RE 29583-XL
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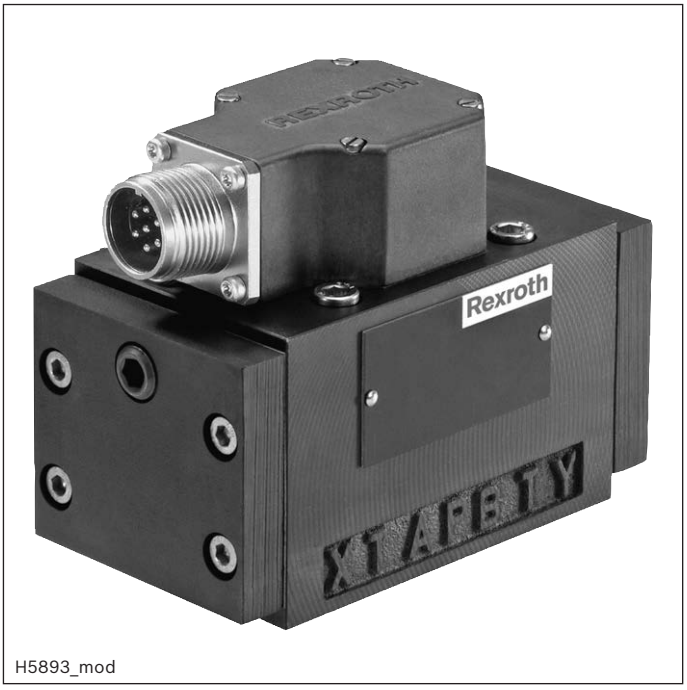
RA87651313_AA

rexroth
A Bosch Company

Directional servo valve with mechanical position feedback

Type 4WS2EM ...XL



H5893_mod

- Size 10
- Component series 5X
- Maximum operating pressure 315 bar
- Maximum flow 180 l/min

CE

ATEX units
For potentially explosive atmospheres

Information on explosion protection:

- Area of application in accordance with the Explosion Protection Directive 2014/34/EU: **II 3G**
- Type of protection: Ex ic IIC T4 Gc according to EN IEC 60079-0 / EN 60079-11 and IEC 60079-0 / IEC 60079-11

Features

- 4 or 3-way version
- For intended use in potentially explosive atmosphere
- Valve for position, force, pressure or velocity control
- For subplate mounting
- Porting pattern according to ISO 4401-05-05-0-05
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free control spool return element
- Pressure chambers at the control sleeve with gap seal, therefore no wear of seal ring

Contents

☞ **Notice:** The documentation version with which the product was supplied is valid.

Ordering code

01	02		03		04	05	06	07	08	09	10	11	12	13
4WS2EM	**10**	**–**	**5X**	**/**		**B**	**11**	**XL**			**K31**		**V**	

01	Directional servo valve, 4-way version, 2-stage, with mechanical feedback, for **external** control electronics, electrically operated	**4WS2EM**
02	Size 10	**10**
03	Component series 50 ... 59 (50 ... 59: unchanged installation and connection dimensions)	**5X**

Nominal flow

04	5 l/min	**5**
	10 l/min	**10**
	20 l/min	**20**
	30 l/min	**30**
	45 l/min	**45**
	60 l/min	**60**
	75 l/min	**75**
	90 l/min	**90**
	Characteristic curves, see page 10 (observe tolerance field of the flow/signal function)	
05	Control sleeve exchangeable	**B**
06	Valve for **external** control electronics; coil no. 11 (30 mA/85 Ω per coil)	**11**

Explosion protection

07	"Type of protection ic"	**XL**
	For details, see information on explosion protection, page 6	

Pilot oil supply/return [1)]

08	External pilot oil supply, external pilot oil return	**–**
	Internal pilot oil supply, external pilot oil return	**E**
	Internal pilot oil supply, internal pilot oil return	**ET**
	External pilot oil supply, internal pilot oil return	**T**

Inlet pressure range

09	10 ... 210 bar	**210**
	10 ... 315 bar	**315**

Electrical connection

10	**Without** mating connector; connector	**K31** [2)]

Control spool overlap (in % of the nominal stroke)

11	0 ... 0.5% negative	**E**
	0 ... 0.5% positive	**D**
	3 ... 5% positive	**C**

Seal material (observe compatibility of seals with hydraulic fluid used, see page 6)

12	FKM seals	**V**

Ordering code

01	02	03			04	05	06	07	08	09	10	11	12	13
4WS2EM	**10**	**–**	**5X**	**/**		**B**	**11**	**XL**			**K31**		**V**	

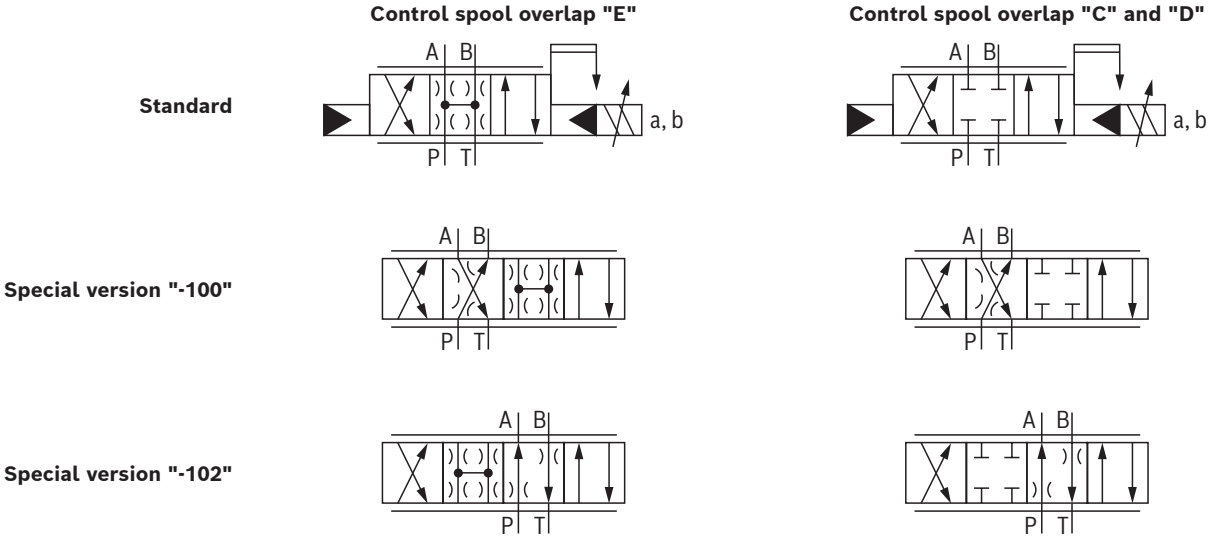
Special versions

13	Standard version	**no code**
	The channels P → B and A → T are open 10% of the nominal quantity without control (de-energized state).	**-100**
	The channels P → A and B → T are open 10% of the nominal quantity without control (de-energized state).	**-102**

1) Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous. The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form. Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

2) Mating connector, separate order, see page 15.

