Open center control block in sandwich plate design SM12

RE 64122/07.2016
Replaces: 05.2003

3SM12

- Series 1X
- Maximum pressure — Medium pr. — High pr.
  - pump side — 250 bar — 350 bar
  - actuator side — 300 bar — 400 bar
- Flow at each directional valve 70 l/min

Features

- Control principle: 6/3-way system
- Circuit types: parallel, tandem or series circuits
- Low internal leakage
- Compact control block with low pressure losses
- Good fine control due to the extensive use of fine control grooves
- System protection via primary and secondary pressure relief valves

Design

- Compact sandwich plate design, can be combined so that the control block can meet the requirements of differing machines:
  - Inlet element
  - Up to 10 directional valves
  - End element
- Type of actuation
  - Hydraulic
  - Mechanical

Fields of application

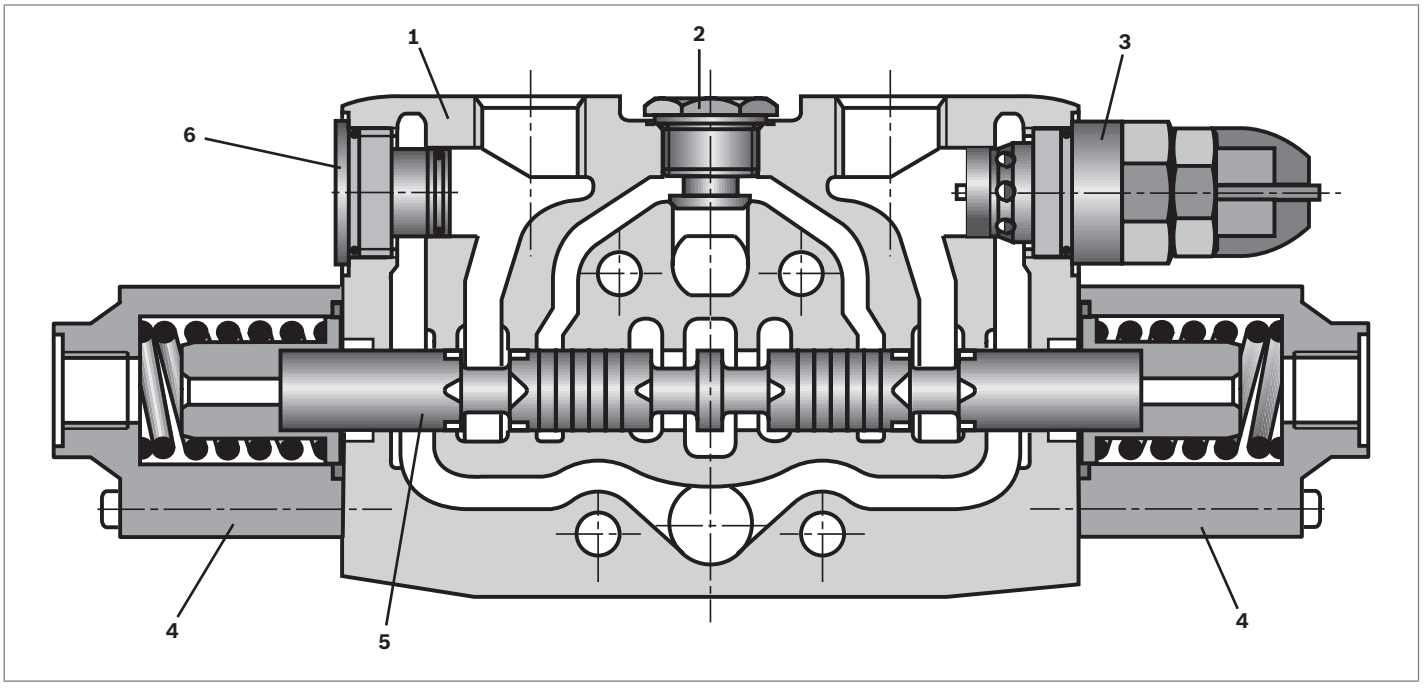
- Mini excavators, excavators, auxiliary functions on agricultural tractors, loaders, drilling rigs, lifting machines, material handling

Contents

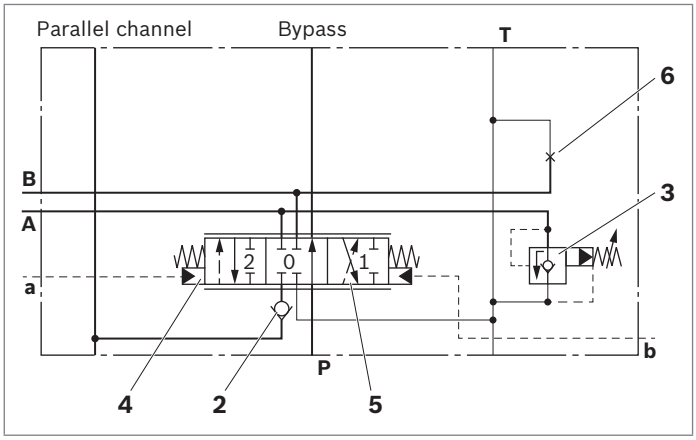
Functional description

The SM12 control block basically comprises of an inlet element, directional valve elements and an outlet element. The control blocks are designed to the 6-way principle and comprises of a housing (**1**), control spool (**5**), load holding check valve (**2**), spool actuation and return system (**4**), cavities (**3**) for the secondary pressure valves or relief/ anti-cavitation valves, as well as anti-cavitation valves or plugs (**6**).
With all of the spool axes in their neutral position the flow passes via the bypass channel at zero pressure to tank. If one of the control spools is actuated then the connection from the pump to the actuator is opened via the fine control grooves, whilst the bypass is throttled by fine control grooves. If the pump pressure exceeds the actuator pressure, the pressure fluid starts to flow over the check valve to the actuator. With further movement of the control spool (**5**) the volume of fluid is increasingly diverted from the bypass channel to the actuator (fine control).
The spool stroke is divided into three phases: overlap (leak-free in the neutral position), fine control range (flow and pressure), residual stroke (fully open). Due to the large fine control range of the spool stroke it is possible to sensitively control the actuators.

▼ **Section SM12**



▼ **Symbol SM12, hydraulic**

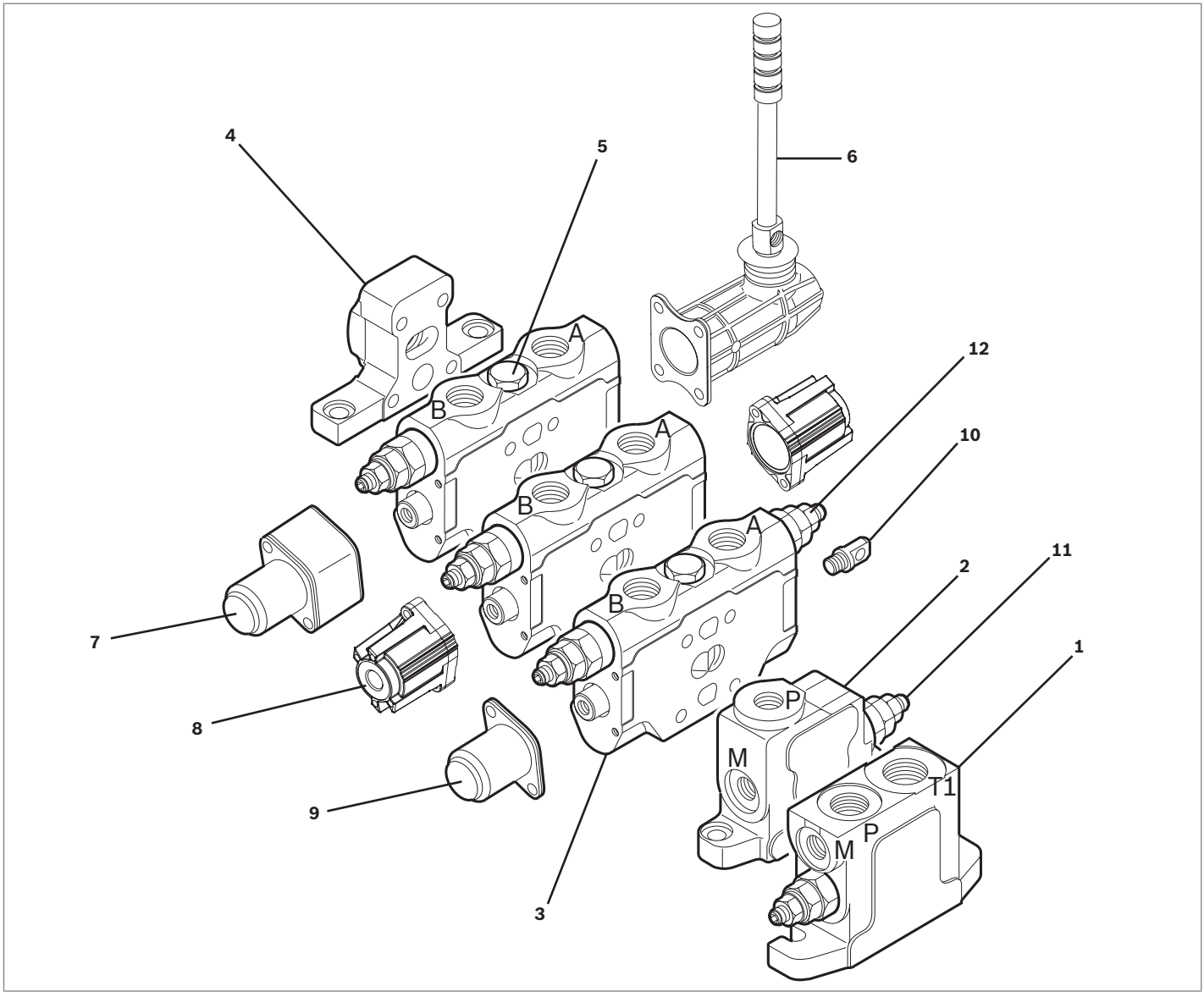


1 Housing
2 Check valve
3 Secondary valve
4 Operating element
5 Spool
6 Plug screw

Ports	
P	Pump
A, B	Actuator
T	Tank

Control block, basic version: Modular design

▼ **Modular design SM12**



1 Inlet element, separate, with connection **T1**, version **E** (only for the medium pressure version)
2 Inlet element, separate, without connection **T1**, version **A** (only for the high pressure version)
3 Directional valve element
4 End element, version **R** or **C**
5 Check valve
6 Manual operator, encapsulated lever, version **R5**
7 Spring return mechanism, detents in switched positions 3, version **E2**
8 Control cover for hydraulic actuation **H200**
9 Spring return cover, version **A2**
10 Mechanical operator with tongue, version **Z1**
11 Primary pressure relief valve
12 Secondary valve

