

# Directional servo valve with mechanical position feedback

**RE 29564-XN-100/04.16**  
Replaces: 05.10

## Type 4WS2EM ...XN...-100

Size 6  
Component series 2X  
Maximum operating pressure 315 bar  
Maximum flow 48 l/min



### ATEX units – For potentially explosive atmospheres



#### Information on the explosion protection:

- ▶ Area of application in accordance with the Explosion Protection Directive 2014/34/EU: **II 3G; II 3D**
- ▶ Types of protection:
  - Ex nA II T5X according to EN 60079-0 / EN 60079-15
  - Ex tD A22 IP 65 TX according to EN 61241-0 / EN 61241-1

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## Features

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- 4/3-way version
- Directional servo valve for intended use in potentially explosive atmospheres of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting
- Porting pattern according to ISO 4401-03-02-0-05 (but without locating hole)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- External control electronics in Euro-card format or in modular design (separate order)
- Valve is adjusted and tested
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

## Ordering code

<b>4WS2EM</b>	<b>6</b>	<b>-2X/</b>	<b>B</b>	<b>11</b>	<b>XN</b>	<b>ET</b>	<b>K17</b>	<b>V</b>	<b>-100</b>
Electrically operated 2-stage servo valve in 4/3 directional design with mechanical feedback for <b>external</b> control electronics	Size 6	= 6		Component series 20 to 29 (20 to 29: unchanged installation and mounting dimensions)	= 2X			<b>100 =</b> Special number <sup>6)</sup>	<b>Seal material</b> V = FKM seals, suitable for mineral oil (HL, HLP) according to DIN 51524
<b>Rated flow</b> <sup>1)</sup>								<b>Spool overlap</b> <sup>5)</sup>	
2 l/min					= 2			E = 0 ... 0.5 % negative	
5 l/min					= 5			D = 0 ... 0.5 % positive	
10 l/min					= 10			C = 3 ... 5 % positive	
15 l/min					= 15			<b>K17 = Electrical connection via connector</b> Mating connector, separate order, see page 7	
20 l/min					= 20			<b>Inlet pressure range</b> <sup>4)</sup>	
25 l/min					= 25			210 = 10 to 210 bar	
Characteristic curves, see page 8 (observe the tolerance field of flow/signal function)								315 = 10 to 315 bar	
Valve for <b>external</b> control electronics								ET = Pilot oil supply and return internal <sup>3)</sup>	
Coil no. 11 (30 mA/85 Ω per coil) <sup>2)</sup>					= 11			XN = Explosion protection "type of protection nA" For details, see information on the explosion protection, page 6	

### 1) Rated flow

The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of  $\pm 10\%$  must be taken into account (see flow/signal function on page 8).

### 2) External control electronics

The actuating signal must be created from a flow-controlled output stage. Control electronics (servo amplifier), see page 6.

### 3) Pilot oil

This valve is only available with internal pilot oil supply and return.

### 4) Inlet pressure range

Care should be taken that the system pressure is as constant as possible.

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range of 10 ... 210 bar or 10 ... 315 bar.

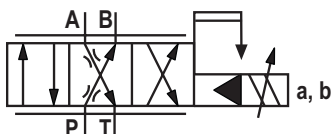
### 5) Spool overlap

The control spool overlap is specified in % of the nominal control spool stroke.

### 6) Special number "100"

The channels P → B und A → T are open 10% of the nominal quantity without control (de-energized state).

## Symbol



## Function, section

### 4WS2EM 6-2X/...XN...-100

Valves of this type are electrically operated, 2-stage directional servo valves with porting pattern according to ISO 4401-03-02-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