Symbols



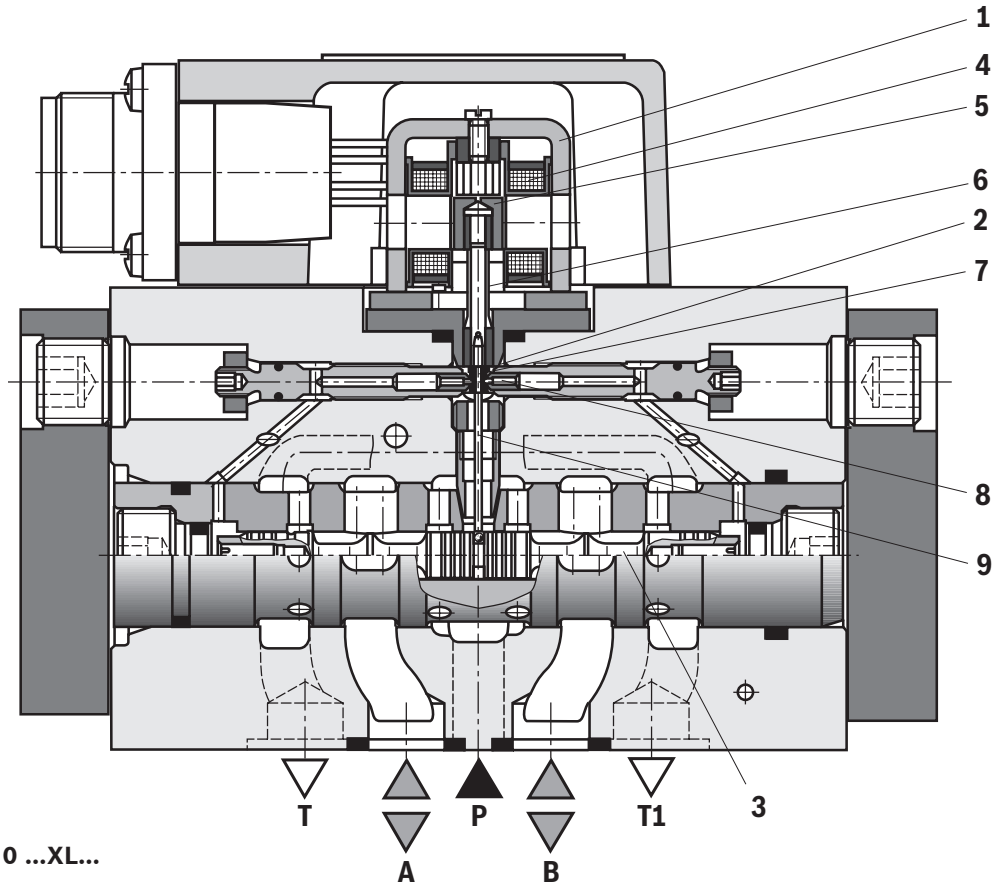
☞ **Notice:**
Representation according to DIN ISO 1219-1.

Function, section

Valves of type 4WS2EM ...XL are electrically operated, 2-stage directional servo valves. They are mainly used to control position, force, pressure or velocity.
The valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (nozzle flapper plate system) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.
An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a bolt to move from the central position between the two control nozzles (8), and a pressure differential is created across the front sides of the control spool (3). The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

The control spool (3) is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the control spool (3) is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.
The stroke of the control spool (3) and consequently the flow of the servo valve are controlled proportionally to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)
External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.
For the limitation of the electric data, a safety barrier is to be connected between valve and amplifier (see page 7).



Type 4WS2EM 10 ...XL...

Technical data
(for applications outside these values, please consult us!)

General			
Installation position			Any - ensure that during start-up of the system, the valve is supplied with sufficient pressure (≥ 10 bar)
Surface protection	▶ Valve body, cover, filter screw		Nitro-carburated
	▶ Cap		Anodized
Storage temperature range		°C	+5 ... +40
Maximum storage time		Years	1
Ambient temperature range		°C	–30 ... +80
Weight		kg	3.46

Hydraulic									
Maximum operating pressure (main valve)	▶ Ports P, A, B	bar	315						
Operating pressure range (pilot control stage)	▶ Pilot oil supply	bar	10 ... 210 or 10 ... 315						
Maximum return flow pressure	▶ Port T	bar							
	– Pilot oil return internal	bar	Pressure peaks < 100						
	– Pilot oil return external	bar	315						
	▶ Port T	bar	Pressure peaks < 100, static < 10						
Hydraulic fluid			See table page 6						
Hydraulic fluid temperature range		°C	–15 ... +80; preferably +40 ... +50						
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45						
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]						
Zero flow $q_{V,L}$		l/min	see characteristic curve on page 10						
Rated flows $q_{V\,nom}$ (tolerance ±10% with valve pressure differential Δp = 70 bar		l/min	5	10	20	30	45	60	75	90
Maximum control spool stroke with mechanical end position (in case of error) related to nominal stroke		%	120 ... 170				120 ... 150			
Feedback system			mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.2							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure amplification with 1% control spool stroke change (from the hydraulic zero point)		% of p_P	≥ 30					≥ 60		≥ 80
Zero adjustment flow across the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
	▶ Hydraulic fluid temperature	% / 20 °C	≤ 1							
	▶ Ambient temperature	% / 20 °C	≤ 1							
	▶ Operating pressure 80 ... 120% of p_P	% / 100 bar	≤ 2							
	▶ Return flow pressure 0 ... 10% of p_P	% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and simultaneously increases the life cycle of the components.
Available filters can be found at www.boschrexroth.com/filter.

$q_{V,L}$ = zero flow in l/min
$q_{V\,nom}$ = rated flow in l/min
p_P = operating pressure in bar

Technical data
(for applications outside these values, please consult us!)

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	

☞ **Important information on hydraulic fluids:**
- ▶ For further information and data on the use of other hydraulic fluids, please refer to the data sheets above or contact us.
- ▶ There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- ▶ The ignition temperature of the hydraulic fluid used must be at least 150 °C.