Technical data

General			
Weight	Inlet element, separate, with connections P and T1	kg	1.8
	Directional valve	kg	2.1
	End element	kg	0.9
Installation position			Any
Type of connection			Pipe threads according to ISO 228/1 (Standard)
Ambient temperature range		°C	–40 to +60

Hydraulic				
			Medium pressure version	**High pressure version**
Nominal pressure		bar	250	350
Max. operating pressure at port	P, M, P3	bar	250	350
	A, B	bar	300	400
	T, T1	bar	20 bar. If EHR12 : 10 bar, if kick-out : 6 bar	
Max. control pressure at port	a, b	bar	35	
	a, b (actuation H200)		We recommend the use of control curve – With a 3 positions spool : 4TH6 curve no. 106 – With a 4 positions spool : 4TH6 curve no. 12	
Leakage oil flow (at 100 bar, 36 mm²/s)		cm³/min	15 [1)]	
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568, as well as hydraulic fluids as specified in data sheet 90221, at request	
Hydraulic fluid temperature range		°C	–20 to +80	
Viscosity range		mm²/s	10 to 380	
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend using a filter with a minimum retention rate of β10 ≥ 75	

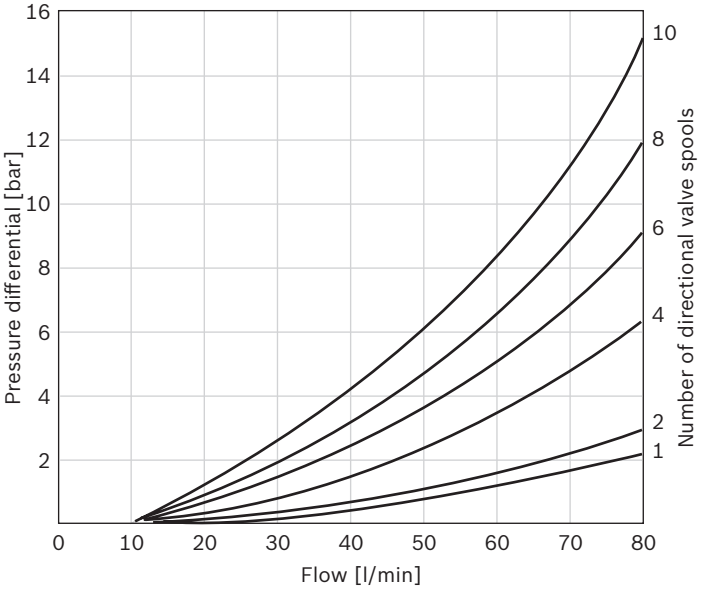
Mechanical			
Spool return force (without detent)		N	90 to 125 (with standard spring)
Max. permissible actuation force on the spool	axial	N	1000 during 20% of total cycles then 500
	radial	N	16

NOTE
For applications outside these parameters, please consult us!

1) Lower oil leakage available on demand.

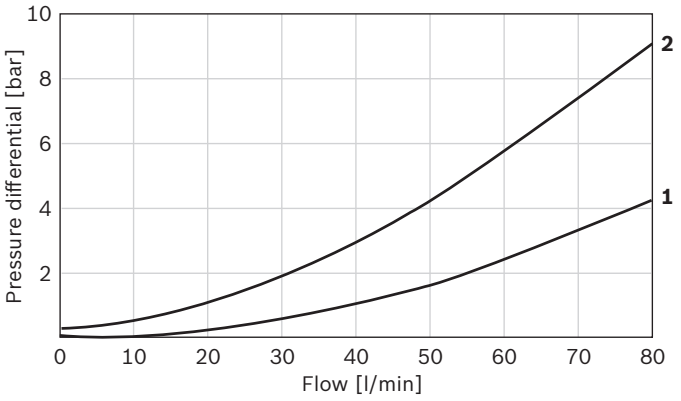
Characteristic curves

▼ **Pressure differential in the neutral position, P → T: for all spool variations**



NOTE
Characteristic curves measured at ν = 41 mm²/s, θ = 50 °C.

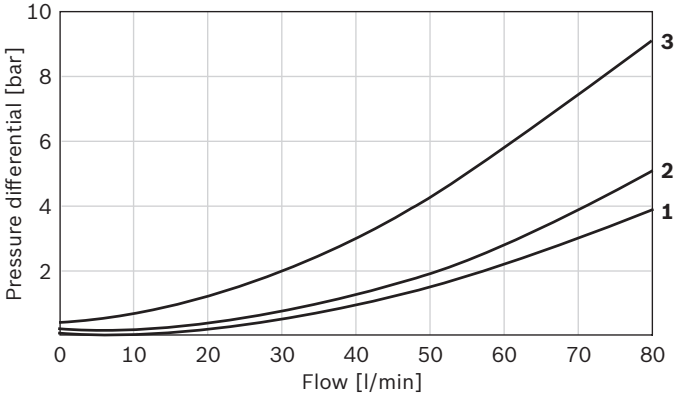
▼ **Pressure differential for a double acting spool (001-011) with switching P → A / B → T with switching P → B / A → T**



1 **B → T / A → T**
2 **P → A / P → B**

(measured at a control block with 1 directional valve spool)

▼ **Pressure differential for a single acting spool (014) with switching P → B with lowering position P → T / B → T**

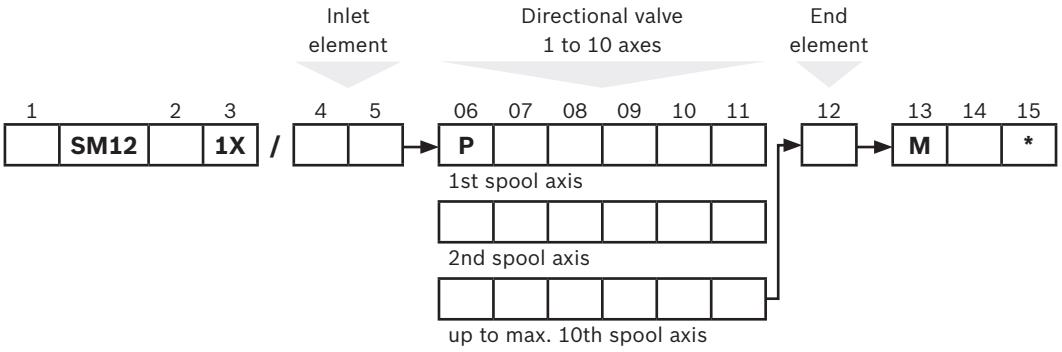


1 **B → T**
2 **P → T**
3 **P → B**

(measured at a control block with 1 directional valve spool)

Ordering code

SM12 control block basic version



01	No. of spool axes 1 to 10	

Design

02	High pressure version (not possible with end element **C**)	**H**
	Medium pressure version	**L**

Series

03	10 to 19 (unchanged installation and connection dimensions)	**1X**

Inlet element[1)]

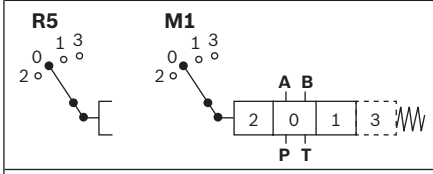
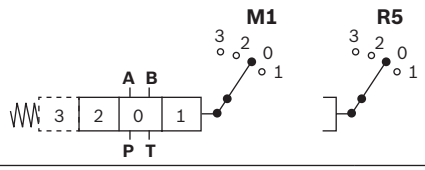
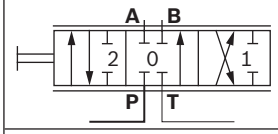
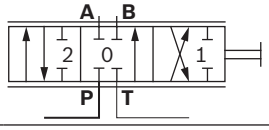
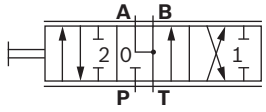
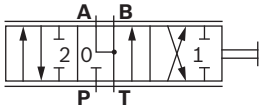
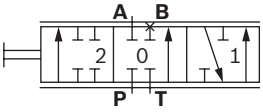
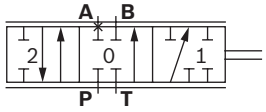
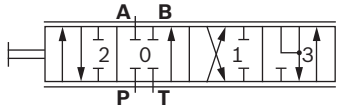
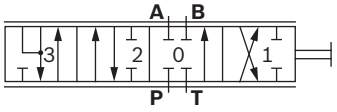
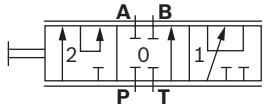
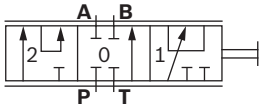
04	With port **P** and **T1** (medium pressure version)	**E**
	With port **P**, without port **T1** (high pressure version)	**A**
05	Without primary pressure relief valve (with plugged cavity)	**000**
	With primary pressure relief valve (pressure details in bar, 3-digit)	**V...0**

Directional valve type

06	Parallel directional valve	**P**
	Tandem directional valve	**T**
	Series directional valve (always used with spool variant **010**, see next page)	**S**

1) The pressure gauge connection **M** is plugged with a metal plug.