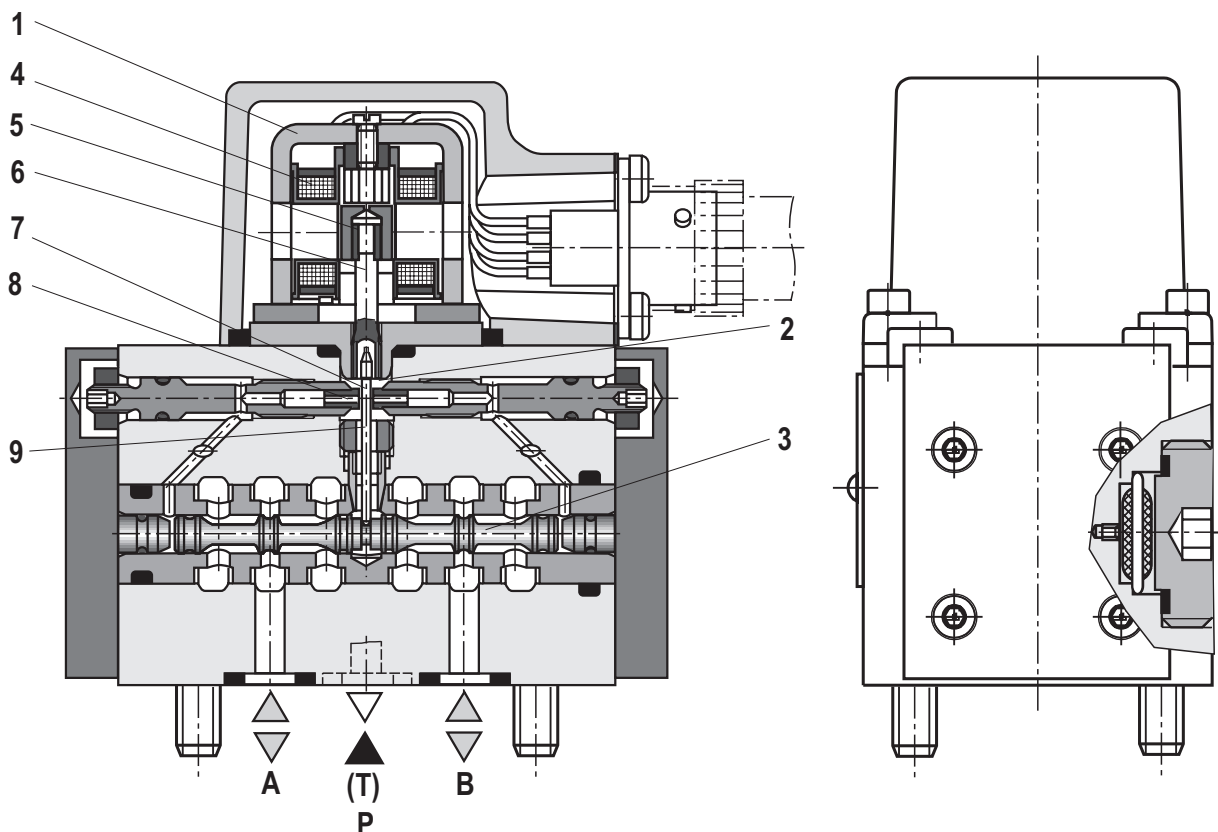
An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a bolt to move 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 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 is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electromagnetic 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 and consequently the flow of the servo valve are regulated 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.



Type 4WS2EM 6-2X/...XN...-100

## Technical data

### general

Porting pattern		ISO 4401-03-02-0-05
Installation position		Any (ensure that during start-up of the system, the valve is supplied with sufficient pressure ( $\geq 10$ bar)!)
Surface protection	Valve body, cover, filter screw	Nitro-carburated
	Cap	Anodized
Storage temperature range	°C	+5 ... +40
Ambient temperature range	°C	-30 ... +80
Weight	kg	1.1