Electric		
Protection class according to EN 60529		IP 65 with mating connector correctly mounted and locked
Type of signal		analog
Nominal flow per coil (command value 100%)	mA	30
Resistance per coil	Ω	85

☞ **Notice:**
In case of control using non-Rexroth amplifiers, we recommend a superimposed dither signal.

Information on explosion protection	
Area of application according to Directive 2014/34/EU	II 3G
Type of protection according to EN IEC 60079-0 / EN 60079-11	Ex ic IIC T4 Gc
"IECEx Certificate of Conformity"	IECEx BVS 18.0045X
Power supply of the valve only from intrinsically safe electric circuits	Maximum values see page 7
Special application conditions for safe application	see ambient and hydraulic fluid temperature range page 5

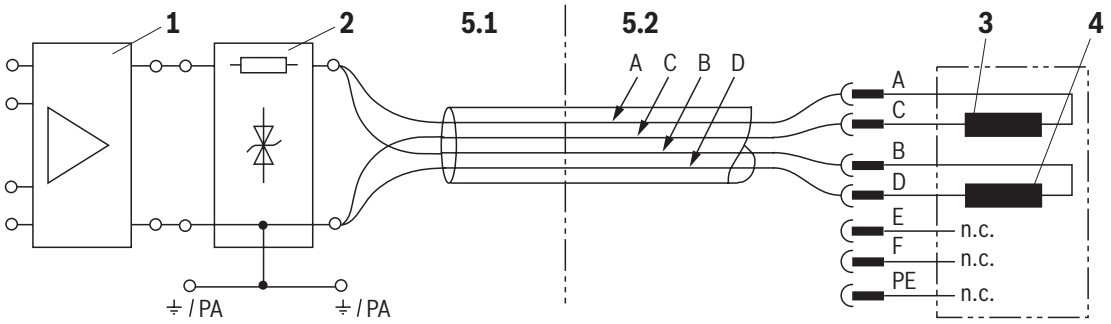
External control electronics		
Recommended safety barrier		see page 7
Servo amplifier in modular design	analog	Type VT 11021 according to data sheet 29743

☞ **Important notice:**
The external servo amplifier and the safety barrier must be operated outside the potentially explosive atmospheres.

Electrical connection

The coils can be connected in **parallel connection** or individual control.

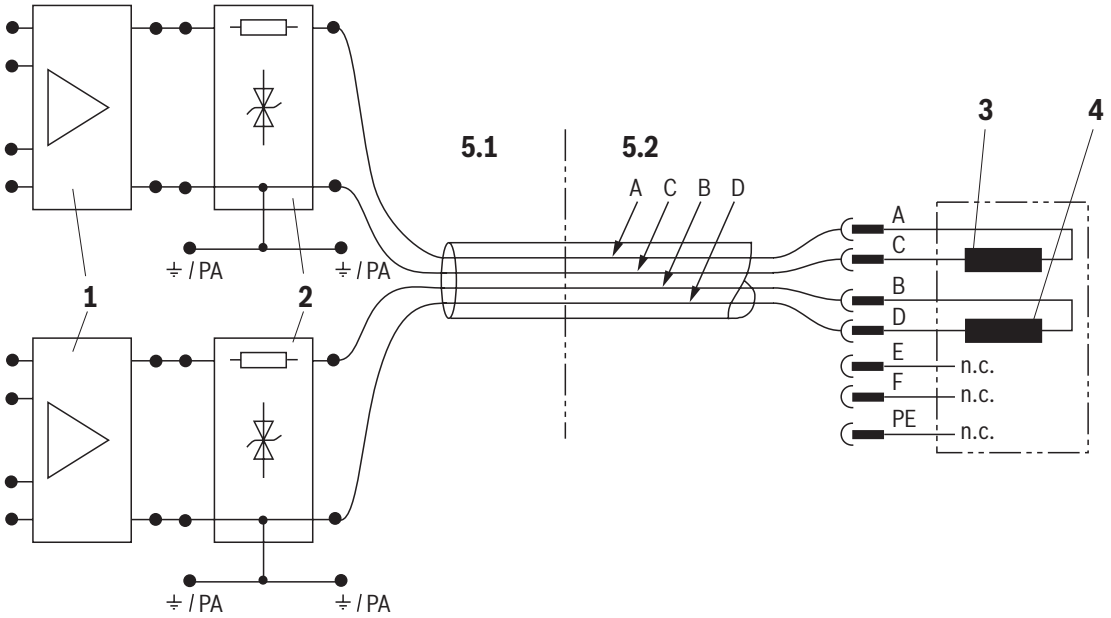
▶ Parallel connection



1 Servo amplifier
2 Safety barrier
3 Valve, coil A
4 Valve, coil B
5.1 Non-explosive area
5.2 Explosive area

Power supply of the valve only from intrinsically safe electric circuits with the following maximum values	▶ U_{max}	V	15
	▶ I_{max}	mA	153
	▶ P_{max}	mW	570
Recommended safety barrier			Type 9001/02-133-150-101 (company Stahl) or Z915 (company Pepperl+Fuchs)

▶ Individual control



1 Servo amplifier
2 Safety barrier
3 Valve, coil A
4 Valve, coil B
5.1 Non-explosive area
5.2 Explosive area

Power supply of the valve only from intrinsically safe electric circuits with the following maximum values	▶ U_{max}	V	9.3	12.5
	▶ I_{max}	mA	205	90
	▶ P_{max}	mW	476	282
Recommended safety barrier			9002/77-093-300-001 (company Stahl)	Z966 (company Pepperl+Fuchs)

☞ **Notice:**
Only use approved cables and lines for intrinsically safe electric circuits.