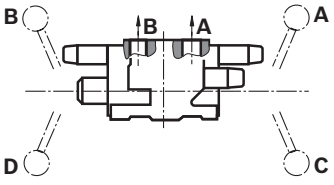
Control spool variants

07	Actuation on connection side A	Actuation on connection side B		
				
			3 positions double acting spool closed ports	**001**
			3 positions double acting spool open ports (engine, ...)	**011**
			3 positions single acting spool	**014**
			4 positions double acting spool	**004**
			Serial 3 positions spool	**010**

Type of actuation

08		
	Spool return via a spring	**A2 . .**
	Spool return via a spring with detent in spool position 2	**B2 . .**
	Spool return via a spring with detent in spool position 1	**C2 . .**
	Spool return via a spring with detent in spool positions 1, 2	**D2 . .**
	Spool return via a spring with detent in spool position 3 (4th position)	**E2 . .**
	Manual operator (not possible with secondary valves with lever in position A or B)	**. . M1**
	Manual operator, encapsulated lever (with rubber boot)	**. . R5**
	Spool end with tongue (Ø 6)	**. . Z1**
	Hydraulic operator, spool return via a spring	**H200**
	Hydraulic operator, spool return via a spring for the 4th position spool version **004**	**H400**

Actuation orientation

09			
	Without mechanical or manual operator		**–**
	Manual operator on connection side A – lever up or mechanical operator with tongue on connection side A[2) 3)]		**A**
	Manual operator on connection side B – lever up or mechanical operator with tongue on connection side B[3)]		**B**
	Manual operator on connection side A – lever down		**C**
	Manual operator on connection side B – lever down		**D**

2) **A** = preferred operator location

3) Manual operator M1 is not compatible with orientations A and B

Secondary valves

10	Pressure relief/anti-cavitation valve, pilot operated (pressure details in bar, 3-digit)	**H...0**
11	Anti-cavitation valve	**E**
	Plug	**Q**

End element

12	End element with tank port **T**	**R**
	End element with pressure port **P3** for downstream actuators (port **T1** is in the inlet element) (not possible with high pressure version **H**)	**C**

Seal material

13	NBR seals	**M**

Line connections

14	Pipe threads according to ISO 228/1	**01**
	UNF threads according to ISO 11926	**41**

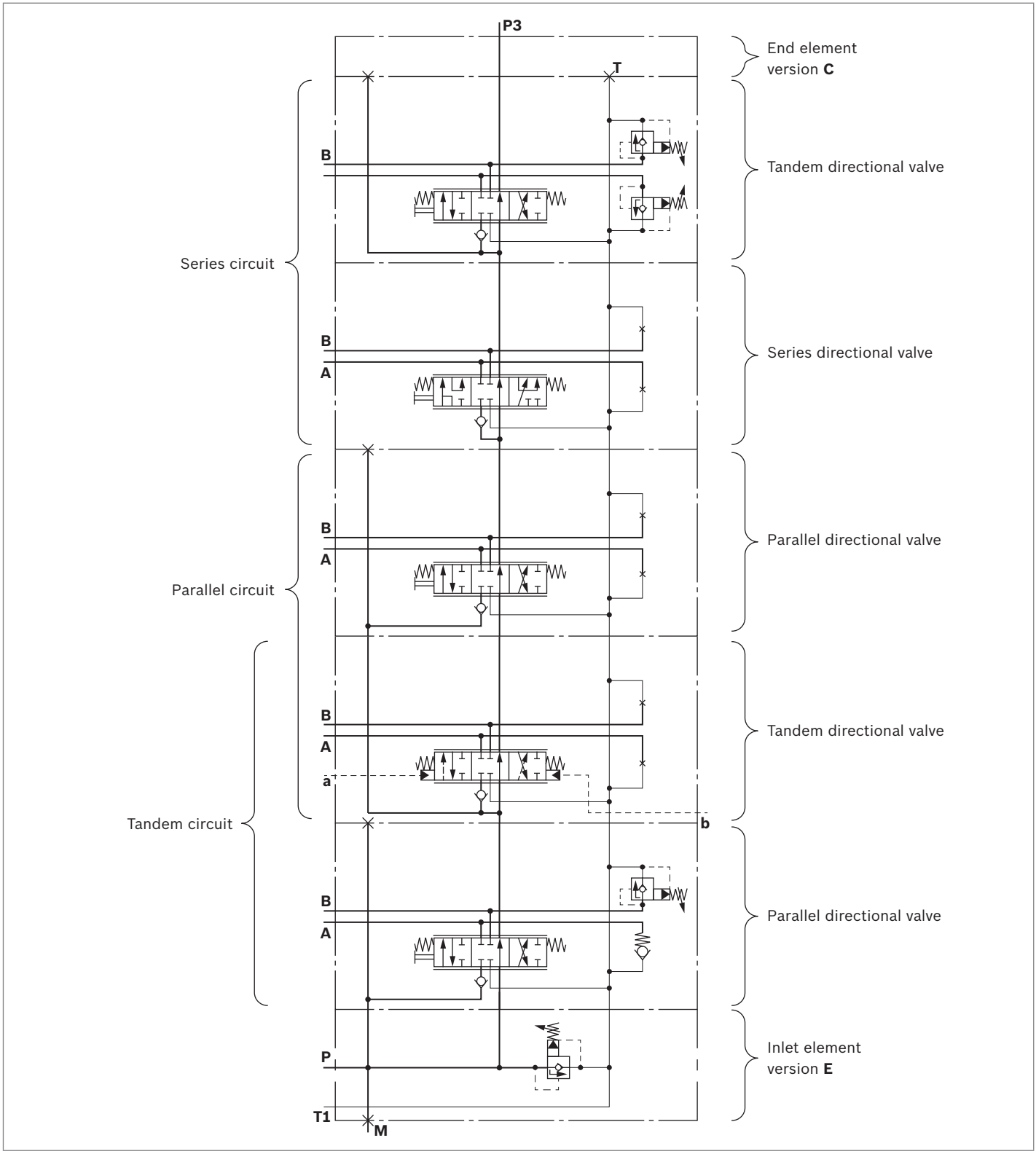
15	Further details in clear text	*

Ordering example:

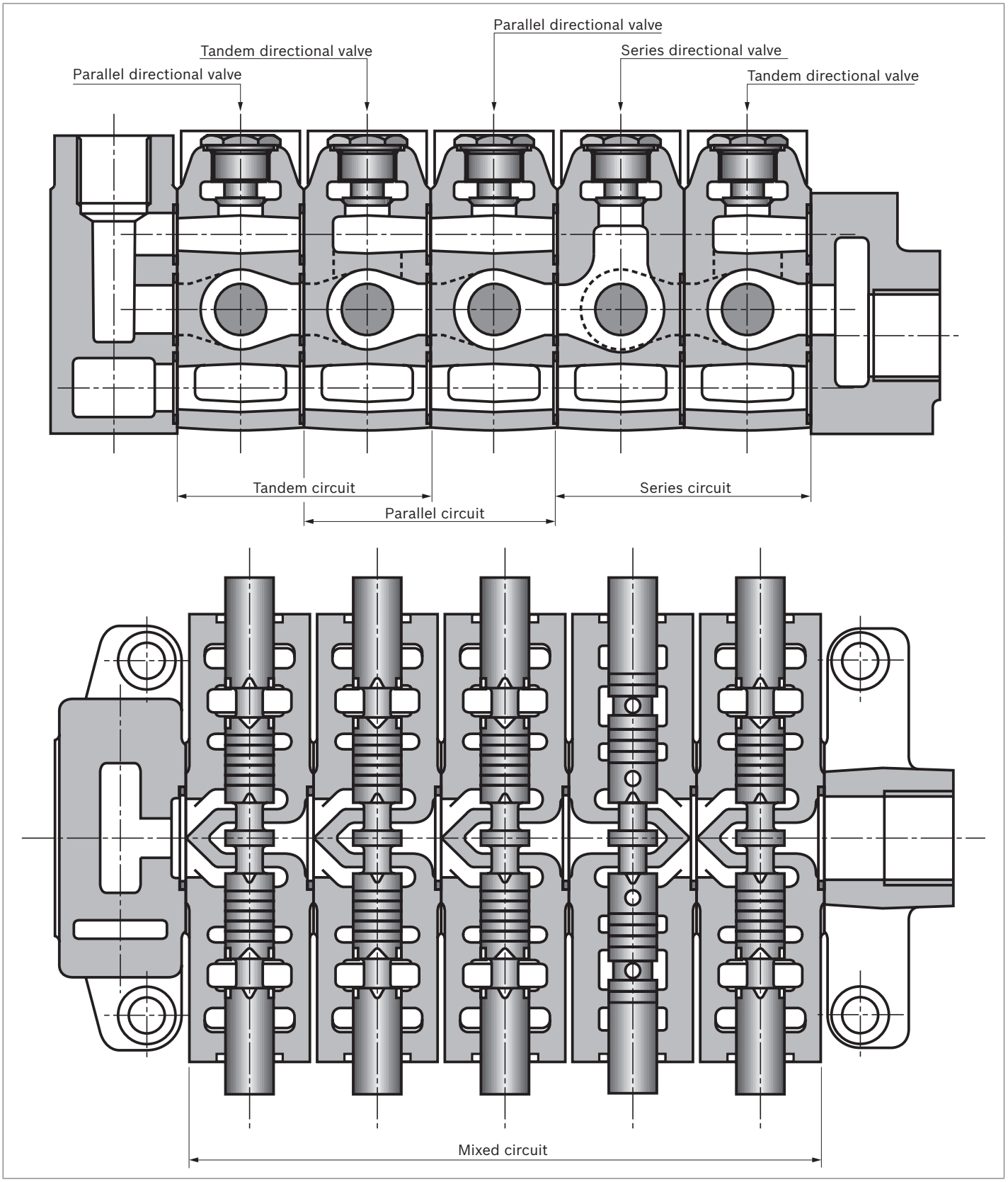
2 SM12 L 1X / E 220 P 001 A2Z1 A Q Q
P 004 E2Z1 A H250 H250 R M01

Types of circuit

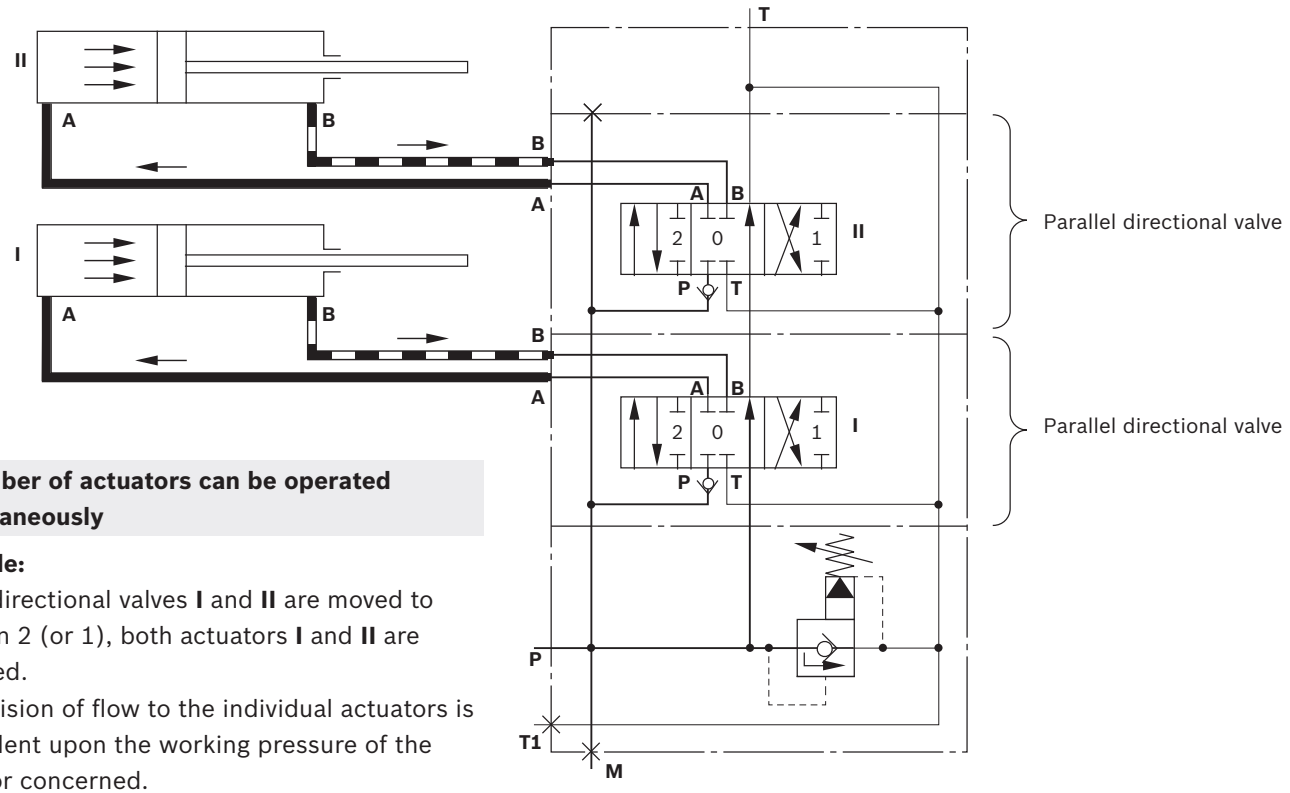
▼ **Circuit example: complete control block**



