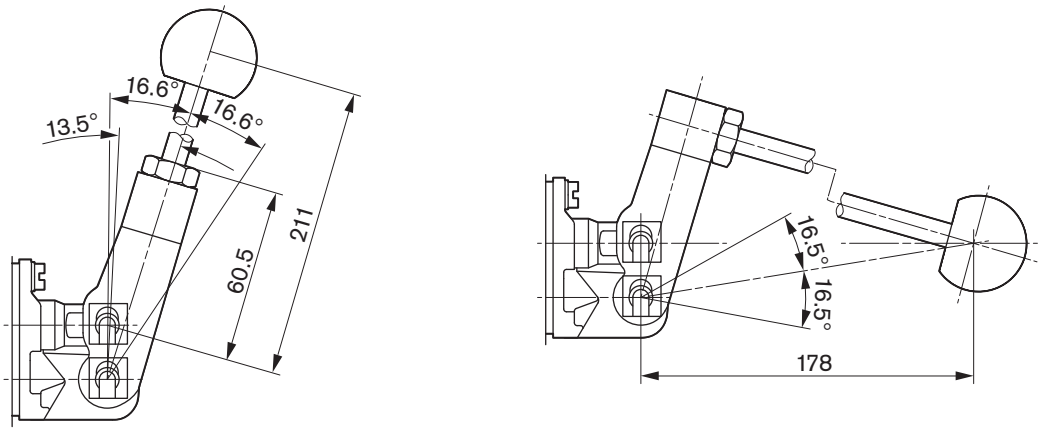


Dimensions

SB12-M directional control valve, mechanically actuated
Base valve: L 10, L 20, L 30, L 50



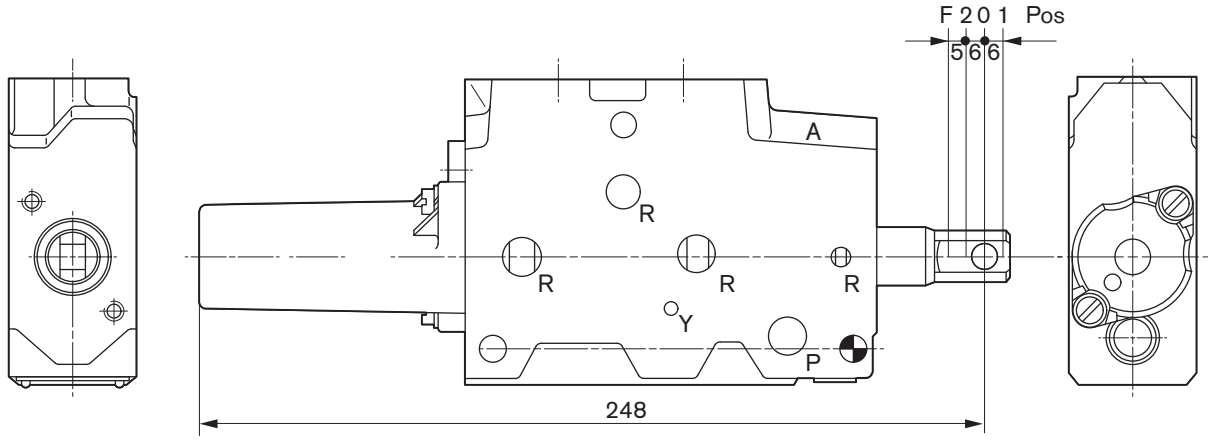
Operating element



Dimensions

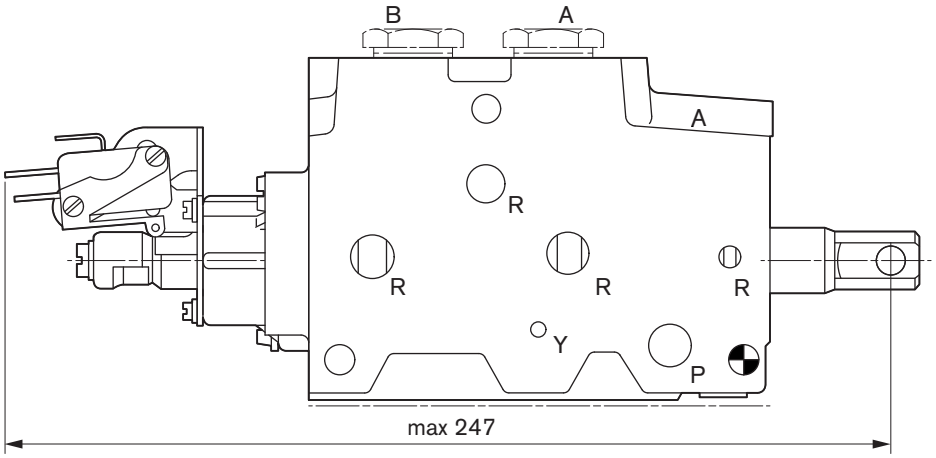
Directional control valve with auxiliary function

RM



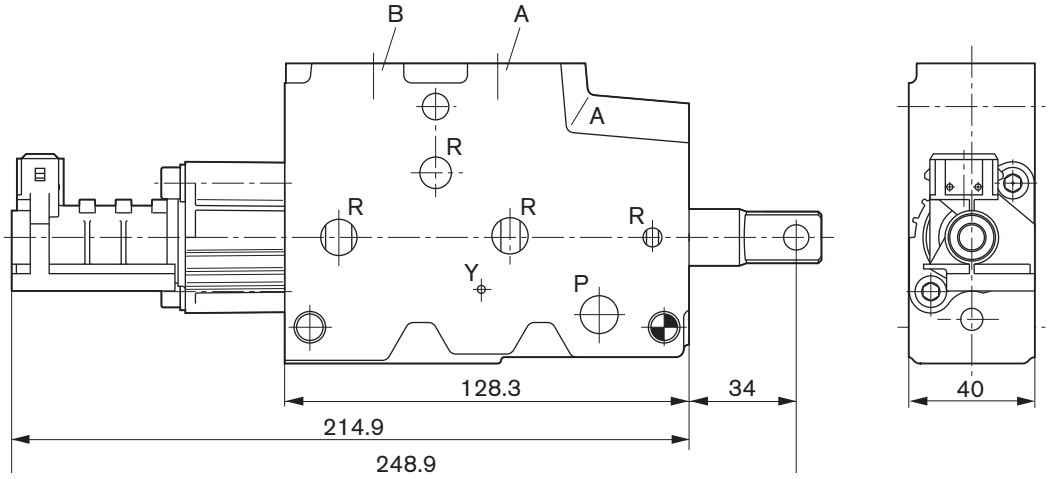
Directional control valve with auxiliary function

ES 1



Directional control valve with auxiliary function

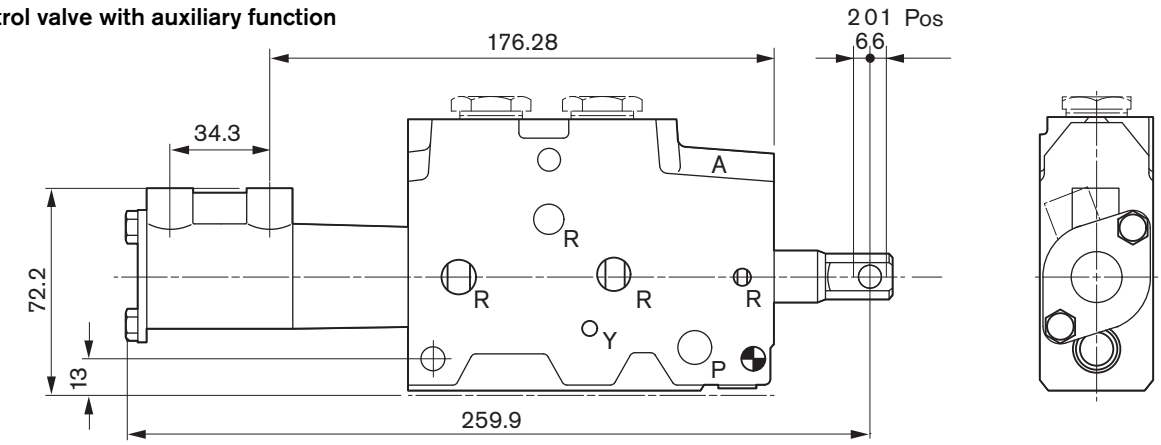
ES 2



Dimensions

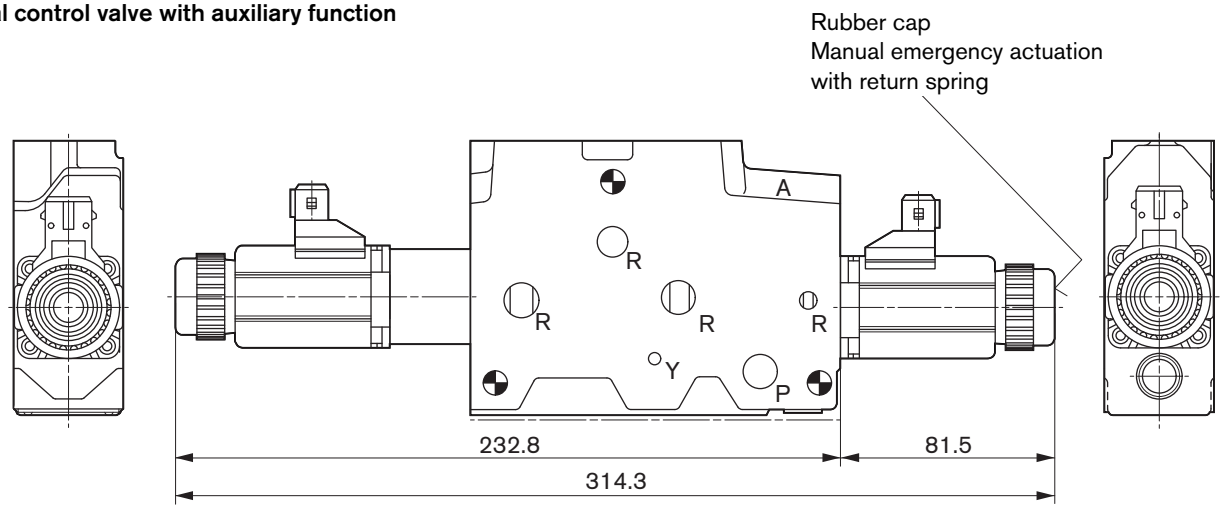
Directional control valve with auxiliary function