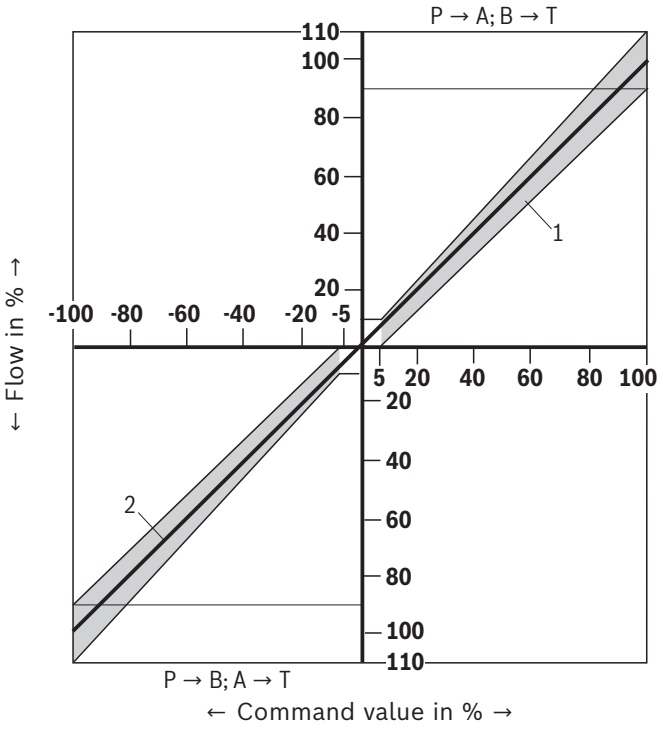
The electric control with plus (+) at A and B and minus (–) at C and D results in direction of flow P → A and B → T.
Inverted electric control results in direction of flow P → B and A → T.
The pins E, F and PE at the connector are not connected.

Characteristic curves

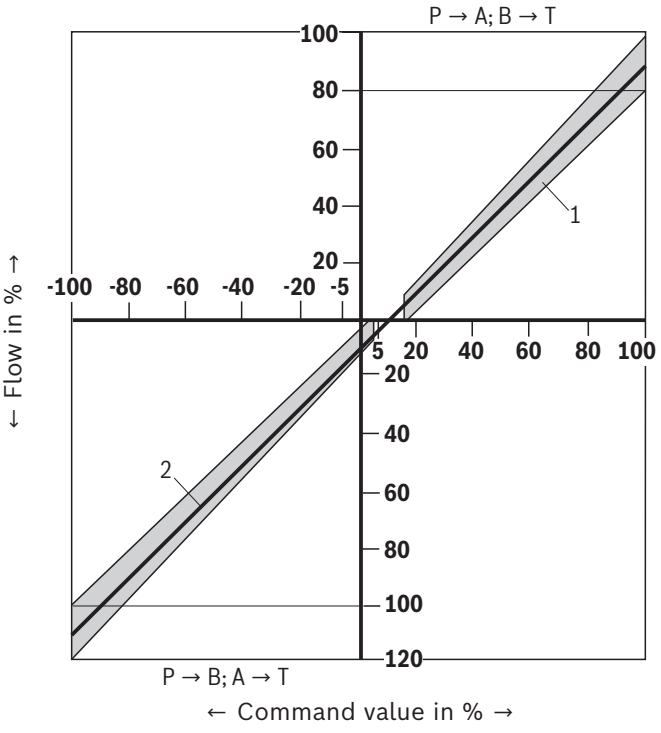
(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Tolerance field of the flow/signal function at constant valve pressure differential ***Δp***

Standard



Special version "-100"



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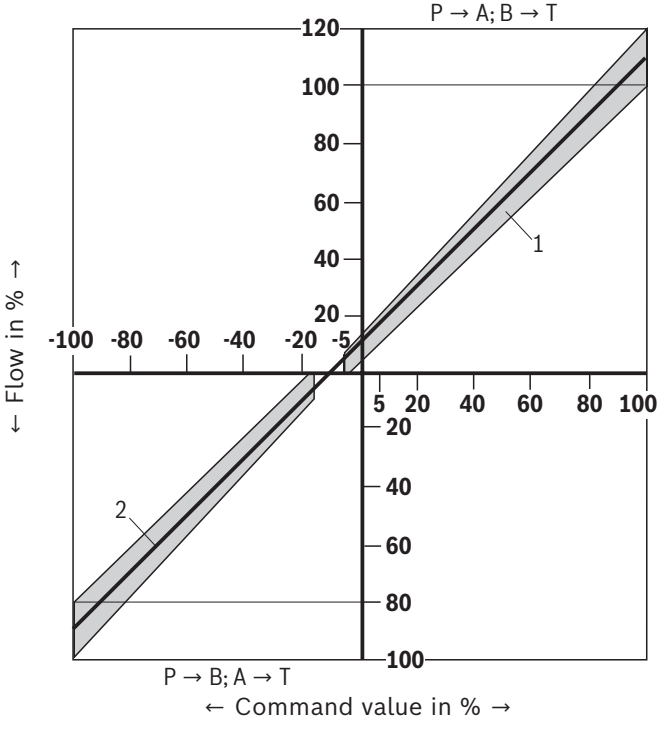


1 Tolerance field

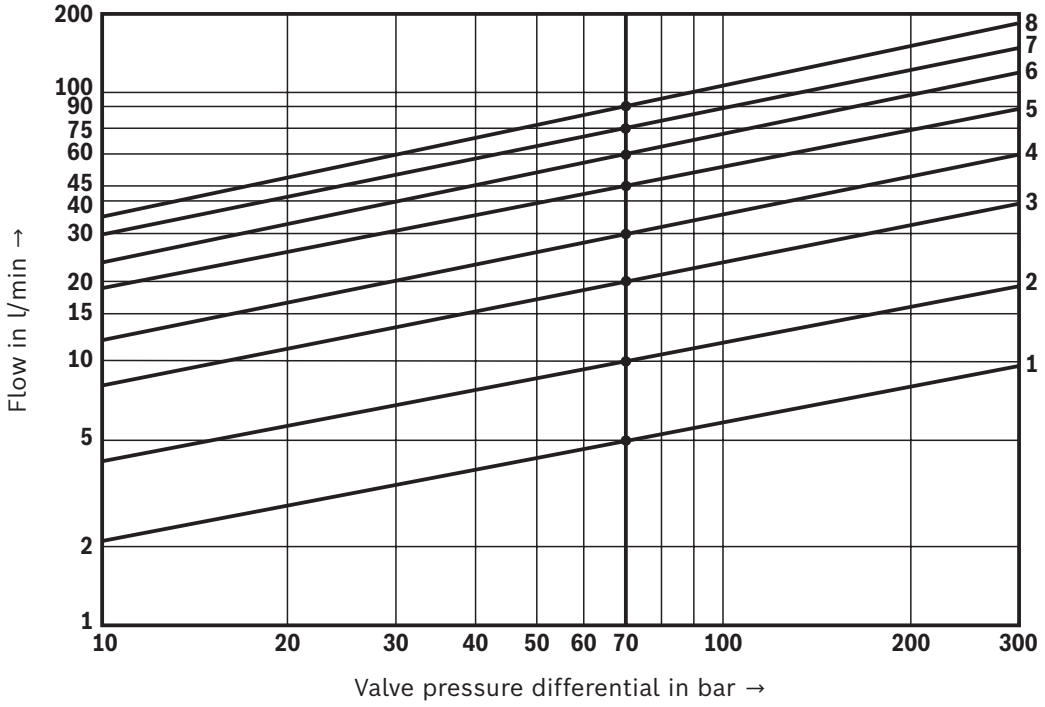
2 Typical flow curve

Characteristic curves

(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function

(tolerance ±10%) with 100% command value signal



Nominal flow

1 5 l/min
2 10 l/min
3 20 l/min
4 30 l/min
5 45 l/min
6 60 l/min
7 75 l/min
8 90 l/min