▼ **Section circuit types**



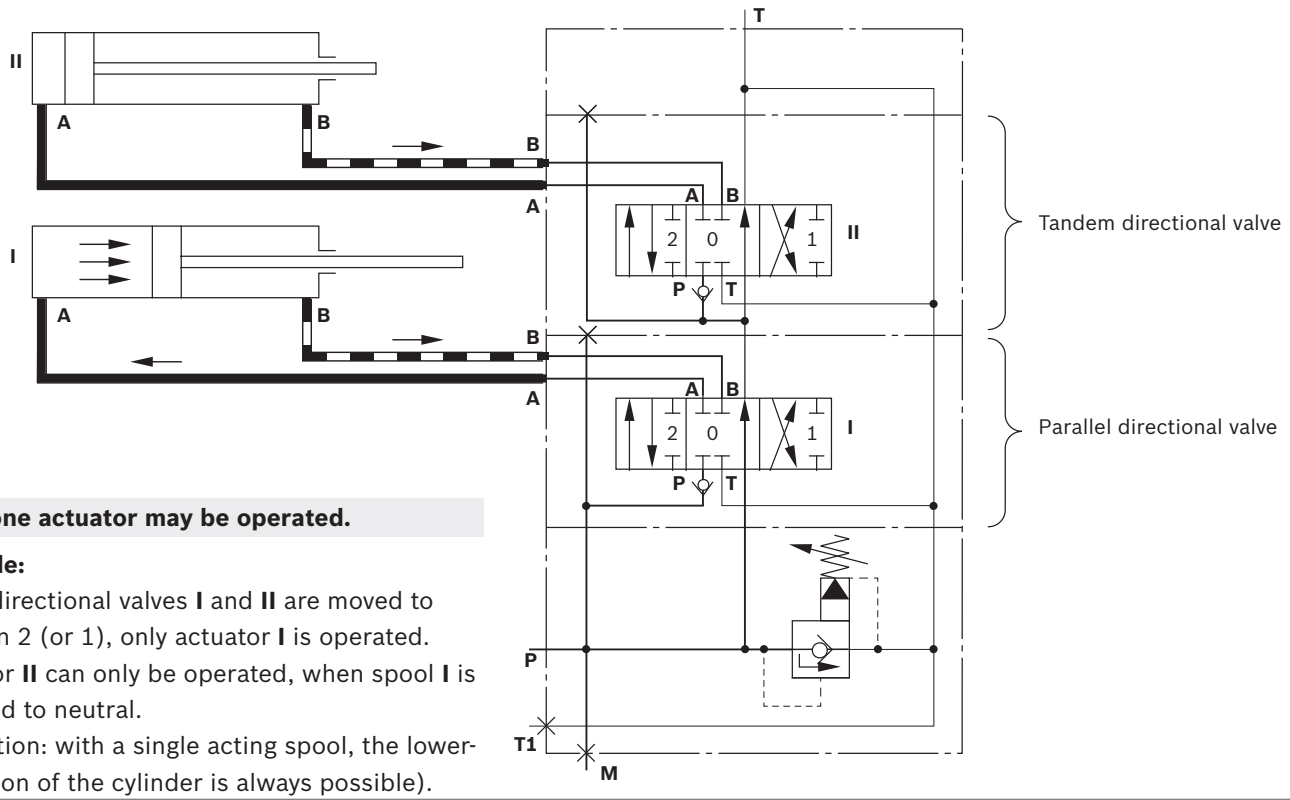
▼ **Parallel circuit**



A number of actuators can be operated simultaneously

Example:
When directional valves **I** and **II** are moved to position 2 (or 1), both actuators **I** and **II** are operated.
The division of flow to the individual actuators is dependent upon the working pressure of the actuator concerned.

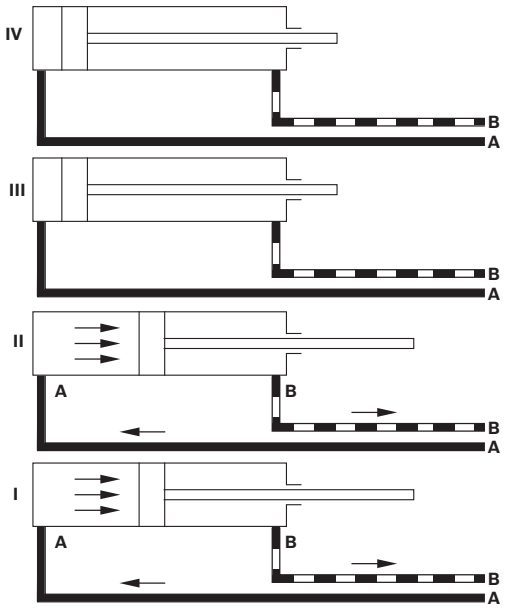
▼ **Tandem circuit**



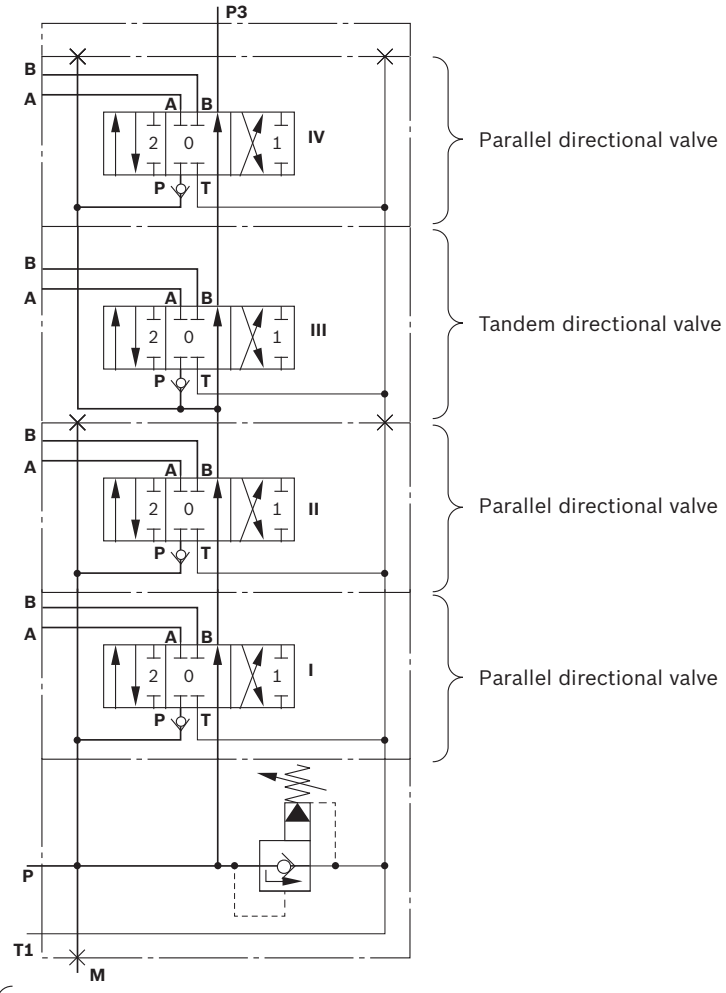
Only one actuator may be operated.

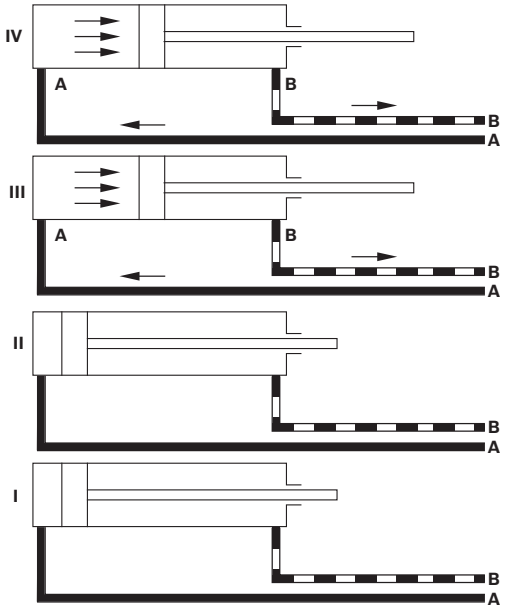
Example:
When directional valves **I** and **II** are moved to position 2 (or 1), only actuator **I** is operated.
Actuator **II** can only be operated, when spool **I** is returned to neutral.
(Exception: with a single acting spool, the lowering action of the cylinder is always possible).

▼ **Mixed circuit**



Example 1:
When directional valves **I** and **II** are simultaneously operated, the oil supply to the other elements is interrupted.





Example 2:
In order to operate actuator **III** and/or **IV**, directional valve spools **I** and **II** must be returned to neutral.