PN



Directional control valve with auxiliary function

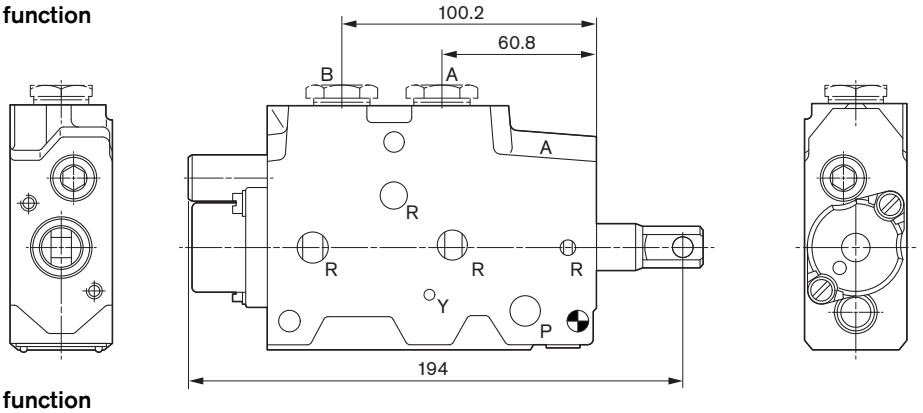
EM



Dimensions

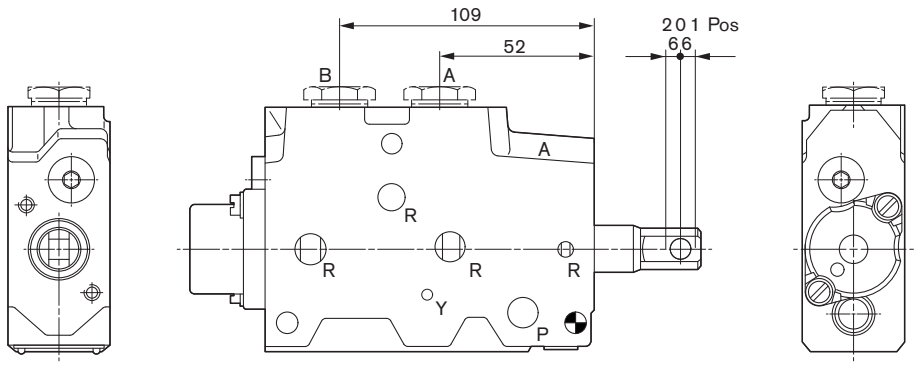
Directional control valve with auxiliary function

A1 **B1** **A2** **B2**



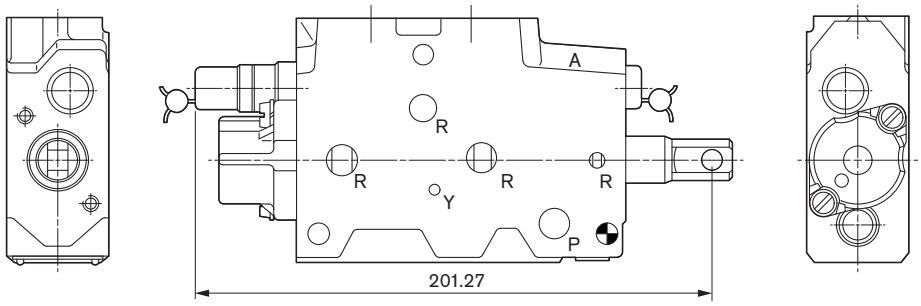
Directional control valve with auxiliary function

C1 **D1**



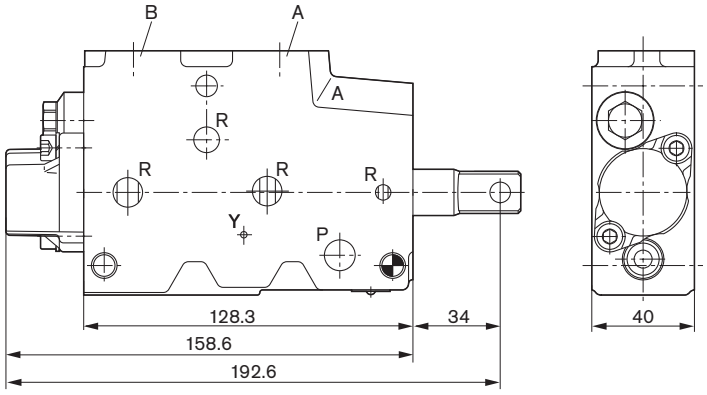
Directional control valve with auxiliary function

E **F**



Directional control valve with auxiliary function

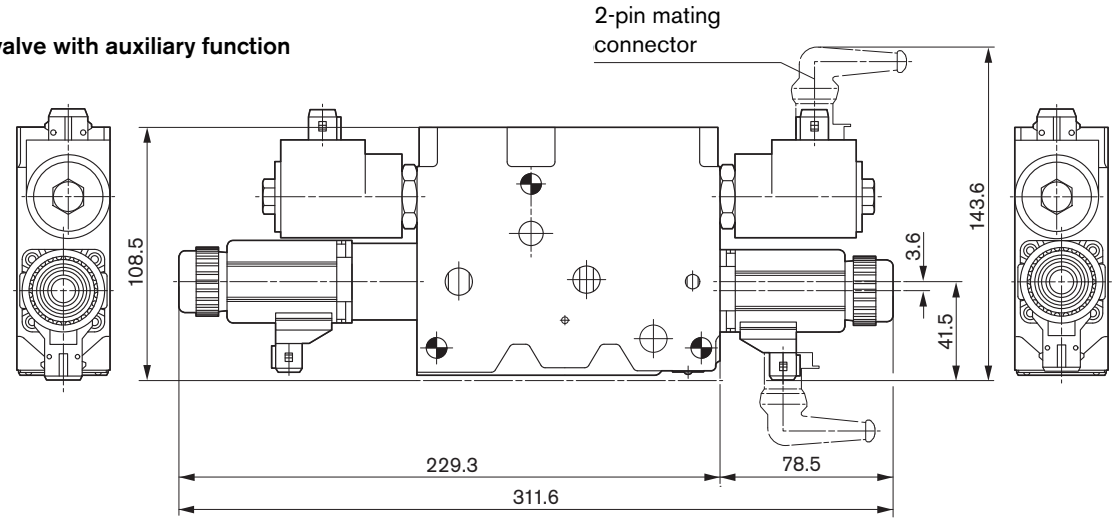
G **H**



Dimensions

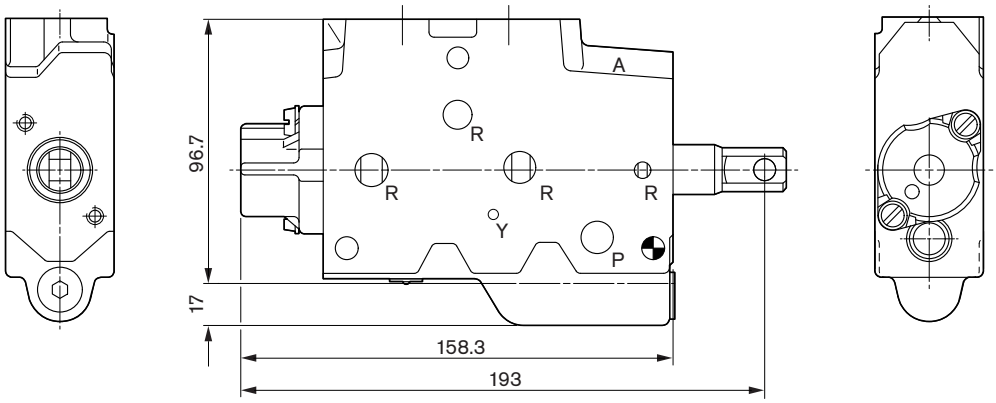
Directional control valve with auxiliary function

C3 D3 EM



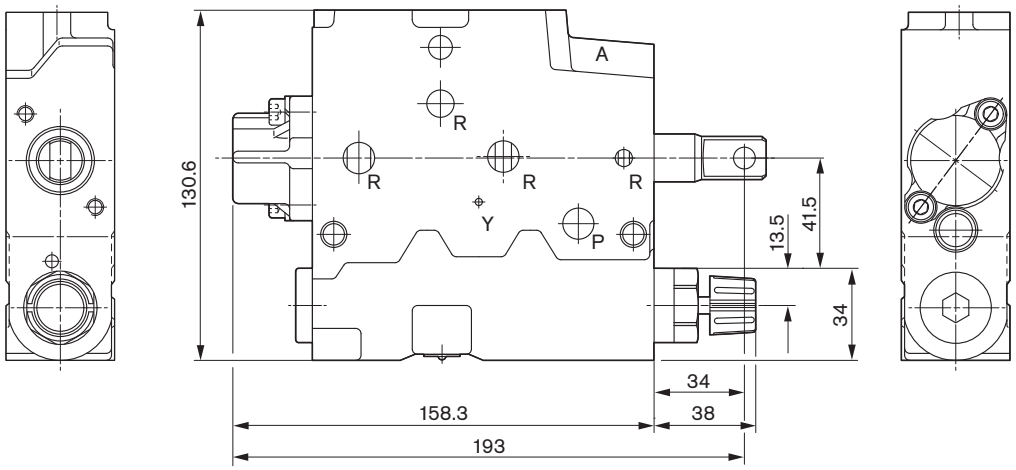
Directional control valve with auxiliary function