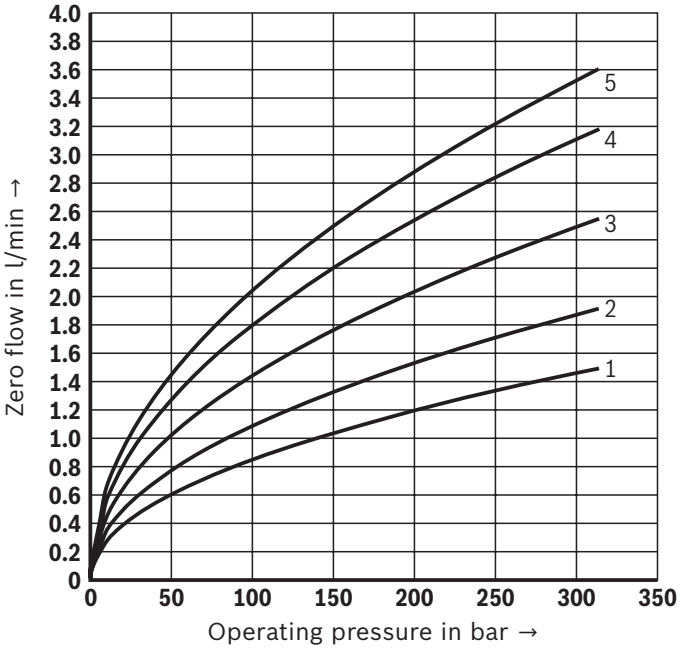
☞ **Notes:**

- Flow values in the maximum command value range (see tolerance field of the flow/signal function)
- $\Delta p = p_P - p_L - p_T$
  Δp valve pressure differential
  p_P inlet pressure
  p_L load pressure
  p_T return flow pressure

Characteristic curves

(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Zero flow (with control spool overlap "E", measured without dither signal)



Nominal flow

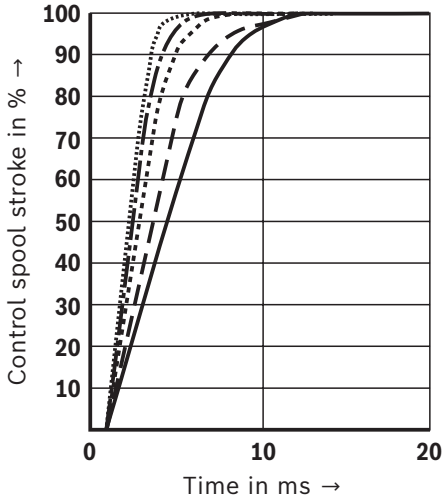
- **1** 5 l/min
- **2** 10 l/min
- **3** 20, 30, 45 l/min
- **4** 60, 75 l/min
- **5** 90 l/min

Characteristic curves

(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

Version "5", "10" and "20"



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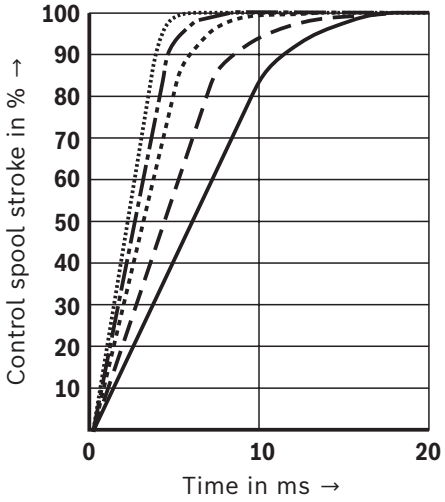

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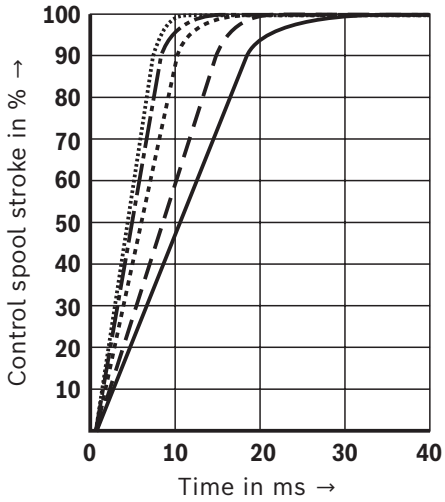

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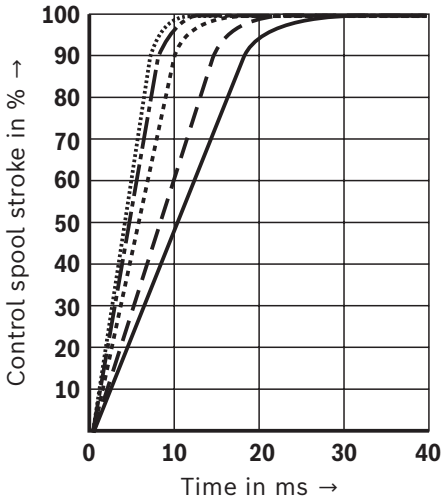

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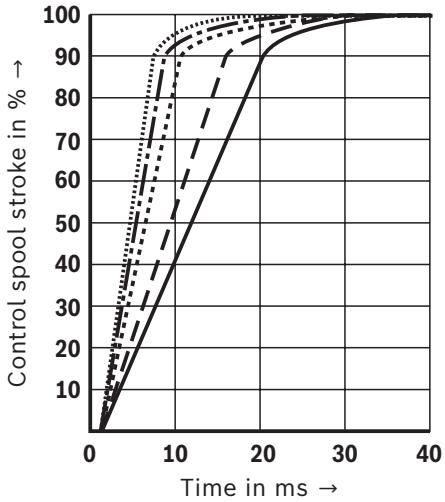