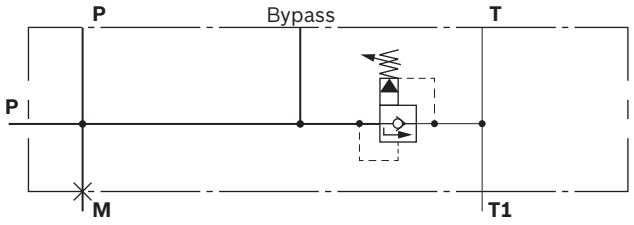
Inlet elements

With ports P and T1 (medium pressure version)

Ordering code:

E	**V...0**

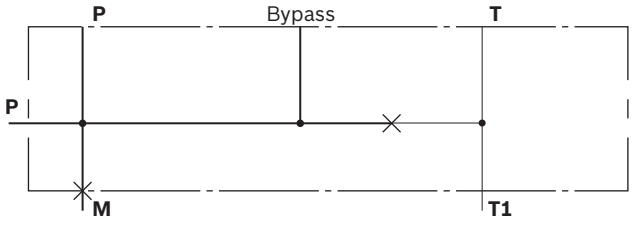
- With primary pressure relief valve[1)]
- Pressure details in bar after **V** required (3-digit)



Ordering code:

E	**000**

- Without primary pressure relief valve



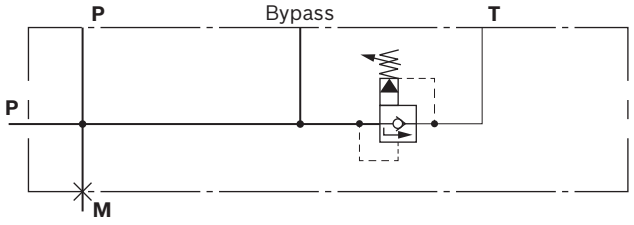
With port P, without port T1

(high pressure version)

Ordering code:

A	**V...0**

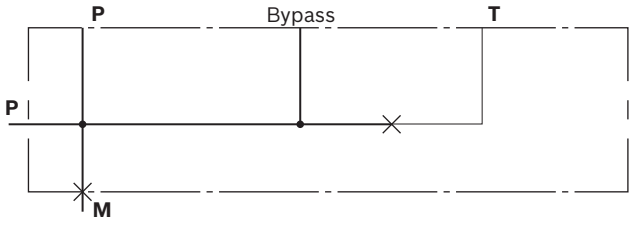
- With primary pressure relief valve[1)]
- Pressure details in bar after **V** required (3-digit)



Ordering code:

A	**000**

- Without primary pressure relief valve



NOTE

The pressure gauge connection **M** is plugged with a metal plug.

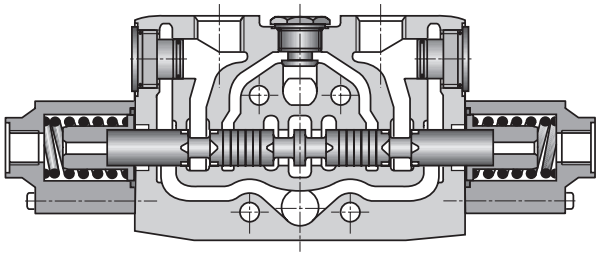
1) The primary pressure relief valve shown above is a pilot operated relief/anti-cavitation valve. The setting of the stated pressure value is carried out with a flow of 15 l/min. The pressure settings of the primary pressure relief valves must not exceed the permissible pressure of the block itself.

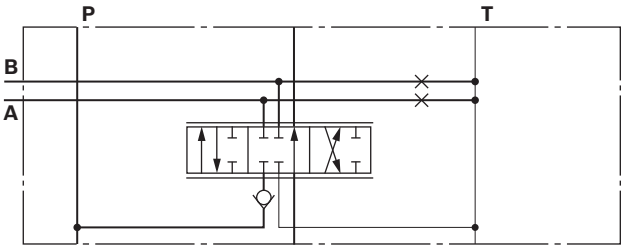
Directional valves

Parallel directional valve with check valve

Ordering code:

P	001			Q	Q

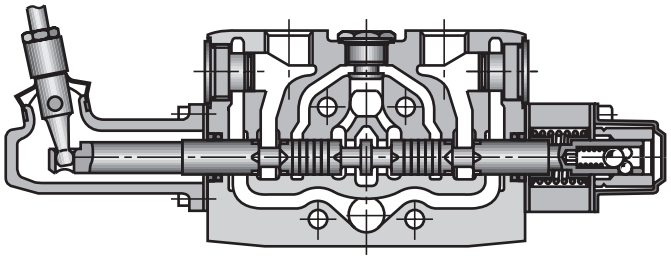


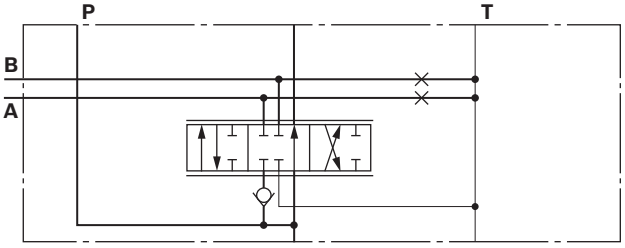


Tandem directional valve with check valve

Ordering code:

T	001			Q	Q

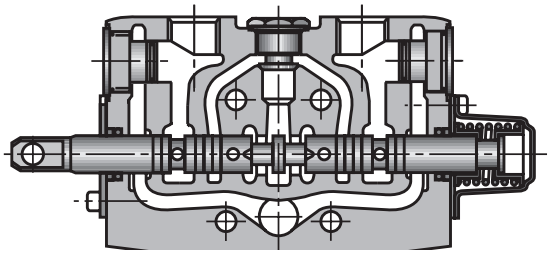


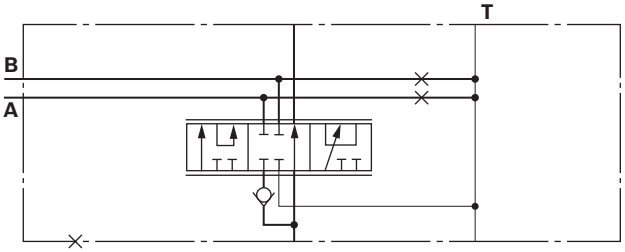


Series directional valve

Ordering code:

S	010			Q	Q



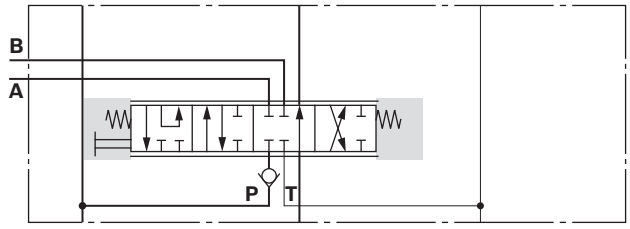


Types of actuation

Mechanical actuation

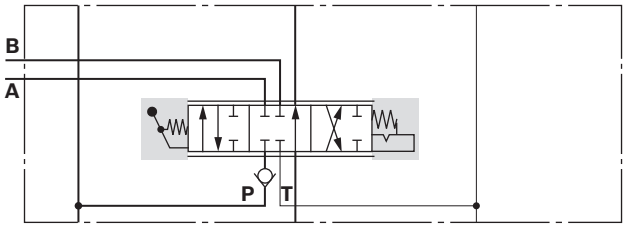
Ordering code:

...	A2Z1	A	...



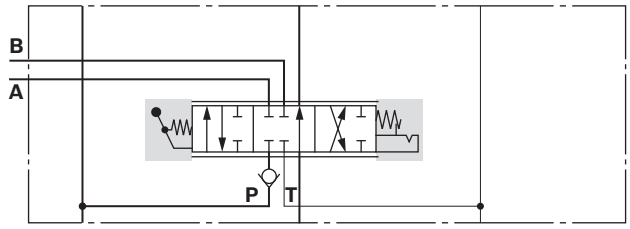
Ordering code:

...	B2M1	A	...



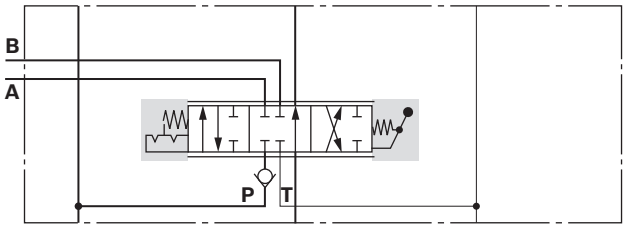
Ordering code:

...	C2M1	A	...



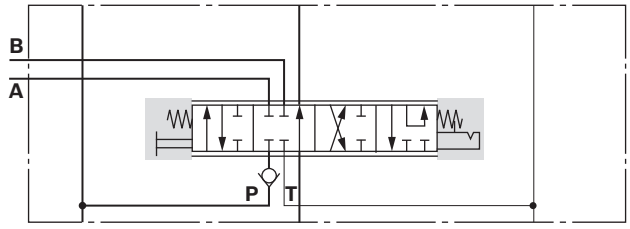
Ordering code:

...	D2R5	B	...



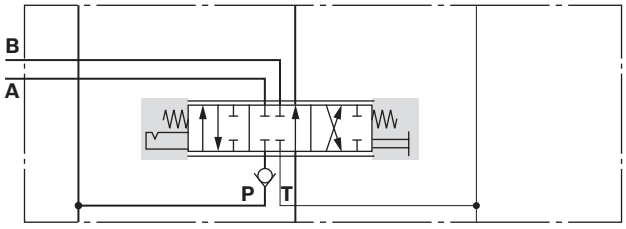
Ordering code:

P	004	E2Z1	A	...



Ordering code:

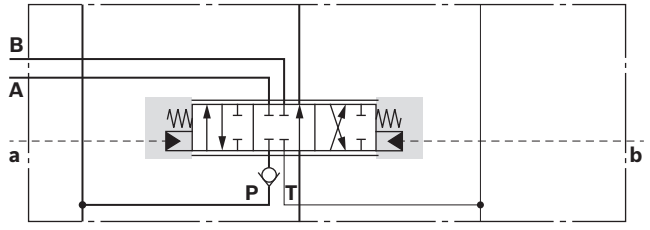
P	004	E2Z1	B	...



Hydraulic actuation

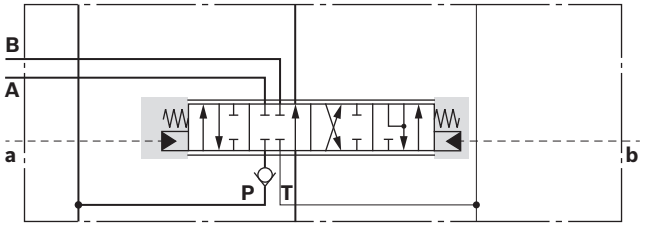
Ordering code:

...	H200	...



Ordering code:

...	H400	...

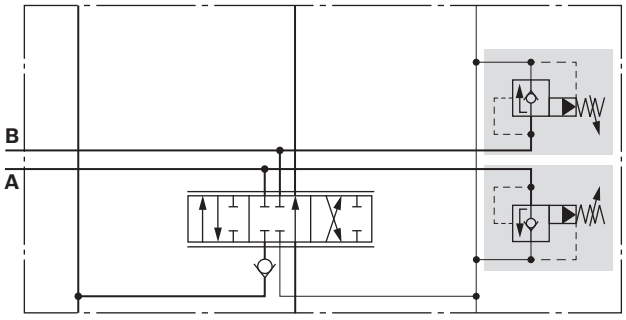


Secondary valves

Ordering code:

...	H...	H...