Q1



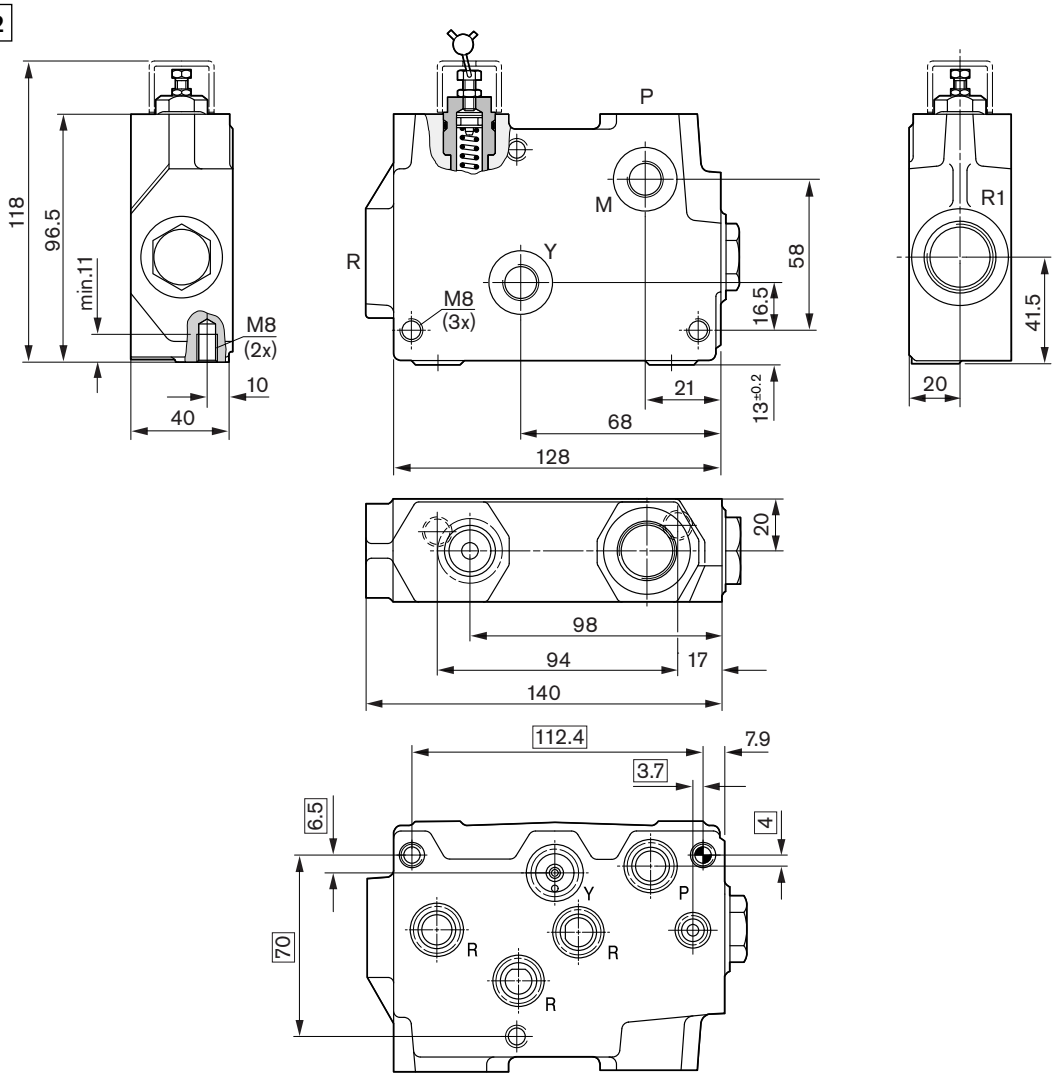
Directional control valve with auxiliary function