### hydraulic (measured with HLP32, $\vartheta_{oil} = 40 \text{ °C} \pm 5 \text{ °C}$ )

Operating pressure	Ports P, A, B	bar	10 ... 210 or 10 ... 315
Return flow pressure	Port T	bar	Pressure peaks < 100 static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	-15 ... +70; preferably +40 ... +50
Viscosity range		mm <sup>2</sup> /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 <sup>1)</sup>
Zero flow $q_{V,L}$ <sup>2)</sup> with spool overlap E measured without dither signal		l/min	$\sqrt{p_p / 70 \text{ bar} \cdot (0.4 \text{ l/min} + 0.02 \cdot q_{v \text{ nom}})^3}$ ; <sup>3); 4)</sup>
Rated flows $q_{v \text{ nom}}$ <sup>3)</sup> , tolerance $\pm 10 \%$ with valve pressure differential $\Delta p = 70$ bar		l/min	2; 5; 10; 15; 20; 25
Max. control spool stroke with mechanical end position (in case of error) related to nominal stroke		%	120 ... 170
Feedback system			Mechanical
Hysteresis (dither-optimized)		%	$\leq 1.5$
Range of inversion (dither-optimized)		%	$\leq 0.2$
Response sensitivity (dither-optimized)		%	$\leq 0.2$
Pressure amplification with 1 % spool stroke change (from the hydraulic zero point)		% of $p_p$ <sup>4)</sup>	$\geq 50$
Zero adjustment flow over the entire operating pressure range		%	$\leq 3$ , long-term $\leq 5$
Zero shift upon change of:			
Hydraulic fluid temperature		% / 20 °C	$\leq 1$
Ambient temperature		% / 20 °C	$\leq 1$
Operating pressure 80 ... 120 % of $p_p$ <sup>4)</sup>		% / 100 bar	$\leq 2$
Return flow pressure 0 ... 10 % of $p_p$ <sup>4)</sup>		% / bar	$\leq 1$

<sup>1)</sup> The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters, see [www.boschrexroth.com/filter](http://www.boschrexroth.com/filter)

<sup>2)</sup>  $q_{V,L}$  = zero flow in l/min

<sup>3)</sup>  $q_{v \text{ nom}}$  = rated flow in l/min

<sup>4)</sup>  $p_p$  = operating pressure in bar

## Technical data

### electric

Protection class according to EN 60529:1991+A1:2000	IP 65 with mating connector correctly mounted and locked		
Type of signal	Analog		
Rated current per coil	mA	30	
Resistance per coil	Ω	85	
Inductivity with 60 Hz and 100% rated current	Serial connection	H	1.0
	Parallel connection	H	0.25
In case of control using non-Rexroth amplifiers, we recommend a superimposed dither signal.			

### Information on the explosion protection

Area of application according to directive 2014/34/EU	II 3G; II 3D		
Type of protection according to EN 60079-0 / EN 60079-15	Ex nA II T5X		
Type of protection according to EN 61241-0 / EN 61241-1	Ex tD A22 IP 65 TX		
Maximum surface temperature	°C	100	
Ambient temperature range	°C	-30 ... +80	
Hydraulic fluid temperature range	°C	-15 ... +70	
Maximum admissible operating voltage of the servo amplifier	V	32 (DC)	
Conditions for use in zone 2 and 22	<p>The valve may only be used in potentially explosive atmospheres of device group II, category 3, with a "low" risk of mechanical hazard according to the harmonized standards EN 60079-0 and EN 61241-0.</p> <p>For use in zones with a "high" risk of mechanical load according to these standards, precautions for reducing the risk of mechanical loads to "low" have to be taken.</p>		

### External control electronics

Servo amplifier (separate order)	Euro-card format	Analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design	Analog	Type VT 11021 according to data sheet 29743

The valve coils may only be connected to these amplifiers in parallel!

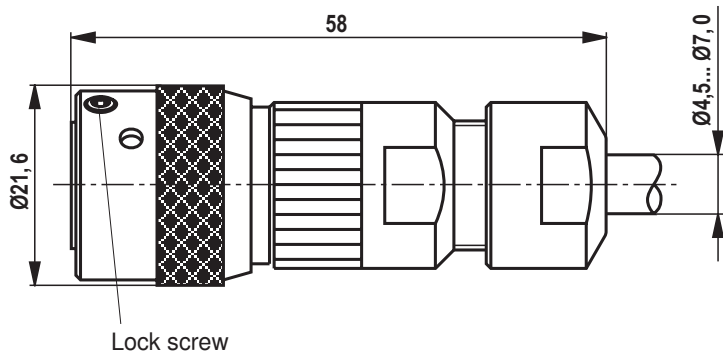
### **WARNING – Explosion hazard**

– The external servo amplifier must be operated outside the potentially explosive atmosphere!

## Mating connector

The servo valve may only be supplied via this mating connector.