- For valve **H...** the setting of the stated pressure values has been carried out at a flow of 5 l/min.

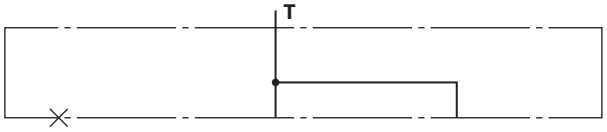


NOTE
The pressure setting of these valves must not exceed the maximum permissible pressure of the control block.

End elements

With tank port T (medium and high pressure version)
Ordering code:

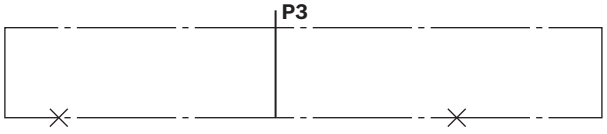
R



With pressure port P3 for downstream actuators
(only for medium pressure version)
Ordering code:

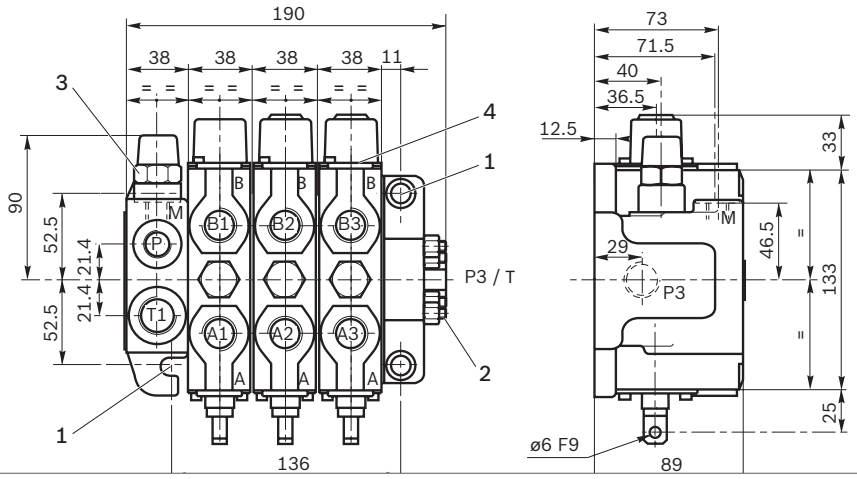
C

- Port **T1** is to be provided in the inlet element



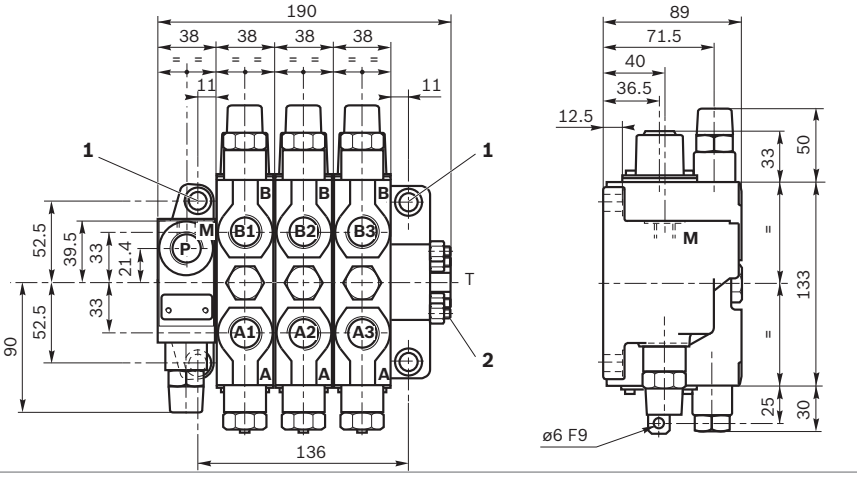
Dimensions

▼ **SM12 control block, medium pressure version (ordering code L)**



- with separate inlet element version **E**
- with separate end element version **R** or **C**

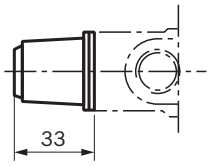
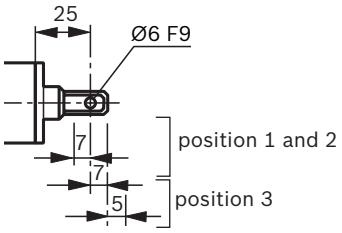
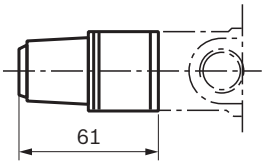
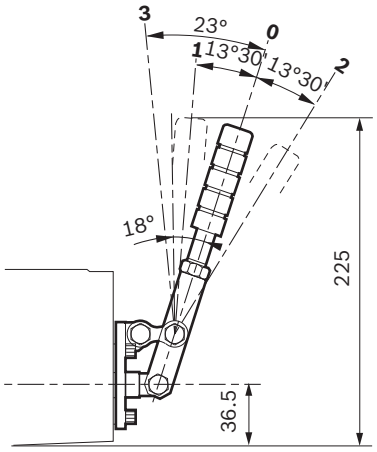
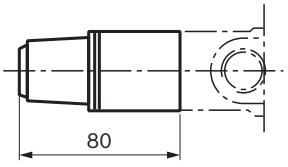
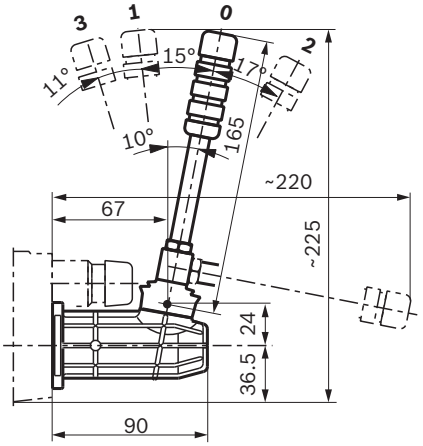
▼ **SM12 control block, high pressure version (ordering code H)**



- with separate inlet element version **A**
- with separate end element version **R**

1 Control block fixing holes Ø11h13
2 4 tie rods (nut tightening torque = $18^{\pm 1.8}$ Nm)
3 Primary pressure relief valve (tightening torque = $70^{\pm 7}$ Nm)
4 Plug screw **Q** (tightening torque = $70^{\pm 7}$ Nm)
5 Secondary valve version **A-B-H** (tightening torque = $70^{\pm 7}$ Nm)
6 Anti-cavitation valve version **E** (tightening torque = $70^{\pm 7}$ Nm)

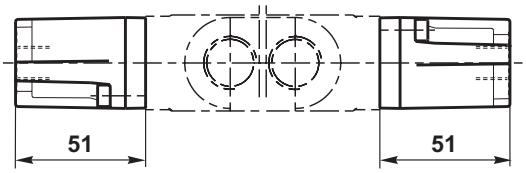
▼ **Types of actuation**

Spring return	Manual operation
Ordering code **A2** 	**Ordering code** **Z1** 
Ordering code **B2 / C2 / D2** 	**Ordering code** **M1** (not possible with secondary valves, with the lever pointing upwards) 
Ordering code **E2** 	**Ordering code** **R5** 

▼ **Types of actuation**

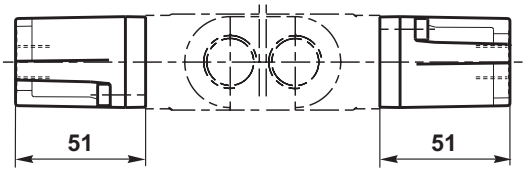
Hydraulic actuation with spool return via a spring

Ordering code
H200



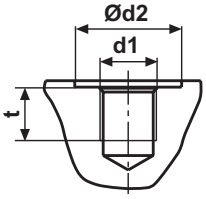
Hydraulic actuation with spool return via a spring for the 4th position spool

Ordering code
H400



Line connections

	01			41		
Ports	**d1**	**Ød2**	**t**	**d1**	**Ød2**	**t**
A, B, P, P3	G 1/2	34	13	7/8-14 UNF-2B	35	13
T	G 3/4	42	20	1-1/16-12 UNF-2B	42	20
M, a, b	G 1/4	25	12.5	9/16-18 UNF-2B	26	13



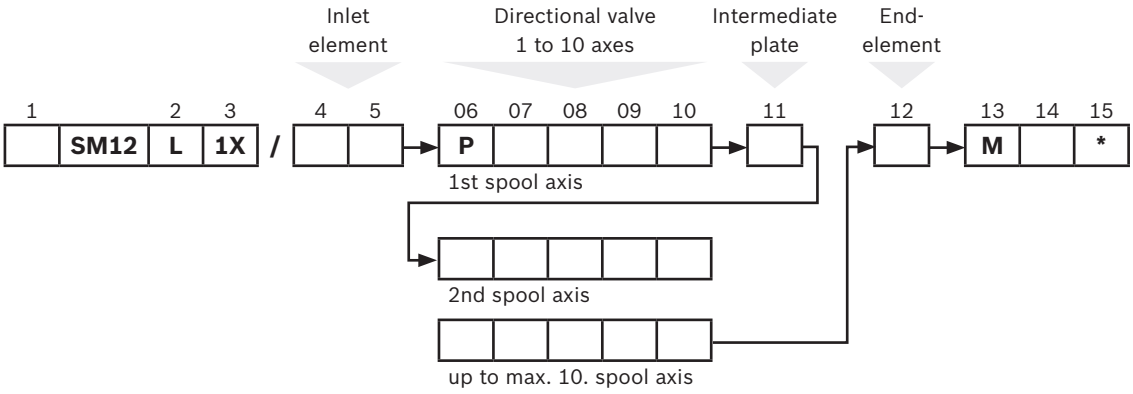
Installation guidelines

Ports	Tightening torque for the pipe connections [Nm]
P, P3, A, B	50
a, b	20
T, T1	70
M	20

- Recommended fixing: in 3 locations
- Mounting surface: Flatness = 0.5 mm
- Do not point the power washer at sensitive components, e.g. rubber components (bellow), electrical connections and operating elements.