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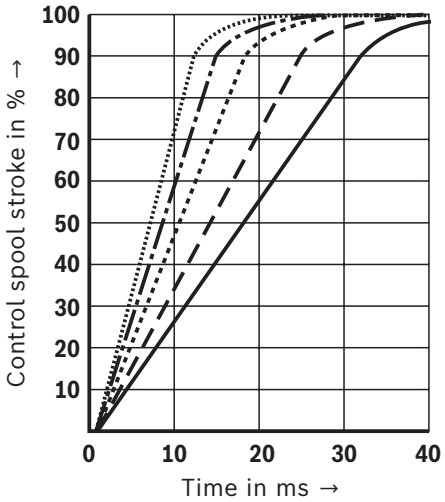
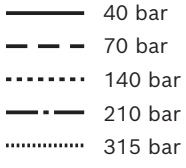


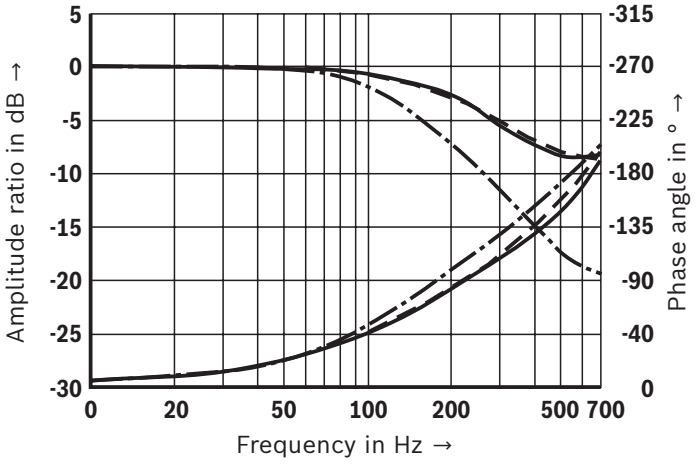


Characteristic curves

(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Frequency response with pressure rating 315 bar, stroke frequency without flow

Version "5", "10" and "20"



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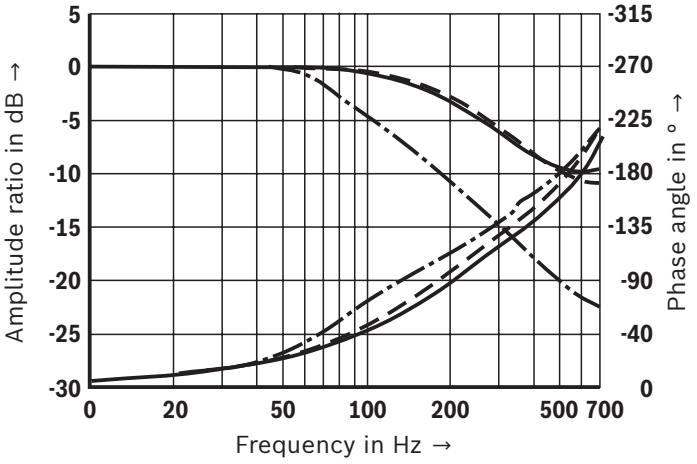

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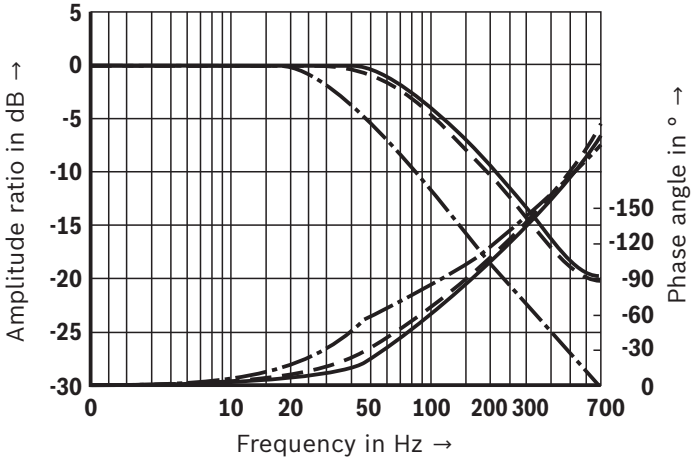

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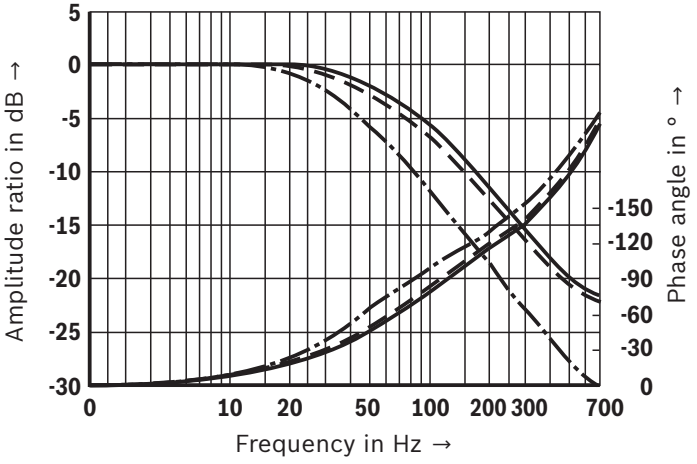

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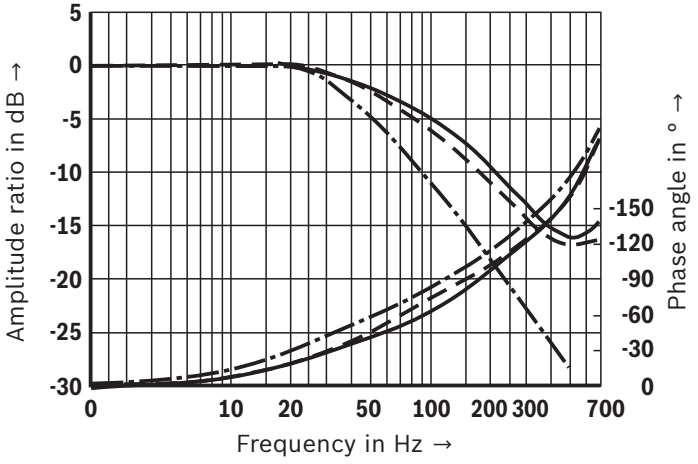