Separate order, material no. **R901043330**



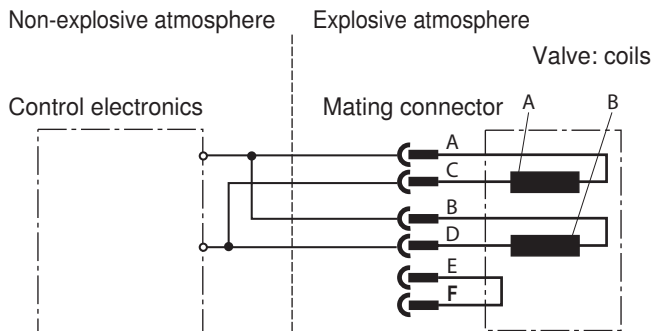
### Connection:

Contact sockets with litz wire connection cross-section 0.4 ... 0.75 mm<sup>2</sup> are enclosed unassembled.

Connection of the litz wires to contact sockets is possible by crimping or soldering.

The tools required for crimping connection are listed in the assembly instructions enclosed with the mating connector.

## Electrical connection (parallel connection example)



The coils are connected in parallel in the mating connector or to the amplifier (see figure).

For serial connection, contacts B and C have to be connected.

The bridge E-F can be used for electrical recognition of the correct connection of the connector or for cable break detection.

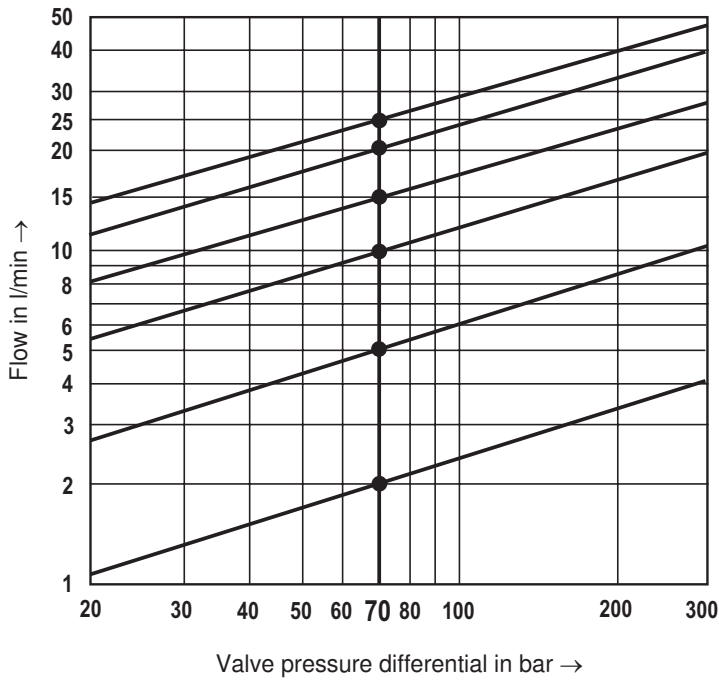
Electrical control from A (+) to D (-) provides for the direction of flow P → A and B → T. Reverse electrical control provides for direction of flow P → B and A → T.

### Characteristic curves (measured with HLP32, $\vartheta_{oil} = 40 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ )

**Flow/load function** (tolerance  $\pm 10 \%$ ) with 100 % command value signal

Notice:

Observe the flow values in max. command value range (see tolerance field of the flow/signal function)

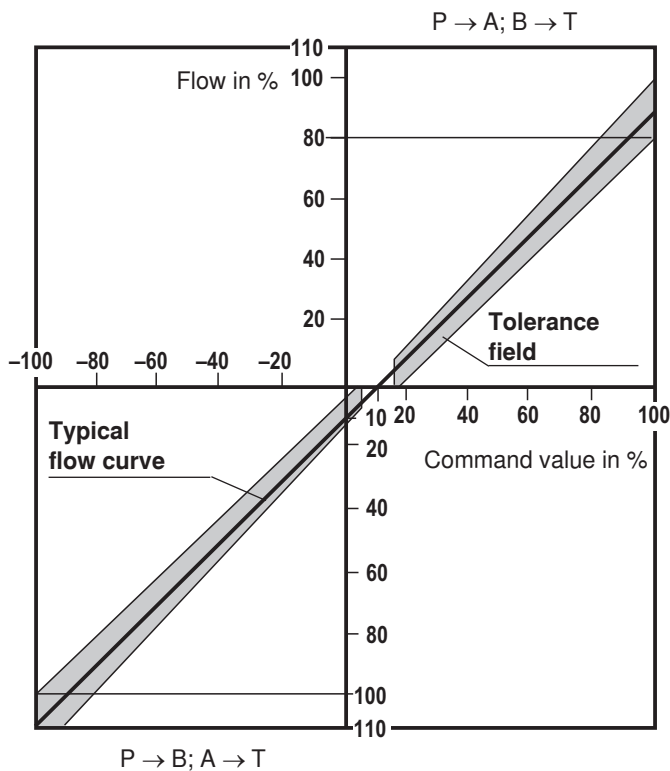


Ordering code	Rated flow	Curve
2	2 l/min	1
5	5 l/min	2
10	10 l/min	3
15	15 l/min	4
20	20 l/min	5
25	25 l/min	6