Q3

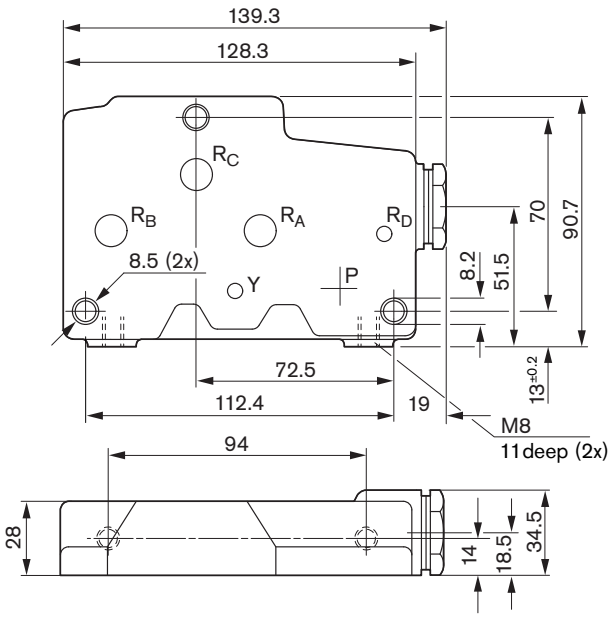


Dimensions

Port plates A1 A2
Left-hand version

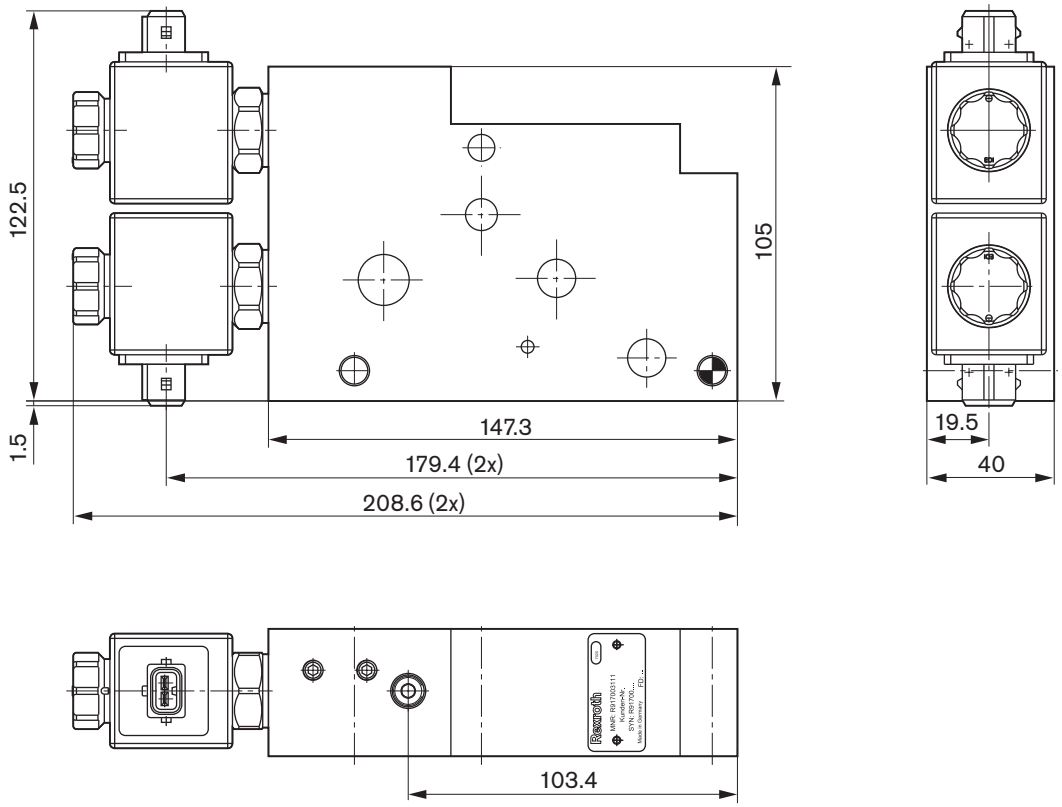


End plate E2
Left-hand version



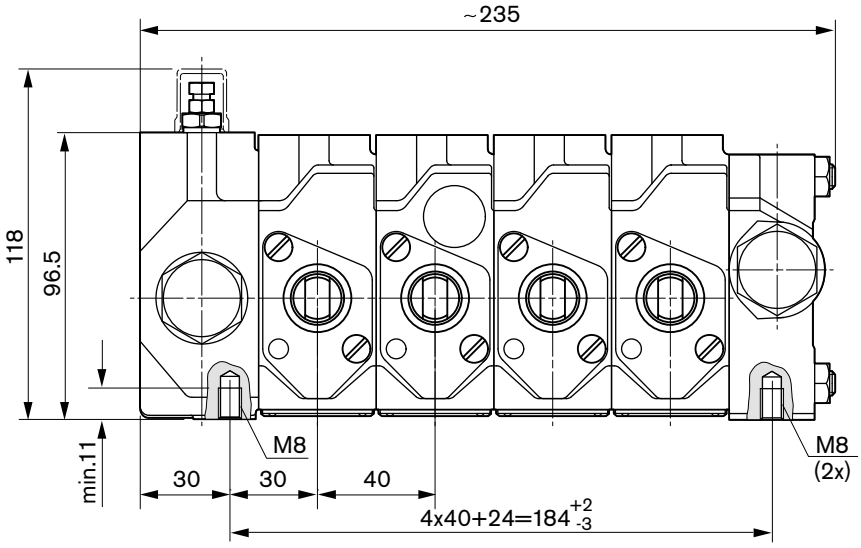
Dimensions

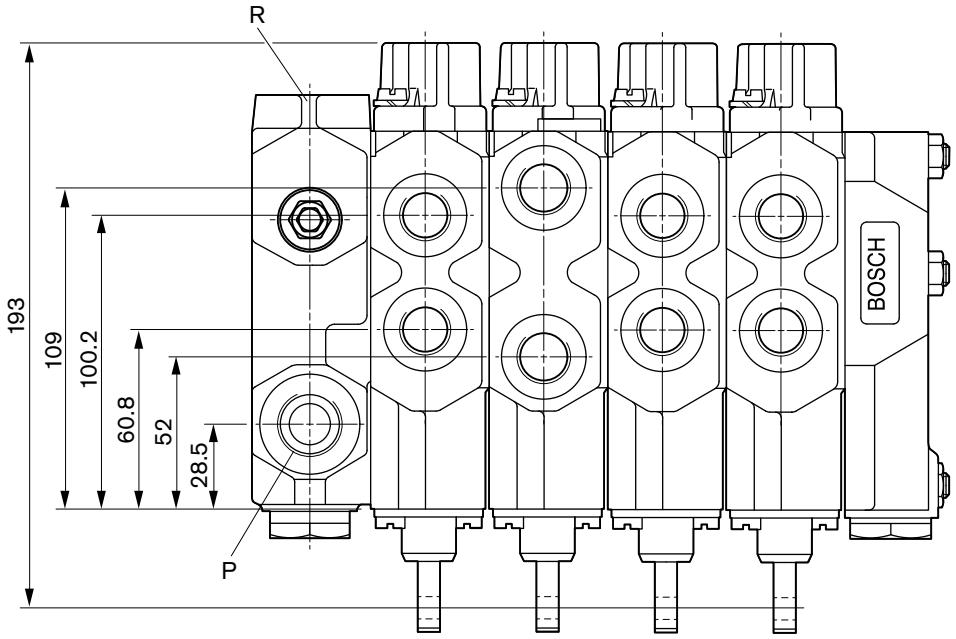
Subplate, cut-out function



Dimensions

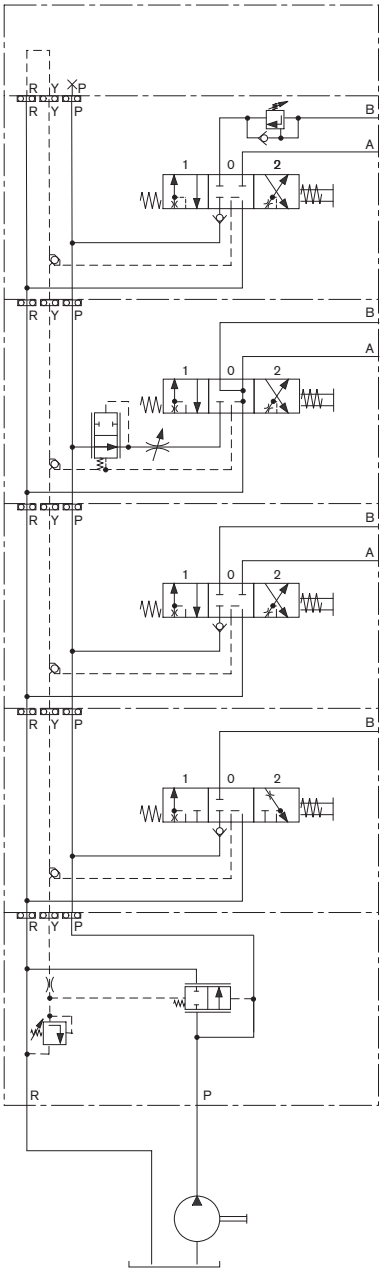
Complete control block



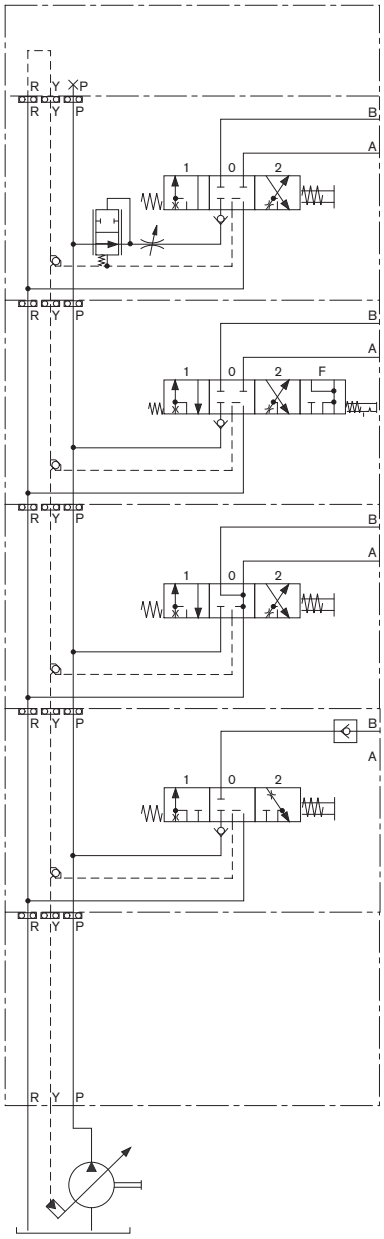


LS circuit examples

Standard control block with fixed pump

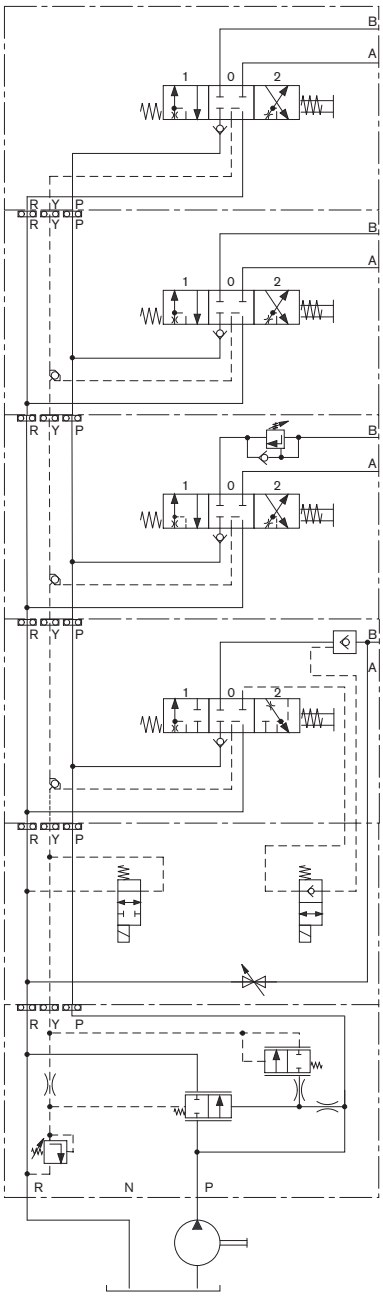


Standard control block with variable pump



Example circuit diagram:

Control block with fixed pump, SB12-M for fork lift truck applications



Endplate valve unit, double acting, as block termination.
The end plate is not necessary.

Double acting valve for the auxiliary function

Double-acting valve with integrated pilot pressure insert
for a continuous transition from pushing load to pulling load
during tilting.

Single-acting valve with integrated check valve for leak-free
load holding with the lift/lower function

Subplate with LS switching valve for connection of load sensing to check flow,
check valve switching valve for relief of check valve of bordering directional control
valve L20 D1 N and manual lowering function.

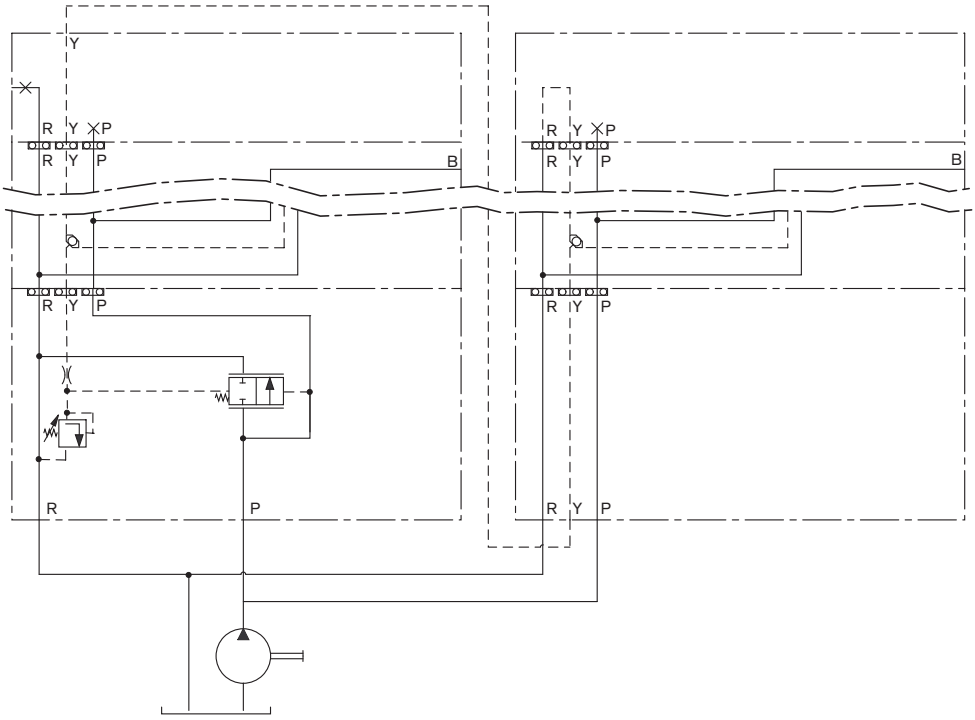
Port plate with Δp switchover for reducing the open center
pump control

Parallel switching of two LS blocks

Open center pump control, fine-control residual flow and primary PRV function via pressure compensator in block 1, i.e. block II does not require a pressure compensator of its own.

Connection:
Control line Y via port plate from block 2 to end plate block 1.
P and R via pipeline with branch before block 1.

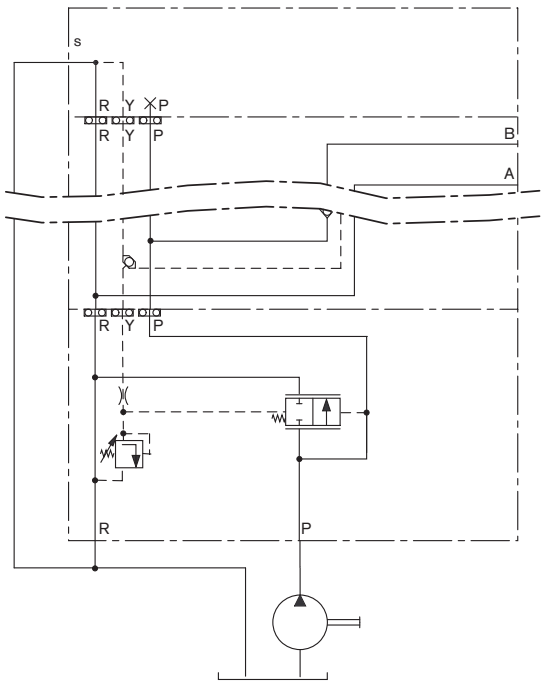
Block 1 **Block 2**

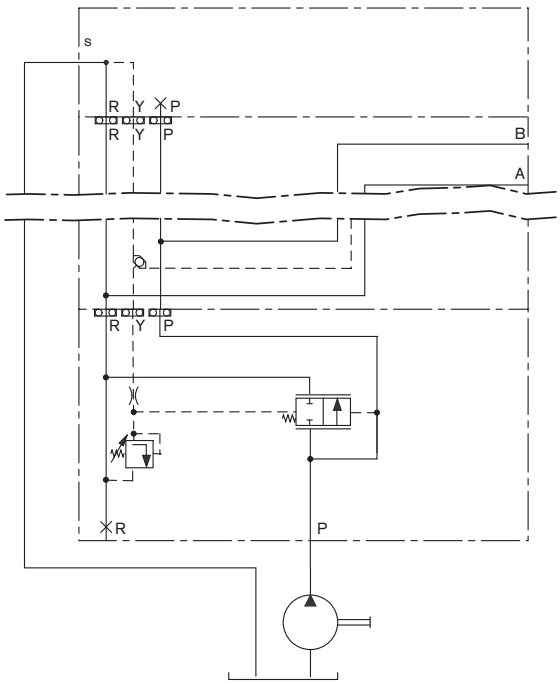


SB12 – EM

Return port in the end plate at port plate with Q greater than 30 l/min.
Port plate symb. A3/A4 not usable.

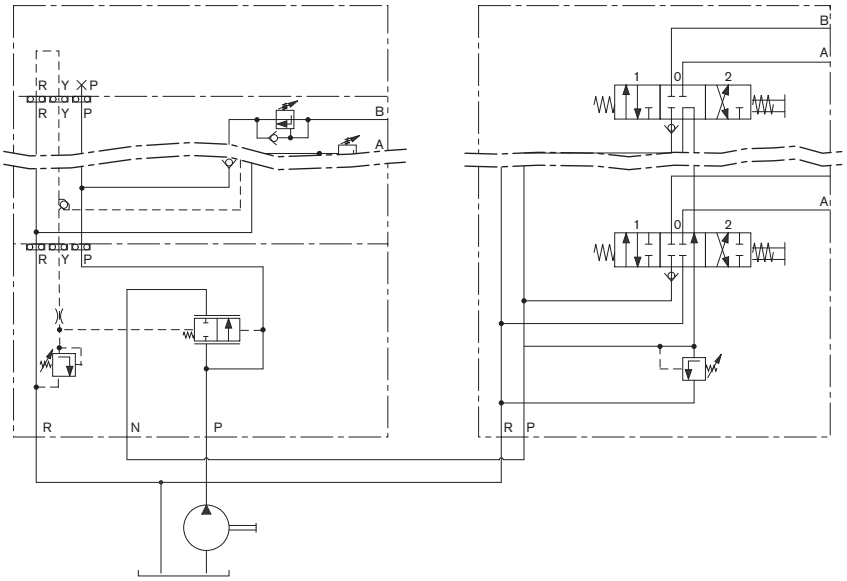
Return port only in end plate up to $Q = 30$ l/min.
Port plate symb. A3/A4 not usable.