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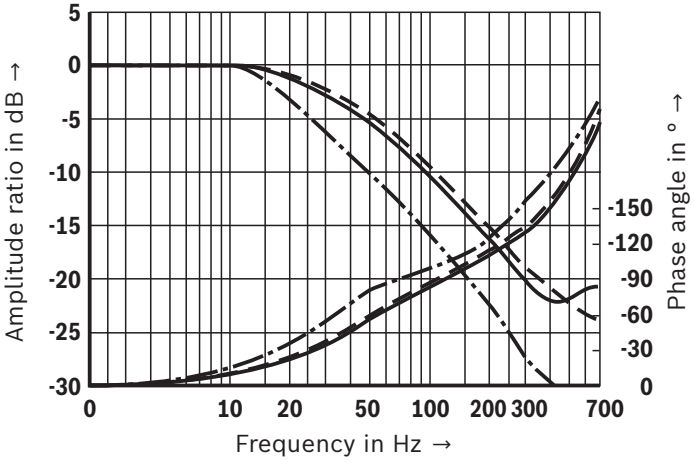
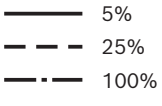


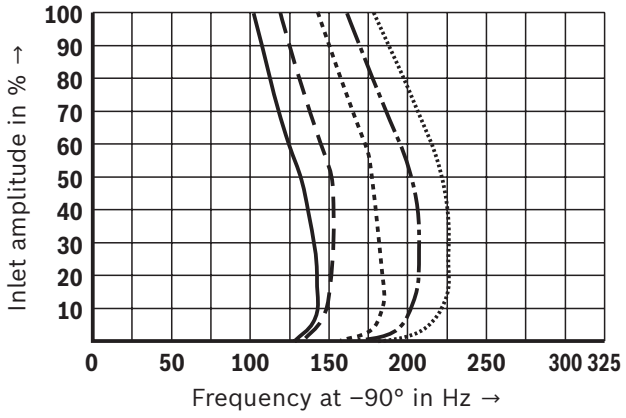


Characteristic curves

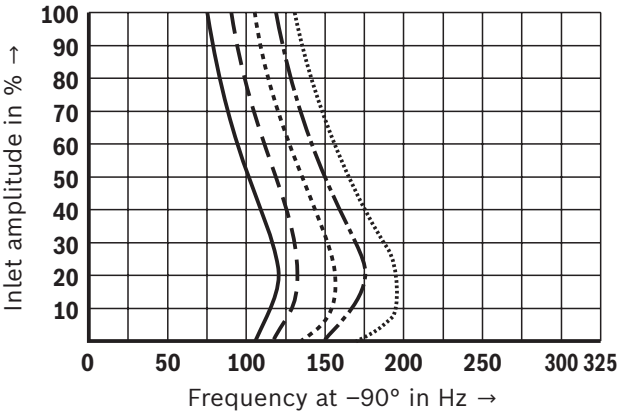
(measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

Version "5", "10" and "20"



Version "30"



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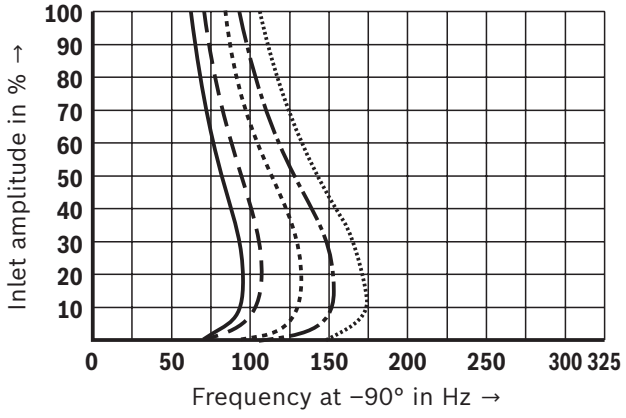

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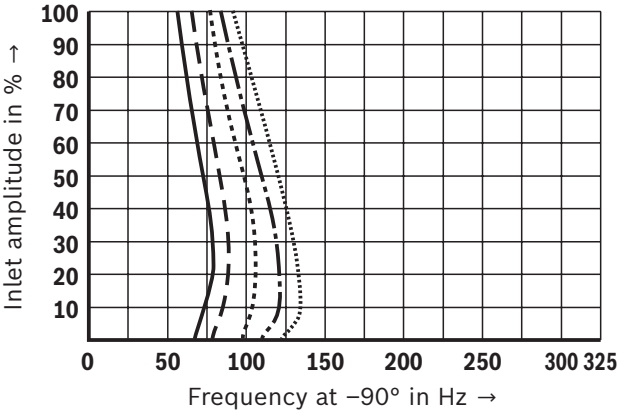

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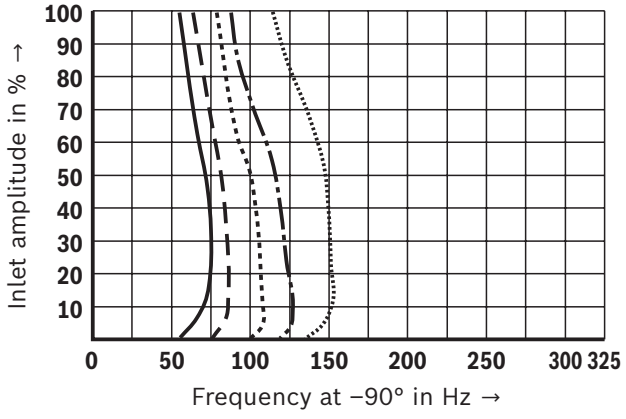
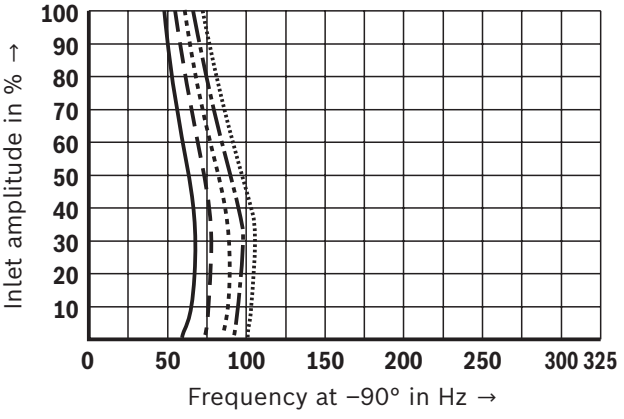
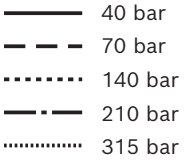
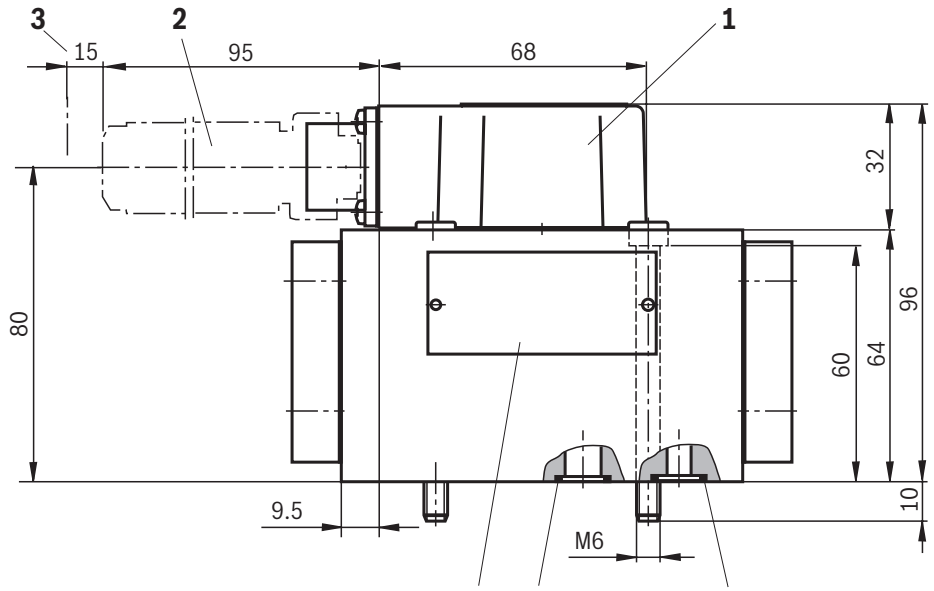