$\Delta p$  = Valve pressure differential  
(inlet pressure  $p_p$  minus load pressure  $p_L$  minus return flow pressure  $p_T$ )

### Tolerance field of flow/signal function

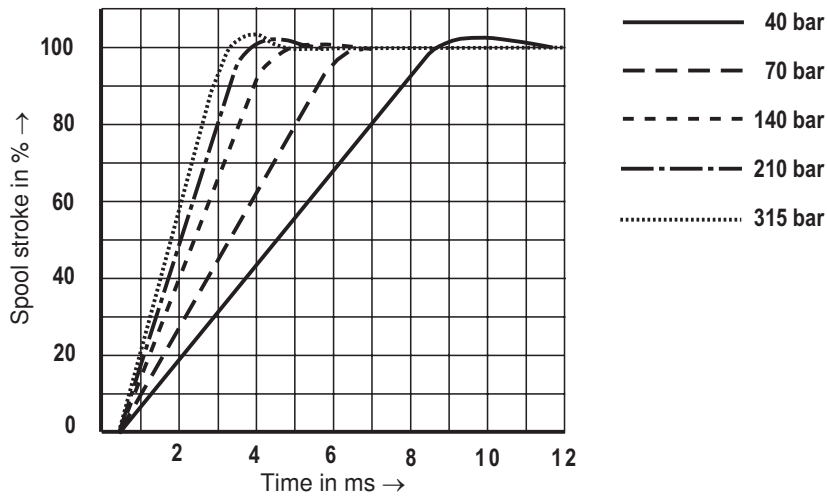
at constant valve pressure differential  $\Delta p$



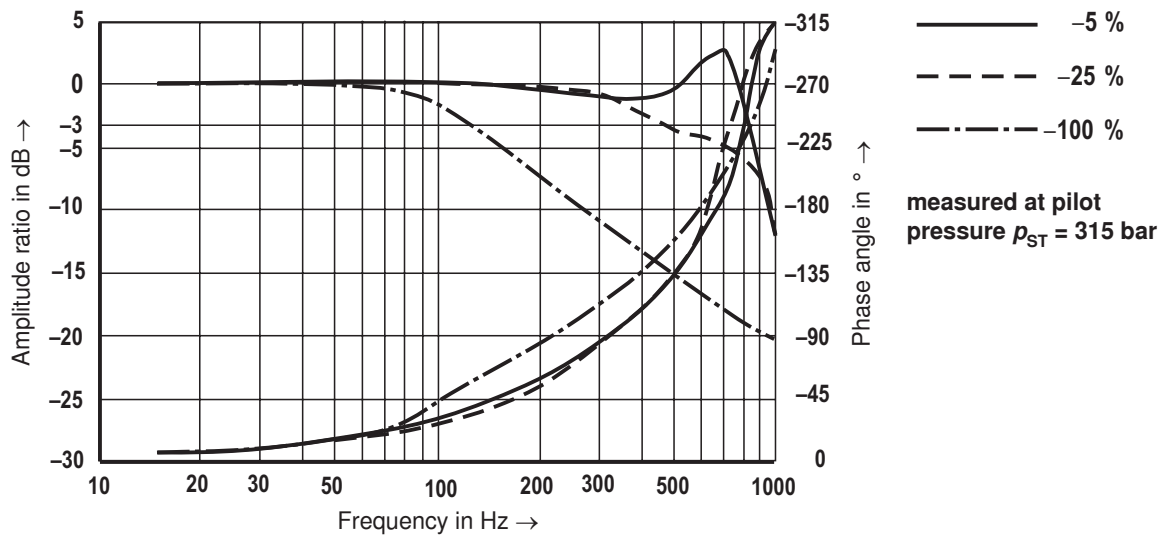


### Characteristic curves (measured with HLP32, $\vartheta_{oil} = 40 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ )

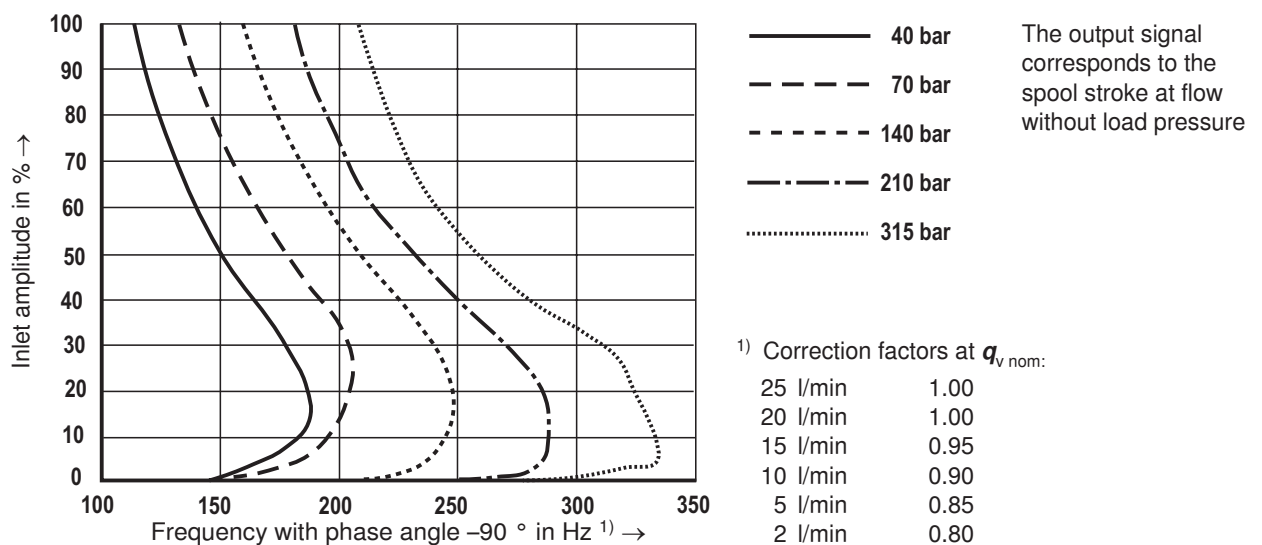
Transition function with pressure rating 315 bar, step response without flow