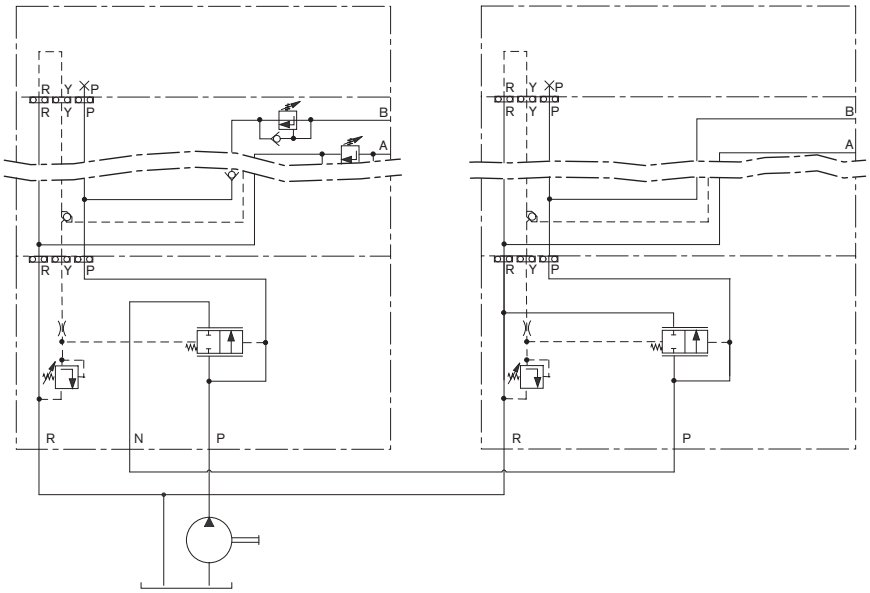
Relay link, LS block to OC block

Block II is connected in series to block I.
Block II must have own primary pressure limitation.
Open center pump control by means of block II.



Relay link with two LS blocks

Block II is connected in series to block I.



Functional description

“Load sensing” principle
Load sensing, i.e. the variable load pressure, is detected and fed to a pressure compensator or a pump controller. This principle offers the following advantages over other systems:

1. Load-independent flow control
The pressure differential Δp at the variable throttle cross-section of the directional control valve is kept constant. As a result, load fluctuations are compensated and the flow or cylinder speed is kept constant. This only applies for the cylinder with the highest load pressure which is accessed via shuttle valves.

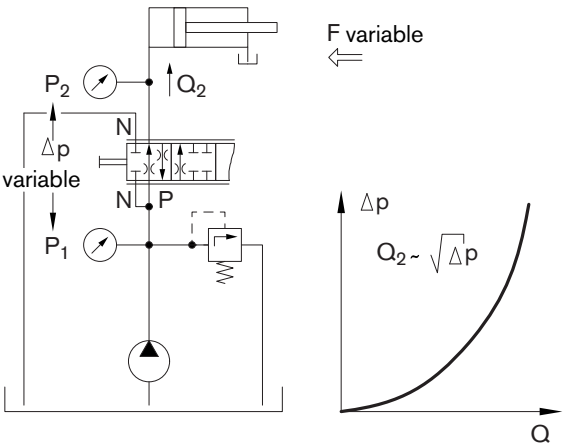
2. Power drops in the fine control range
Flow control through throttling inevitably has losses. These losses are minimized through the “load sensing” principle. A comparison with other systems illustrates this advantage.

2.1 Fixed pump with open center pump control
The excess flow is removed via the pressure-relief valve. Because its set value p_1 exceeds the load pressure p_2, there is excess pressure. Thus, there is excess power which is shared between the throttle and the pressure-relief valve and converted to heat. With negative switching overlap of the open center pump control, the excess pressure can be reduced.

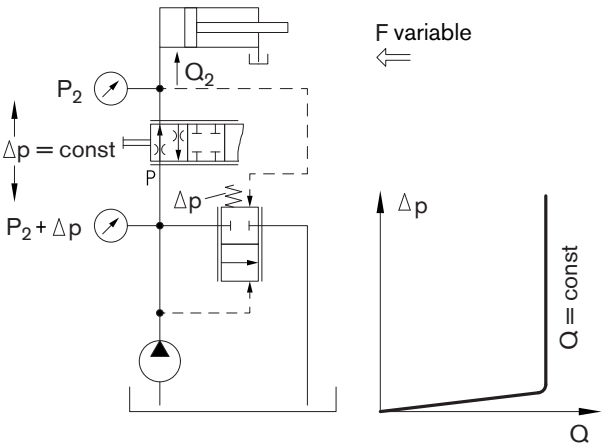
2.2 Fixed pump with “load sensing”
The excess flow is not removed by means of the maximum pressure valve, but instead via a parallel pressure compensator. This does not open at p_1, but instead at the measured load pressure p_2 plus the spring precharge pressure, which determines the pressure difference Δp at the throttle. This configuration corresponds to a 3-way flow control valve and ensures not only improved power balance, but also a consumer flow which is independent of load fluctuations.

2.3 Variable pump with “load sensing”
The pressure compensator is a component of the pump control system and controls the delivery according to the opening cross section of the throttle. This adaptation occurs when the load pressure is detected, i.e. neither excess pressure nor excess delivery occurs. Only the pressure difference Δp at the throttle, determined by the spring of the pressure compensator, still generates a slight dissipation power. This system requires a variable pump with corresponding controller.

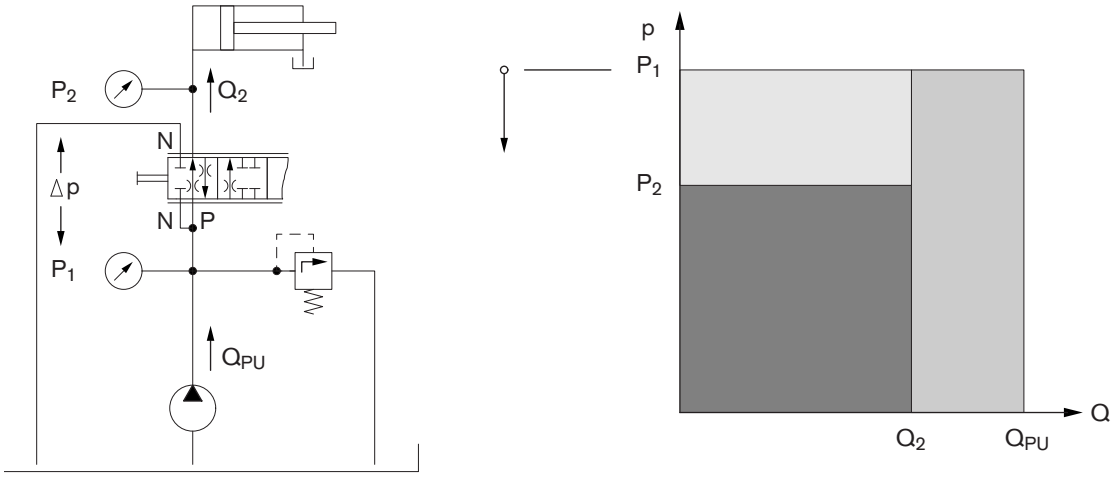
OC system



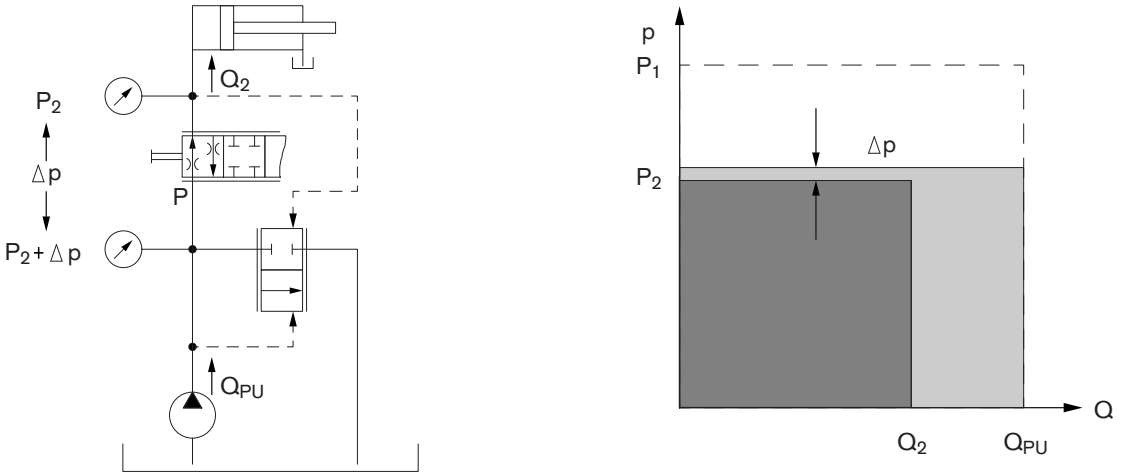
LS system



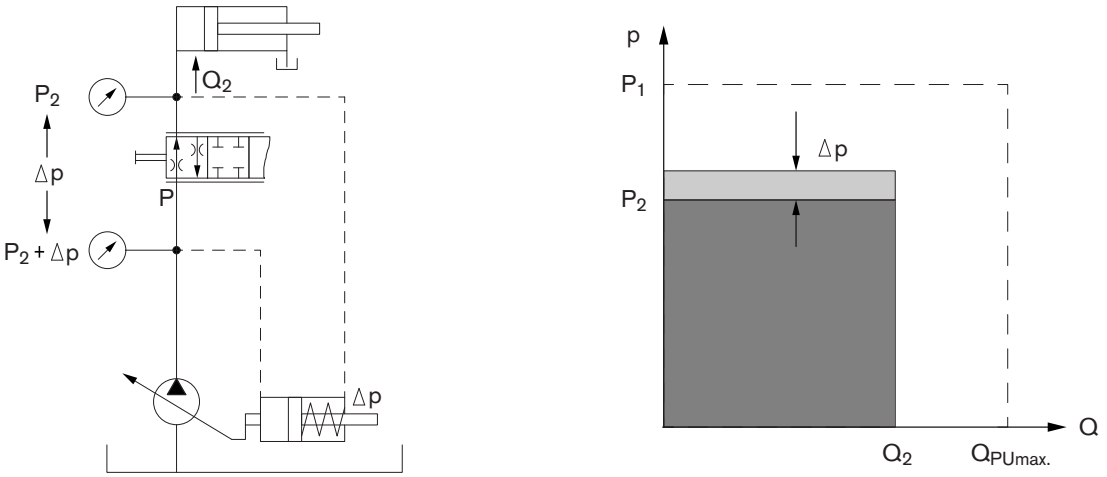
Fixed pump with open center pump control N