SM12 control block for tractor auxiliary functions

Ordering code



01	No. of spool axes 1 to 10	

Design

02	Medium pressure version	**L**

Series

03	10 to 19 (unchanged installation and connection dimensions)	**1X**

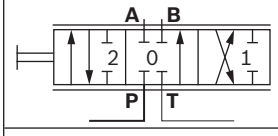
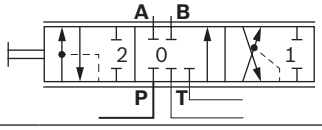
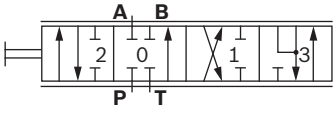
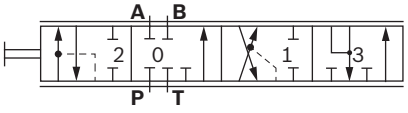
Inlet element[1)]

04	With ports **P** and **T1** with primary pressure relief valve (pressure details in bar, 3-digit)	**EV...0**
	With ports **P** and **T1** without primary pressure relief valve (with plugged cavity)	**E000**
05	With adjustable priority flow divider (always without primary pressure relief valve)	**C**

Directional valve type

06	Parallel directional valve	**P**
	Parallel directional valve with leak-free valve on connection side B (It is not possible to fit a secondary valve to side B)	**D**

Control spool

07	**Actuation on side A, conventional version**	**Actuation on side B, „Kick-out“ version**	**with check valve**
			**001**
			**004**

1) The pressure gauge connection **M** is plugged with a metal plug.

Type of actuation

08	Spool return via a spring	**A2 . .**
	Spool return via a spring with detent in spool position 2	**B2 . .**
	Spool return via a spring with detent in spool position 1	**C2 . .**
	Spool return via a spring with detent in spool positions 1, 2	**D2 . .**
	Spool return via a spring with detent in spool position 3 (4th position)	**E2 . .**
	Spool return via a spring, with detent in switched positions 1, 2 internal hydraulic detent release with p = 145 +15 -0 bar (Kick-out)	**KD2**
	Spool return via a spring, with detent in switched positions 1, 2 internal hydraulic detent release with p = 145 +15 -0 bar (Kick-out) for 4 positions spool type **004**	**KE2**
	Spool end with tongue (Ø 8)	**. . Z3**
	Spool end with fork	**. . G1**

Secondary valves

09 10	Pressure relief/anti-cavitation valve, pilot operated (pressure details in bar, 3-digit)	**H...**
	Anti-cavitation valve	**E**
	Plug	**Q**
	Switch for change-over to single acting / double acting version	**R**
	Without secondary valve cavity **Attention!** Only in port B for a directional valve with leak-free valve	**Z**

Intermediate plate

11	Intermediate inlet element with tube [2)]	**U1**
	With spacer	**S**

End element

12	End element with pressure port **P3** for downstream actuators (port **T1** is in the inlet element)	**C**
	End element with electro-hydraulic hitch control valves EHR12	**EHR**

Seal material

13	NBR seals	**M**

Line connections

14	Metric threads according to ISO 6149	**06**

15	Further details in clear text	*****

Ordering example:

4 SM12 L 1X / EV000 P 001 KD2 Z1 B Q R
S
D 001 KD2 Z1 B H200 Z
S
P 004 KE2 Z1 B H200 Q
S
P 001 A2 Z1 B Q Q C M06

2) Only possible between the 1st and 2nd directional valve

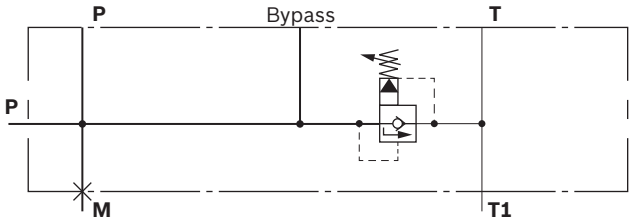
Inlet elements

With port P and T1

Ordering code:

EV...0

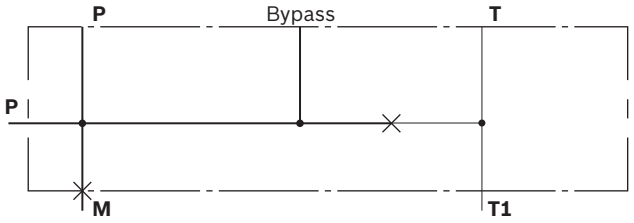
- With primary pressure relief valve[1)]
- Pressure details in bar after **V** required (3-digit)



Ordering code:

E000

- Without primary pressure relief valve

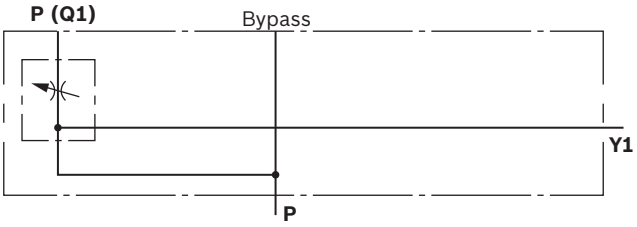


Inlet element with adjustable priority flow divider

Ordering code:

C

- Without primary pressure relief valve
- **Q1** = adjustable priority flow, 2 to 50 l/min
- **Y1** = residual flow (**Y1** can have pressure applied that can be up to the set value of the circuit pressure relief valve)
- Can be used as a single inlet element or combination with EV...



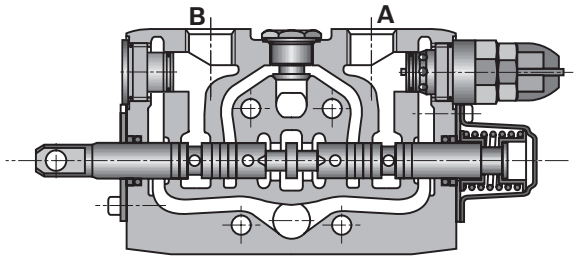
NOTE
The pressure gauge connection **M** is plugged with a metal plug.

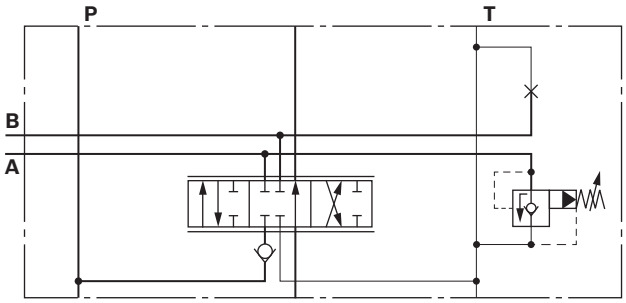
1) The primary pressure relief valve shown above is a pilot operated relief/anti-cavitation valve. The setting of the stated pressure value is carried out with a flow of 15 l/min. The pressure settings of the primary pressure relief valves must not exceed the permissible pressure of the block itself.

Directional valves

Parallel directional valve with check valve
Ordering code:

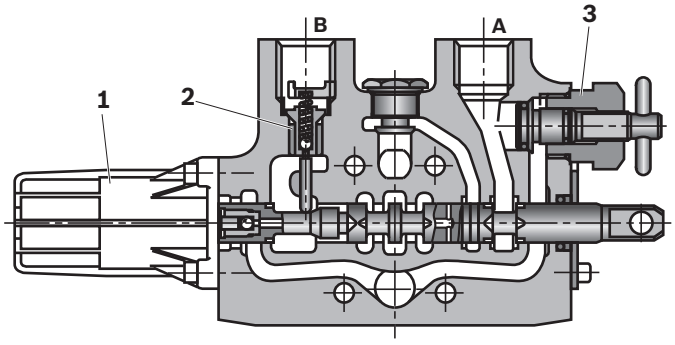
P	001			H	Q

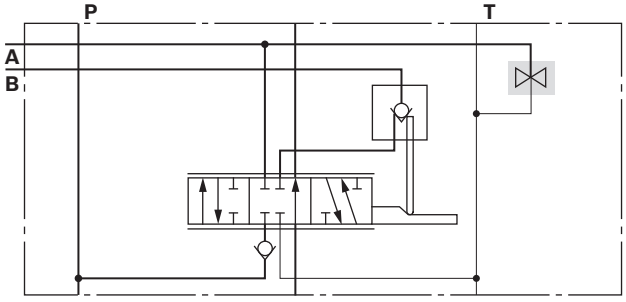




Parallel directional valve with leak-free valve on connection side B
Ordering code:

D	001			R	Z



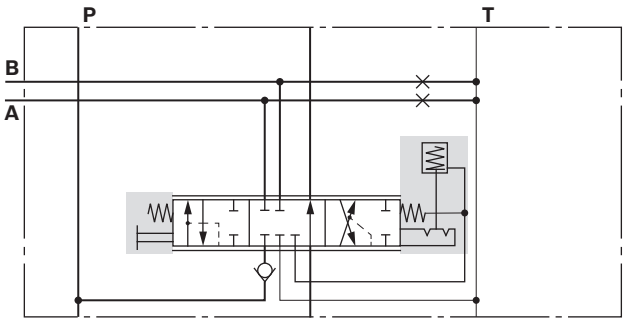


1 Cover for hydraulic detent release (Kick-out)
2 Leak-free valve
3 Change-over to single-acting / double acting version

Types of actuation

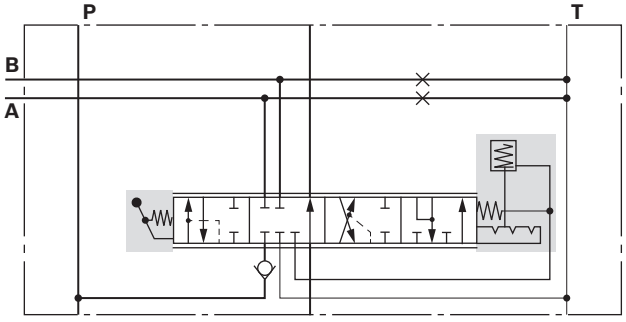
Ordering code:

P	001	KD2Z1	A	Q	Q



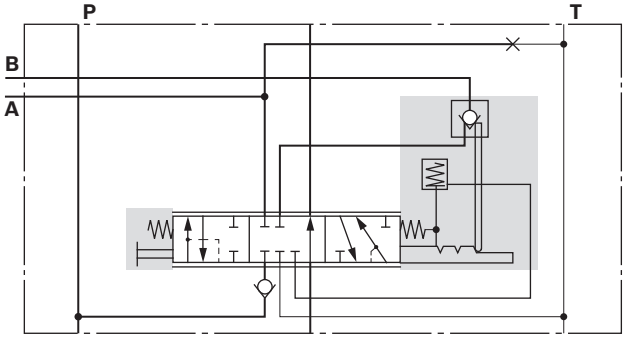
Ordering code:

P	004	KE2R5	A	Q	Q



Ordering code:

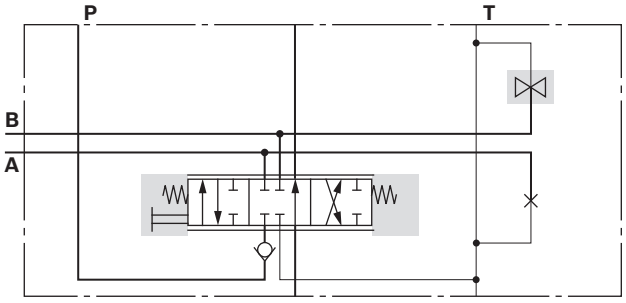
D	001	KD2Z1	A	R	Z



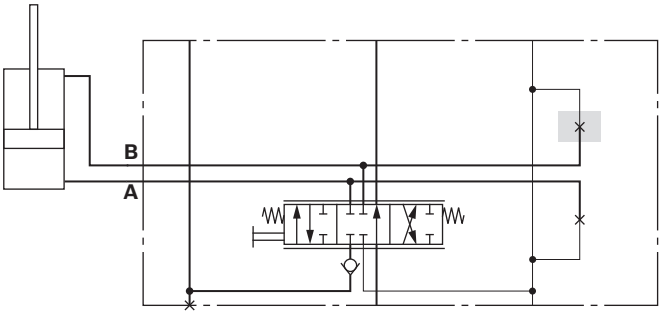
Switch for change over to single acting / double acting cylinder with a double acting spool

Ordering code:

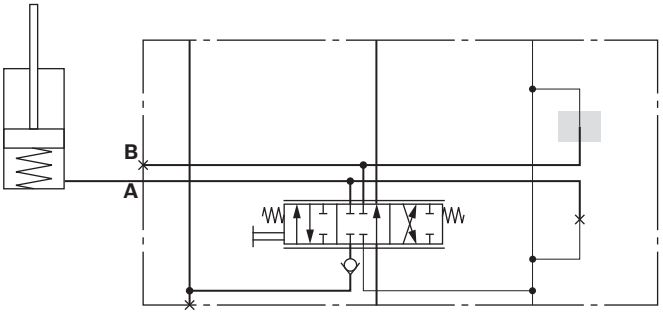
P	001	A2Z1	A	Q	R



▼ **Configuration with double acting cylinder, switch closed**



▼ **Configuration with single acting cylinder, switch open**



NOTE

For the mounting possibilities of a secondary valve : see details on page 16.

Intermediate plate

Intermediate inlet element with tube
Ordering code:

U1

Spacer
Ordering code:

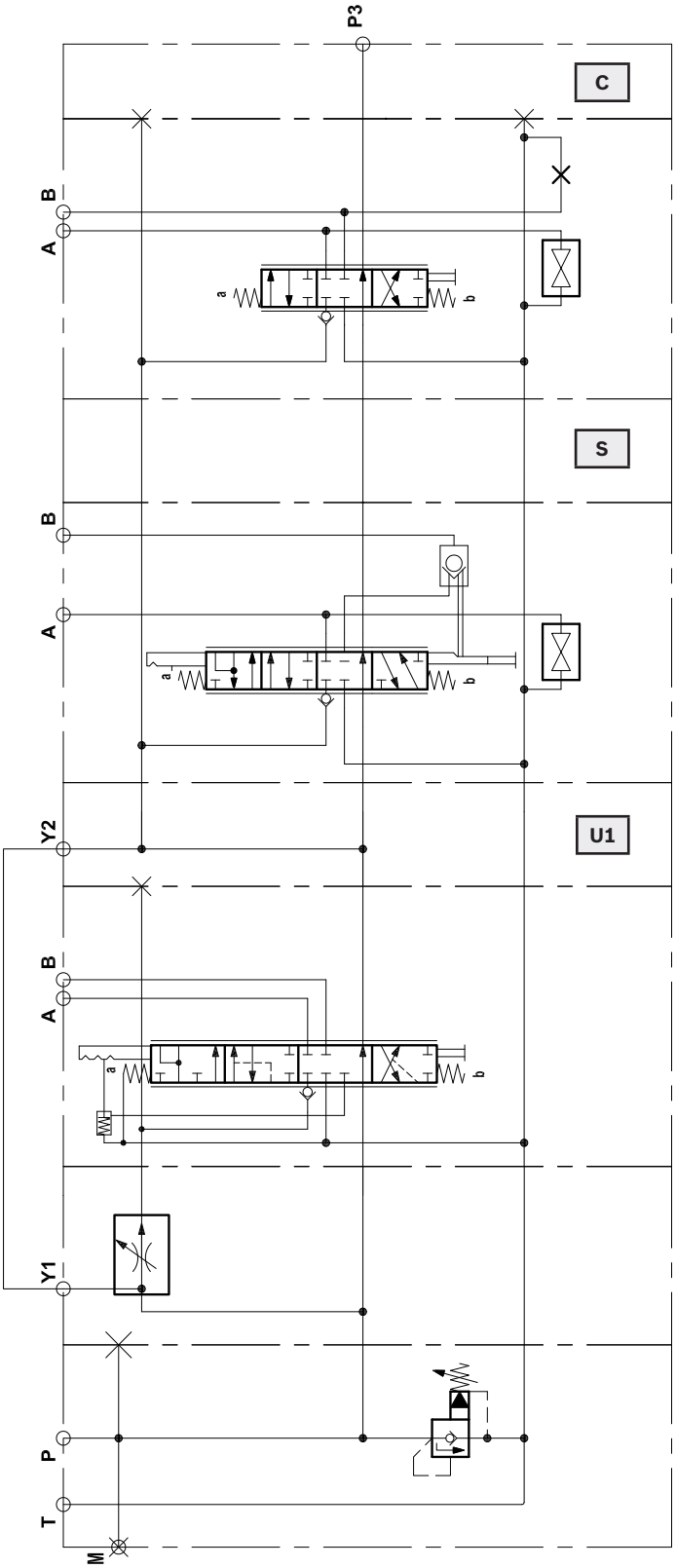
S

End elements

With pressure port P3 for downstream actuators
Ordering code:

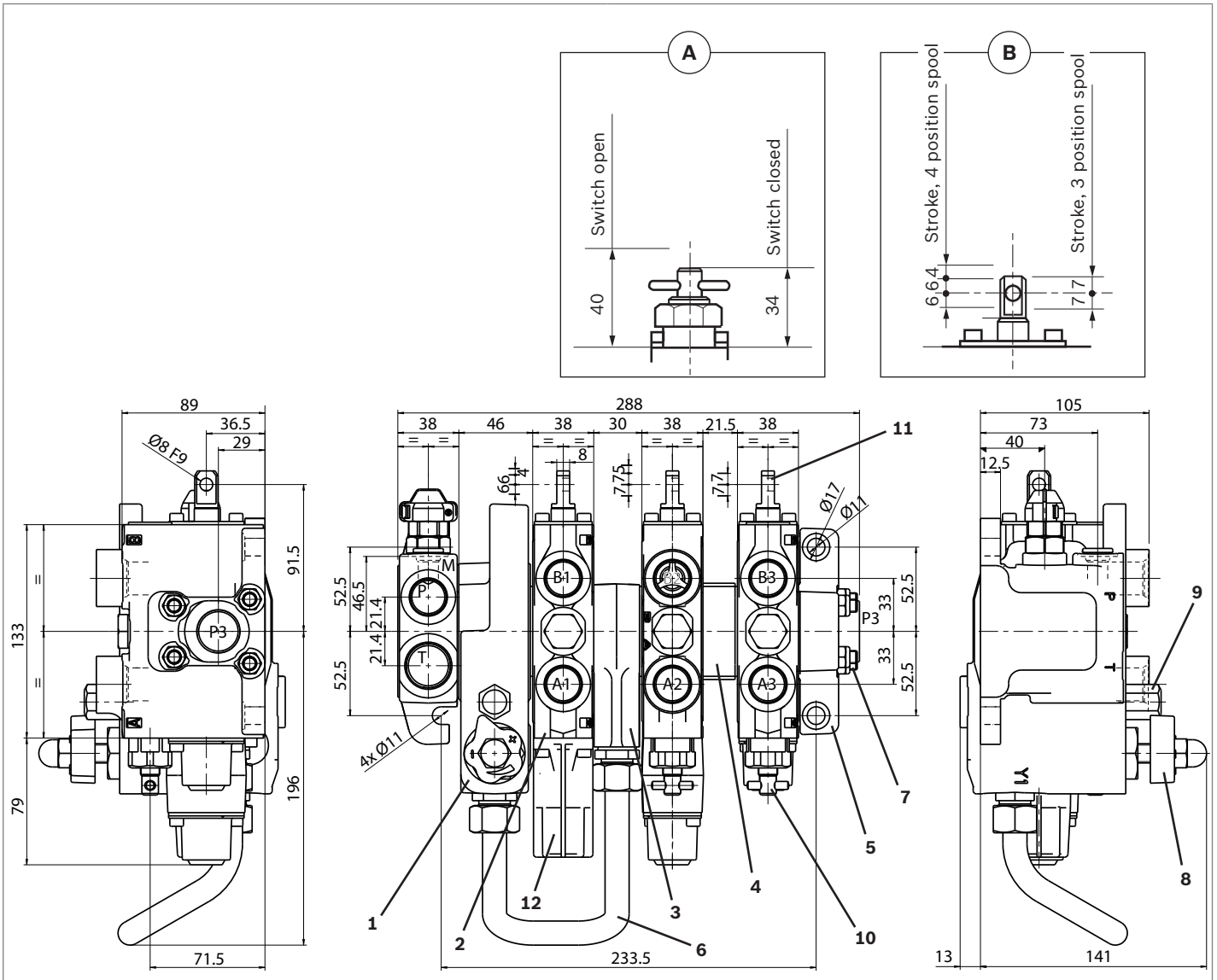
C

- Port **T1** is to be provided in the inlet element



Dimensions

▼ **SM12 control block for auxiliary tractor functions**



1 Element with adjustable flow divider
2 Directional valve
3 Intermediate inlet element
4 Spacer for mounting purposes
5 End element
6 Tube for intermediate inlet plate
7 4 tie rods (tightening torque = $18^{\pm 1.8}$ Nm)
8 Throttle screw (range: 2 to 50 l/min)
9 Stop for throttle screw
10 Switch for change-over to double acting / single acting version (for orientation: see Fig. **A**)
11 Mechanical operator with tongue (for stroke: see Fig. **B**)
12 Cover for the spool return

Line connections

Metric threads according to ISO 6149

Ports	
P, P3, A, B	M22 × 1.5
T, T1	M27 × 2
M	M14 × 1.5

Bosch Rexroth AG
Mobile Applications
Zum Eisengießer
97816 Lohr am Main, Germany
Phone +49 9352 18-0
info.ma@boschrexroth.de
www.boschrexroth.com

Bosch Rexroth DSI S.A.S.
BP 101
91, bd Irène Joliot-Curie
69634 Vénissieux Cedex, France
Phone +33 47878 52 52
www.boschrexroth.fr