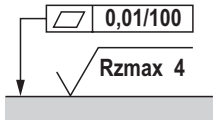
Version "90"



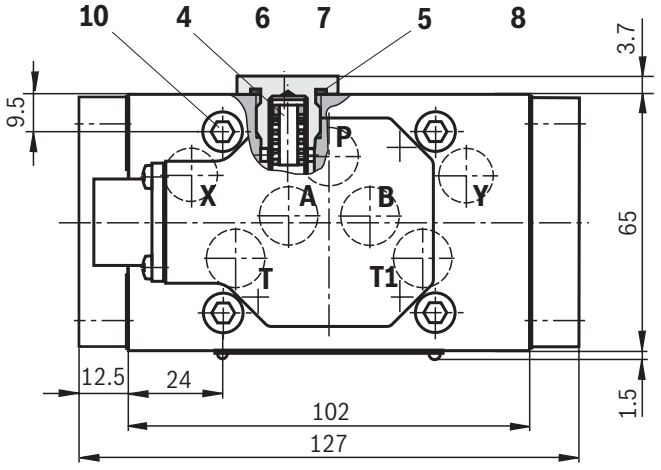


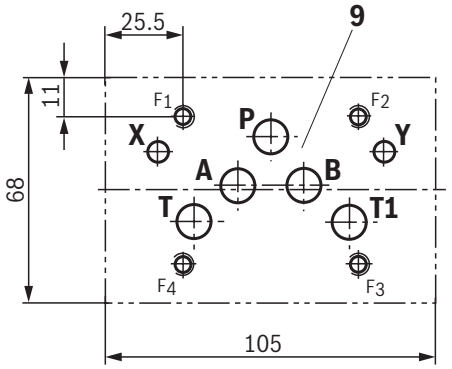
Dimensions
(dimensions in mm)





Required surface quality
of the valve contact surface





1 Cap

2 Mating connector (separate order, see page 15)

3 Space required for removing the mating connector, also observe the bending radius of the connection line

4 Exchangeable filter element, material no. **R900306843**

5 Profile seal for filter screw M16 x 1.5;
Material no. **R900012503** (FKM)

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return

9 Machined valve contact surface;
Porting pattern according to ISO 4401-05-05-0-05;
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

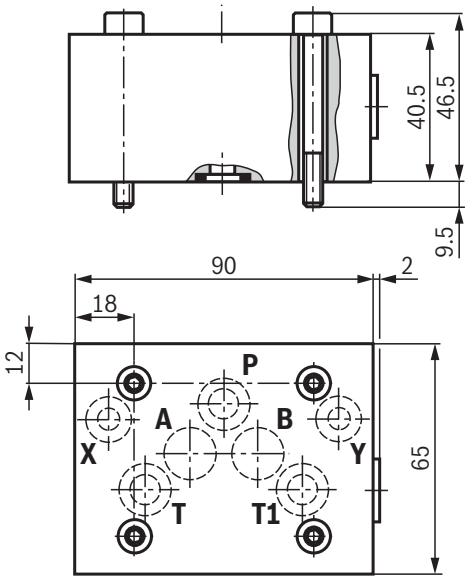
10 **Valve mounting screws** (included in the scope of delivery)
Only use valve mounting screws with the subsequently listed thread diameters and strength properties. Observe the screw-in depth.
4 hexagon socket head cap screws ISO 4762 - M6 x 70 - 10.9
(Friction coefficient μ_{total} = 0.09 ... 0.14)
Tightening torque M_A = 12.5$^{\pm 1.5}$ Nm

Subplates (separate order) with porting pattern according to ISO 4401-05-05-0-05, see data sheet 45100.

☞ **Notes:**
- The dimensions are nominal dimensions which are subject to tolerances.
- Subplates are no components in the sense of Directive 2014/34/EU and can be used after the manufacturer of the overall system has conducted an assessment of the risk of ignition. The "G...J3" versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol



Ordering code and further information

- Material number **R901541299**
- Weight 2.0 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws (included in the scope of delivery)
  For reasons of stability, exclusively use the following valve mounting screws:
  4 hexagon socket head cap screws
  ISO 4762 - M6 x 50 -10.9
  (Friction coefficient μ_{total} = 0.09 ... 0.14)
  Tightening torque M_A = 12.5±1.5 Nm

☞ **Notice:**
Before assembly and operation, observe the information in the operating instructions 29583-XL-B.

Accessories (separate order)

Mating connectors and cable sets

Item [1]	Designation	Version	Short designation	Material number	Data sheet
2	Mating connector; for valves with round connector, 6-pole + PE	straight, metal	7PZ31 ...M	**R900223890**	08006

[1] See dimensions on page 14.

Further information

▶ Analog amplifier module type VT 11021	Data sheet 29743
▶ Subplates	Data sheet 45100
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Mating connectors and cable sets for valves and sensors	Data sheet 08006
▶ Use of non-electrical hydraulic components in an explosive environment (ATEX)	Data sheet 07011
▶ Selection of filters	
▶ Information on available spare parts	