Fixed pump with “load sensing”



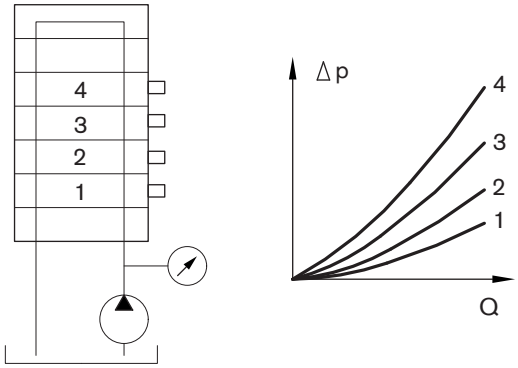
Variable pump with “load sensing”



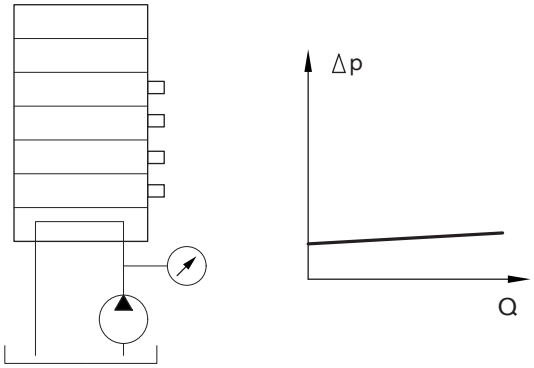
3. Power drops in the open center pump control
In standard systems with open center pump control by means of the valve block, the open center pump control pressure is dependent on the number of directional control valve segments.

For LS systems, the open center pump control occurs with minimal pressure directly in the port plate. With the Δp switch-over (optional), this pressure can also be minimized.

OC system

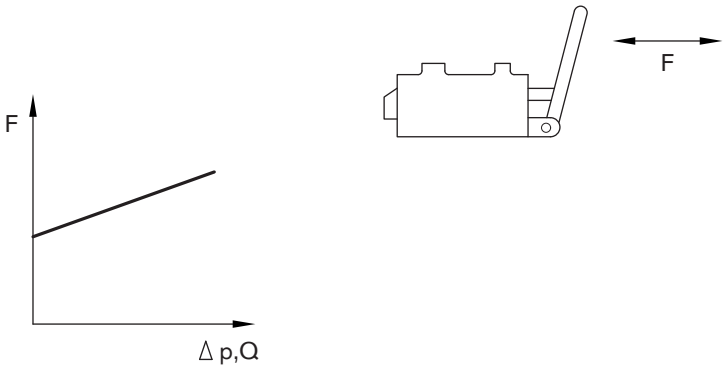


LS system

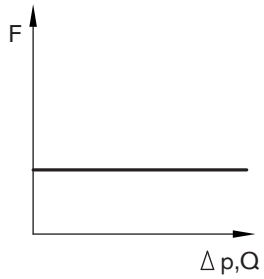


4. Actuation force at the valve spool
In standard systems, the flow forces, and thus the actuating forces at the valve spool, increase with the transmitted hydraulic power. For LS systems, the actuating forces are smaller and remain constant.

OC system

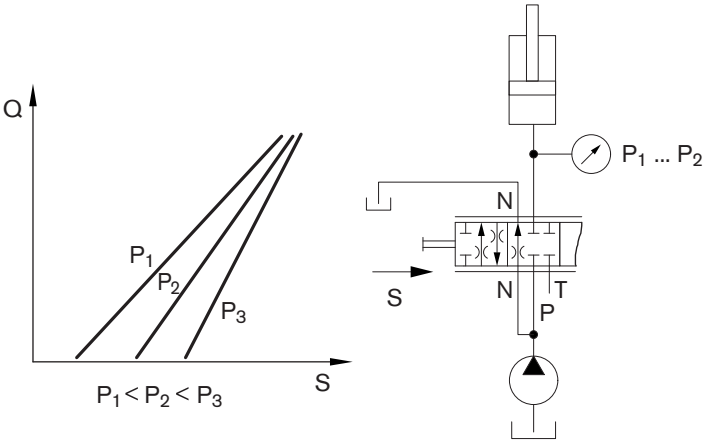


LS system

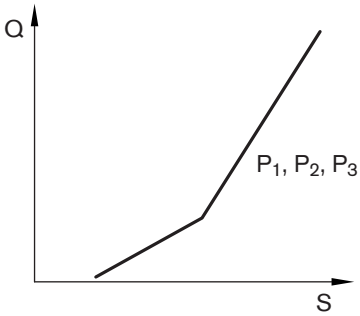


5. Control characteristic
With conventional systems, the flow is load dependent. Moreover, the connection to the consumer at higher load pressures is opened only with a larger spool travel since the connection to the open center pump control must be more strongly throttled. LS systems are characterized by a control characteristic which is independent of load pressure.

OC system



LS system

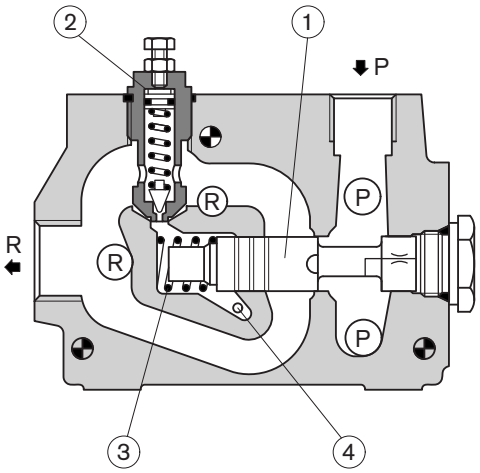


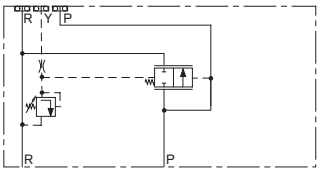
Port plate

Basic version $\Delta p = 3$ bar

In addition to the infeed and return ports of the valve block for use with fixed pumps, the port plate contains a pressure compensator as well as an adjustable pressure-relief valve. The pressure compensator performs 3 functions:

- In combination with the instantaneous throttle cross sections at the directional-control-valve pilot spools, it functions as a 3-way flow regulator. The load pressure acts on the spring side of the pressure compensator via control line Y. The spring determines the pressure differential at the throttle cross sections of the directional control valves. This is held constant by the pressure compensator ($\Delta p = 3$ bar).
- When the control line is depressurized (all directional control valves in the home position), the pressure compensator opens due to the effect of the inflow pressure and releases the open center pump control.
- Together with the adjustable pilot valve, the pressure compensator forms the main level of a pilot controlled pressure-relief valve for ensuring the maximum operating pressure.





Port plate

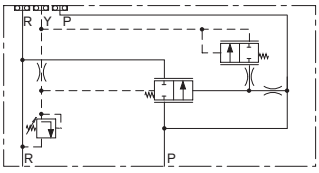
with Δp switchover 2.5 bar/7 bar

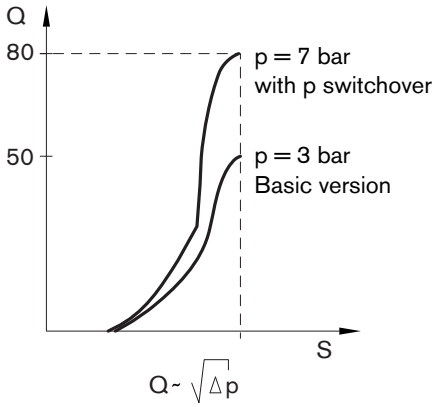
The flow at one throttling point is dependent on the pressure differential according to $Q \sim \sqrt{\Delta p}$.
If the pressure differential is increased from $\Delta p_1 = 2.5$ bar to $\Delta p_2 = 7$ bar, the nominal flow $Q_1 = 50$ l/min can be increased to

$$Q_2 = Q_1 \sqrt{\frac{\Delta p_2}{\Delta p_1}}$$

$$Q_2 = 50 \sqrt{\frac{7}{2.5}} = 80 \text{ l/min}$$

The increased pressure differential does, however, mean increased power drops, which are to be avoided particularly during open center pump control.
A switchover from $\Delta p = 2.5$ bar during open center pump control to $\Delta p = 7$ bar with opened directional control valves is realized with a special port plate. The switchover occurs via a switching valve which is integrated in the pressure compensator.



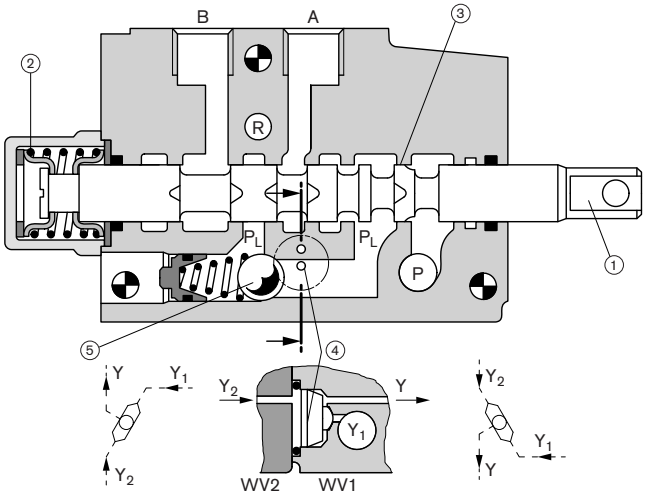


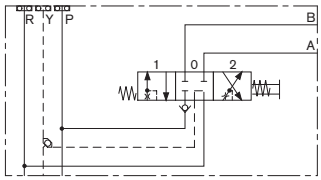
SB12-M directional control valve

Basic version

The basic version shown here is a double-acting directional control valve with 2 service line ports A and B. The valve spool ① is held in the middle position by means of a return spring ②. In addition to the regular metering notches between ports P, A, B and R, the valve spool also controls the opening cross section ③ of the inflow P–P_L, which, together with the pressure compensator in the port plate, determines the speed of the consumer (flow control valve function). A shuttle valve for the load tap ④ is arranged vertically with respect to the spool axis in the flange surface.

A check valve ⑤ in channel P_L prevents an undesired lowering of the load in the fine control range and during simultaneous actuation of multiple directional control valves.



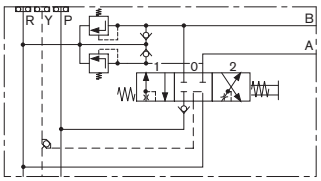


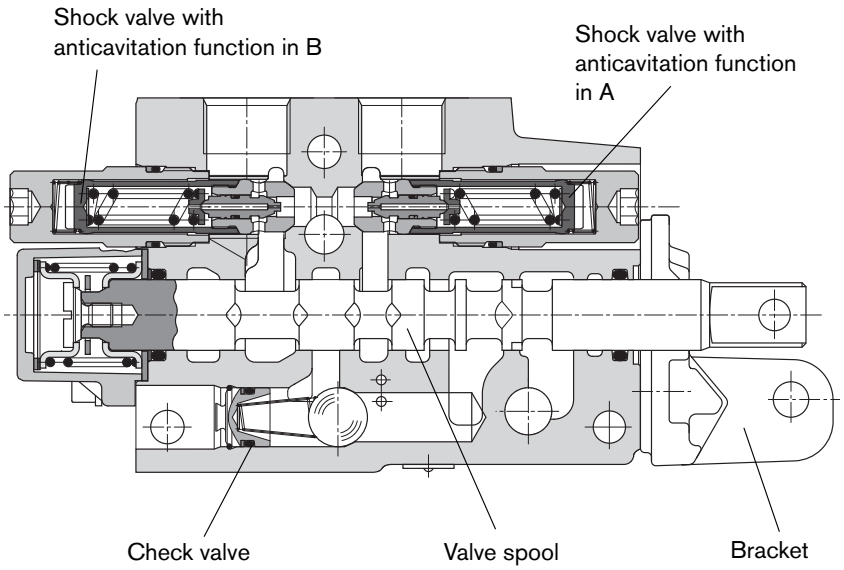
① Valve spool
② Return spring
③ Opening cross section
④ Shuttle valve
⑤ Check valve

Ports

P	Pump
A, B	Consumers
R	Tank
Y	Load Sensing (LS)

Left-hand version of SB12-M directional control valve, mechanically actuated L30-A1 B

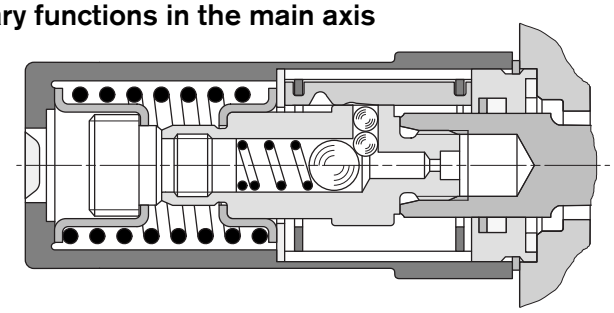




Directional control valve – actuation types, auxiliary functions in the main axis

Mechanical actuation **RM**

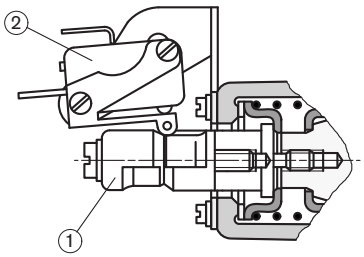
Detent, mechanical release



Electrical switch **ES1**

Various switching points can be set by turning the switch hub ① and the electrical switch ②. Either 1 or 2 electrical switches may be used.

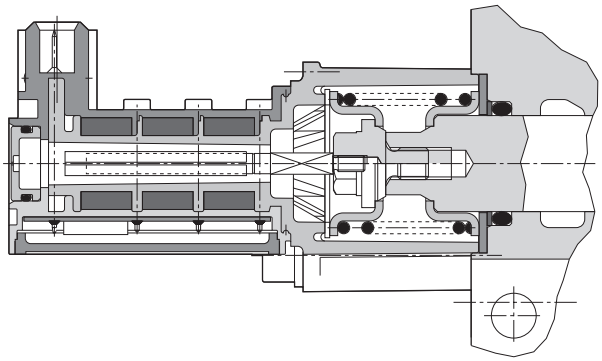
Adjust by turning ① and ②.



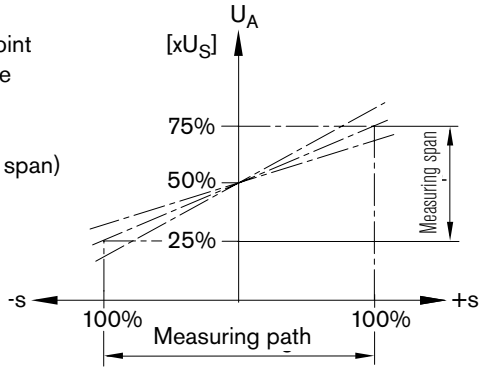
Switch as changeover contact with plug connections.
Type of protection IP 00 DIN 40050.
Load capacity, AC current:
10 A 250 V~, 125 V~/0.25 kW inductive.
Load capacity, DC current:
Inductive loading at NN
0.5 A 125 V=, 0.25 A 250 V=, 5 A 30 V=*).
Ohm's load: 5 A 30 V=**).
Electric engine, continuous current 5 A 30 V=**).
Mechanical service life $> 10^7$ switching cycles.
*) Inductive switching capacity acc. to AN 3179.
**) Switch-on peak must not exceed 6x the specified continuous current.

Position sensor **ES2**

Conversion of the mechanical spool stroke to a proportional electric signal
Supply voltage U_S = 4.75...16.5 V



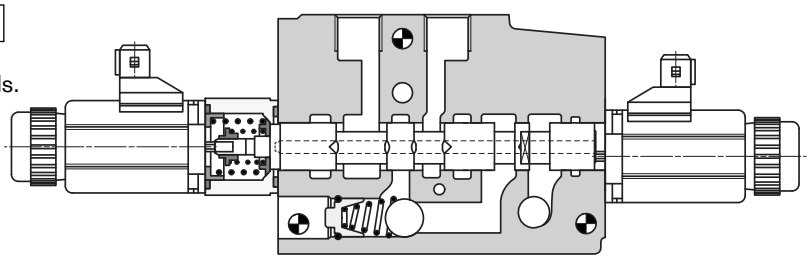
Characteristic
following ideal zero-point calibration on the valve
Sensitivity: ± 6 %
Linearity: ± 1.5 %
(relative to measuring span)



Direct operated electromagnetic actuation **EM**

Solenoids mounted on both sides of the spool ends.

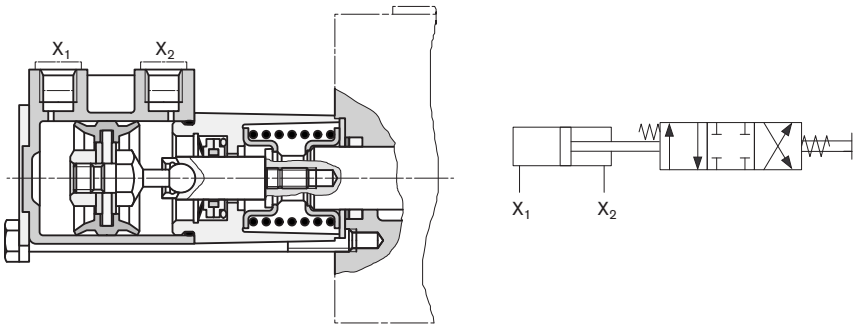
Actuation via joystick potentiometer with integrated electronics or switching.



Auxiliary functions in main axis, actuation types

Pneumatic actuation PN

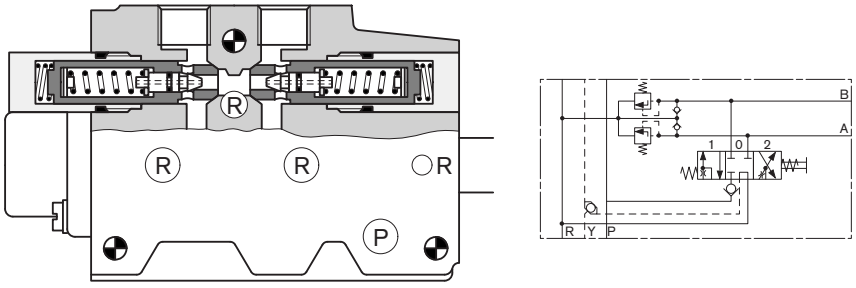
Auxiliary actuation with respect to hand lever.
Actuation via pneumatic switching valve.
p_{st} min. 1 bar
p_{st} max. 4 bar



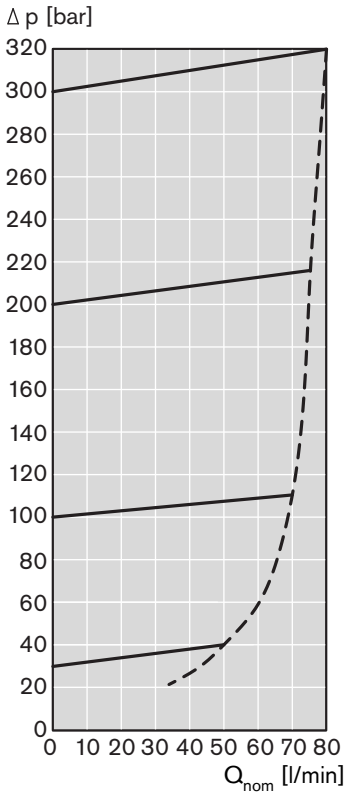
Auxiliary functions of upper axis

Shock valves A1 B1 A2 B2

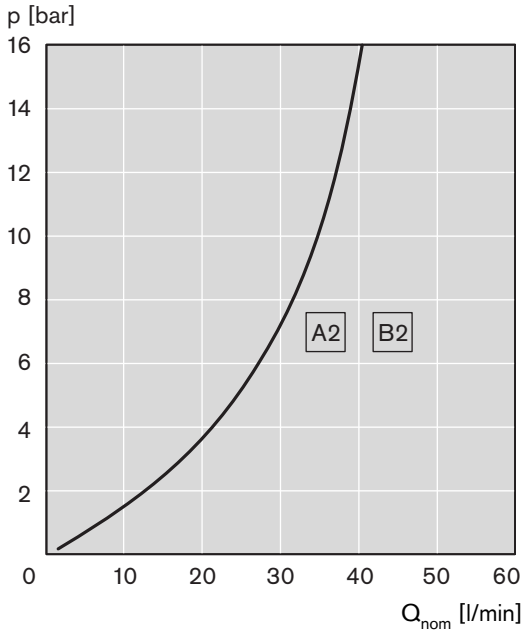
Shock valves, a combination of pressure relief valve and anticavitation valve, are used to safeguard against peak pressures caused by impacts or acceleration forces on the consumer. This auxiliary equipment can be located in one or both service line ports, e.g. A1 B1.



Shock valves A1 B1



Flow resistance of the anticavitation valve A2 B2



Auxiliary functions of upper axis

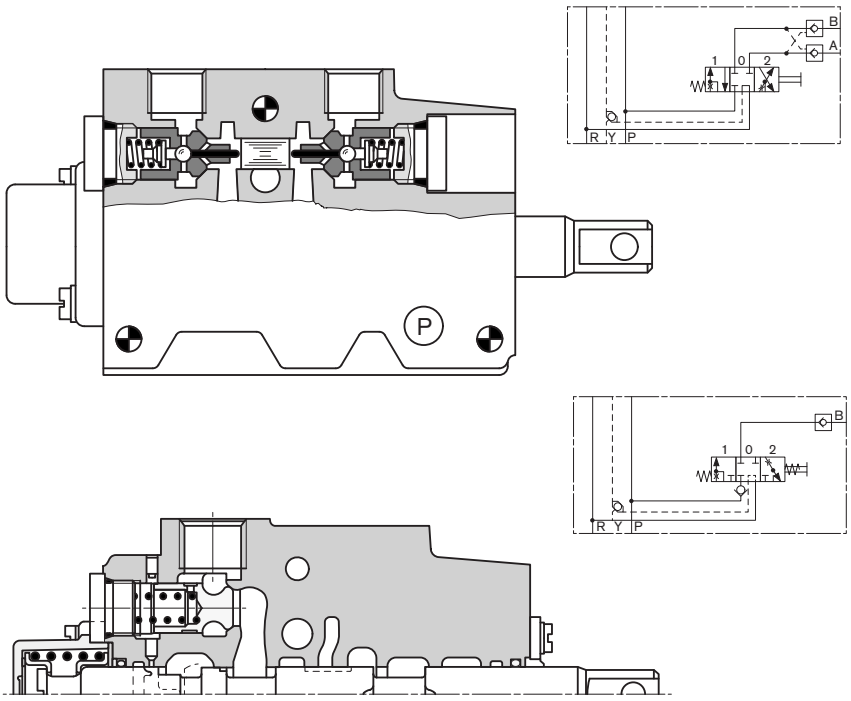
Hydraulically disengaging check valve

C1 D1

The pilot pressure for disengaging is generated by the pump. The pilot controlled sealing cone is disengaged via a spool and a plunger.

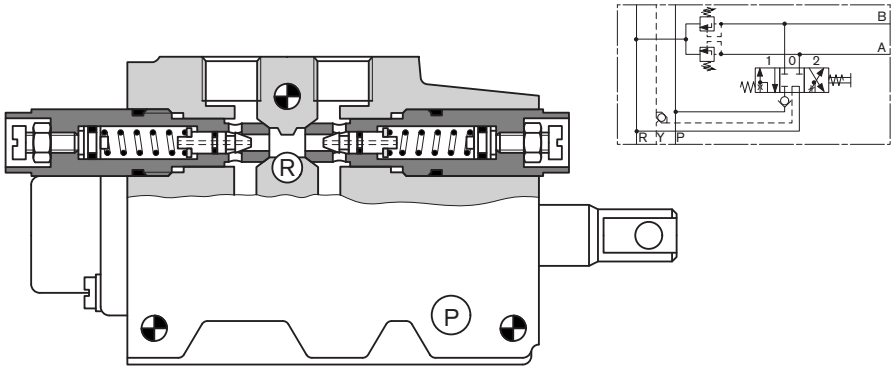
The area ratio of spool to pilot cone is 8 : 1.
The opening pressures are calculated accordingly.

For an L20-D1 single-acting directional control valve, the sealing cone can also be disengaged by the load pressure. For this purpose, the spring chamber of the sealing cone is disengaged while lowering into the back flow.



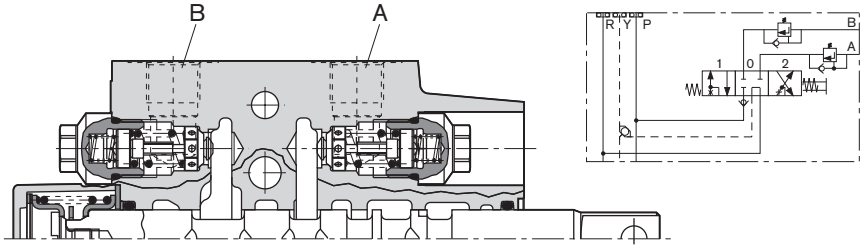
Secondary pressure limiting E F

Adjustable pressure-relief valves in the service line ports limit the inflow pressure of the respective consumer to a value which is less than the pressure safeguarding of the directional control valve block. It can be located in one or both service line ports.



Pilot pressure inserts G H

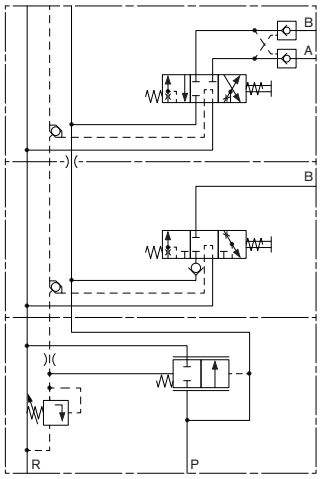
Pilot pressure inserts are used on the return side of double-acting consumers. They act against the load pressure with a permanently set value, thereby preventing the load from advancing. The valves can be located in one or both service line ports.

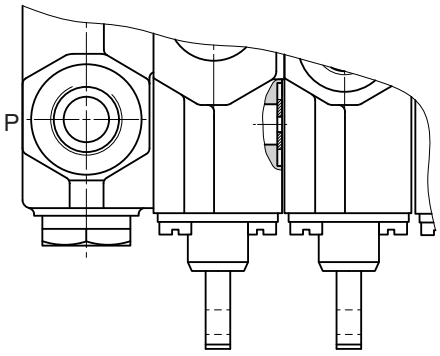


Auxiliary functions of lower axis

Metering restrictor in the P-channel

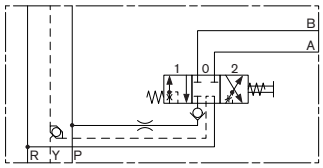
For limiting Q_{max} in independent operation of the directional control valves of the downstream block section.

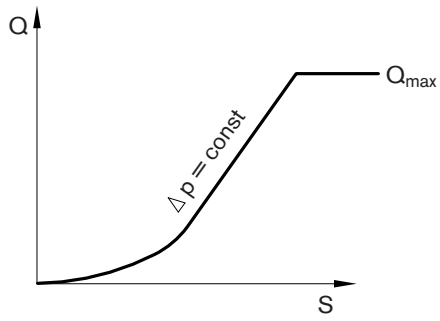




Metering restrictor in the inflow Q1

For limiting Q_{max} in independent operation. It acts together with the pressure compensator of the port plate as a 3-way flow control valve. During parallel operation, the highest load pressure is reported to the pressure compensator. May either be fixed or adjustable.

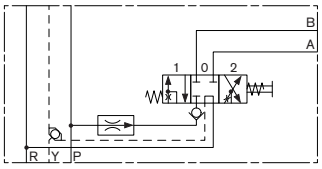


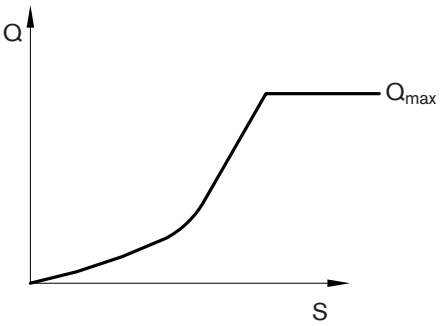


2-way flow control valve in the inflow Q2

For limiting Q_{max} in parallel operation. Also effective if the load pressure of the other consumers is higher.

Permanently set $Q_{max} \leqq 34$ l/min.





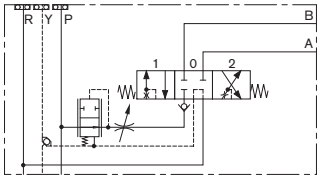
Auxiliary functions of lower axis

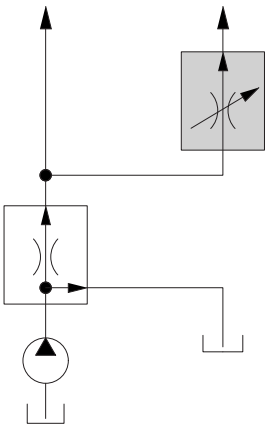
2-way pressure compensator

in the inflow **Q3**
(Individual pressure compensator)

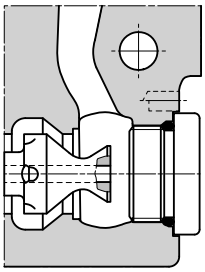
For load-independent speed control over the entire actuation range, even during parallel operation.

Metering restrictor for Q_{max} limiting, fixed or adjustable.

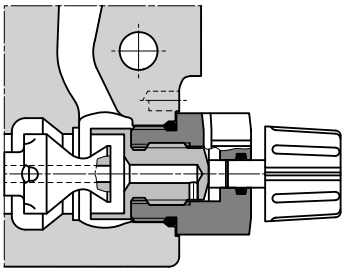




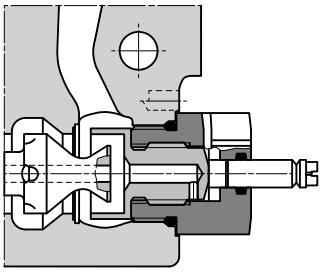
Metering restrictor adjustment Q3, overview



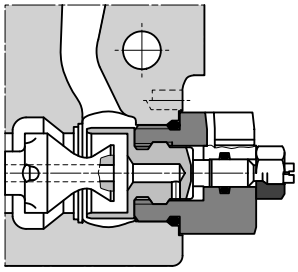
None



Manual adjustment



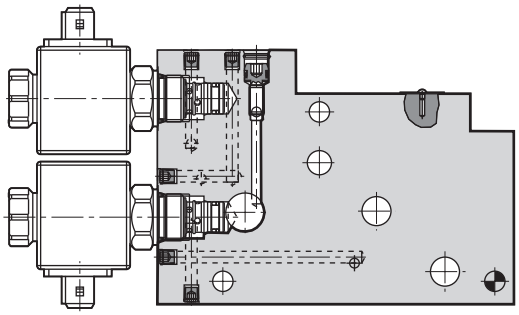
Control shaft

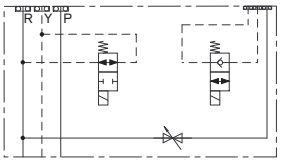


Adjustable restrictor

Subplate

Subplate with LS switching valve for connection of load sensing to return flow, check valve switching valve for relief of check valve of bordering directional control valve L20 D1 N and manual lowering function.





Notes

Notes

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