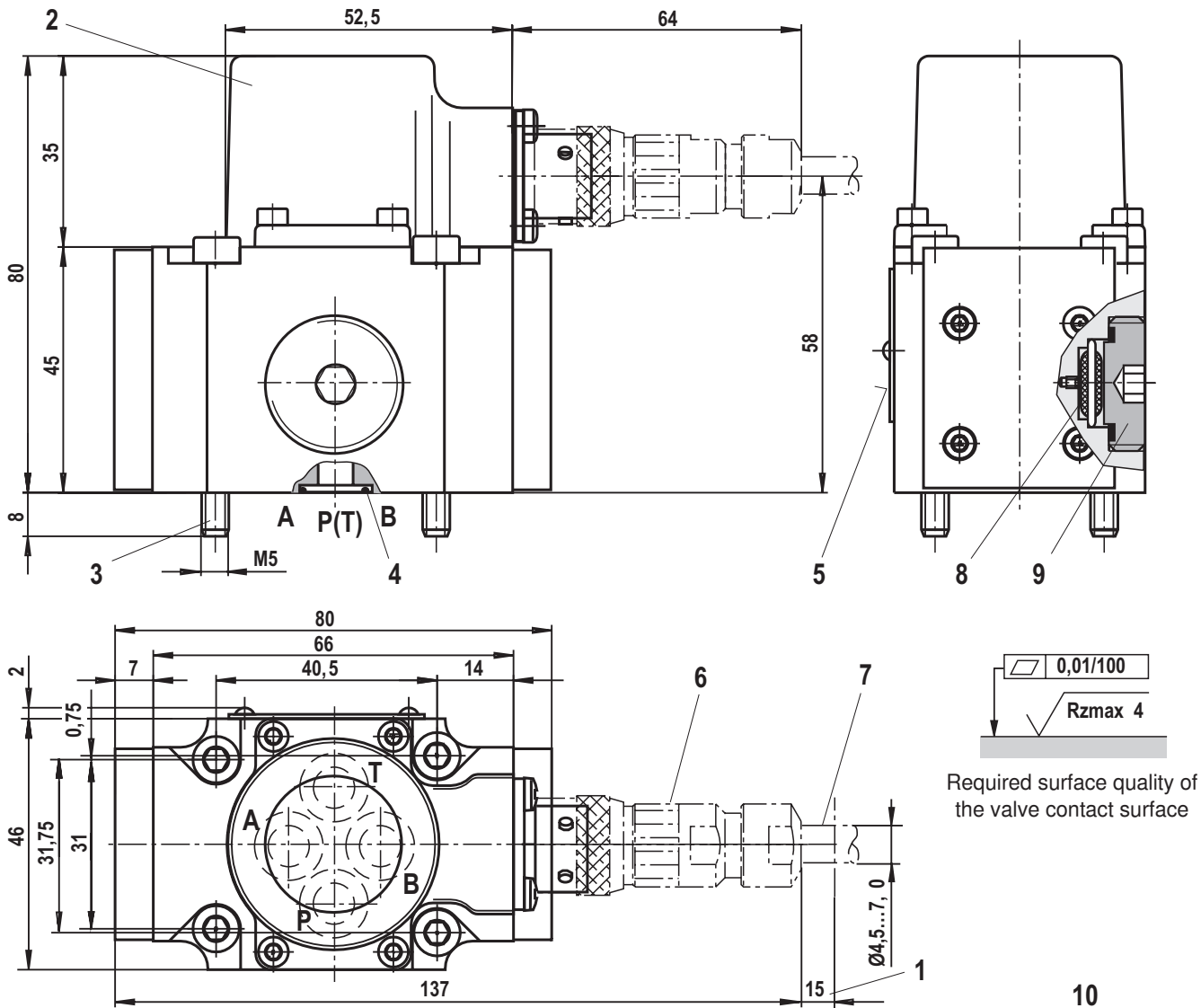
Frequency response with pressure rating 315 bar, stroke frequency without flow



Dependency of the frequency  $f$  at  $-90^\circ$  on the operating pressure  $p$  and the inlet amplitude



**Dimensions** (Dimensions in mm)



- 1 Space required for removing the mating connector, additionally observe the bending radius of the connection line
- 2 Cap
- 3 Valve mounting screws; for reasons of stability, exclusively use the following valve mounting screws:  
**4 hexagon socket head cap screws ISO 4762-M5x50-10.9-flZn-240h-L (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the scope of delivery)**
- 4 Identical seal rings for ports P, A, B and T
- 5 Name plate
- 6 Mating connector (separate order, see page 7)
- 7 Connection line, further information on page 7
- 8 Filter
- 9 Plug screw
- 10 Machined valve contact surface; porting pattern according to ISO 4401-03-02-0-05 (but without locating hole)

**Subplates** (separate order) with porting pattern according to ISO 4401-03-02-0-05, see data sheet 45100.

**Notice:**

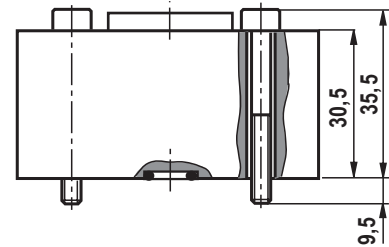
Subplates are no components in the sense of directive 2014/34/EU and can be used after the manufacturer of the overall system has conducted an assessment of the risk of ignition. The "G...J3" versions are free from aluminum and/or magnesium and galvanized.

## Flushing plate with porting pattern according to ISO 4401-03-02-0-05 (dimensions in mm)



### Ordering code and further information

- Material number: **R900936049**
- Weight: 0.6 kg
- Identical seal rings for ports P, A, B and T
- Mounting screws;  
for reasons of stability, exclusively use the following mounting screws:  
**4 hexagon socket head cap screws**  
**ISO 4762-M5x40-10.9-fIZn-240h-L**  
**(friction coefficient 0.09 – 0.14 according to**  
**VDA 235-101) (included in the scope of delivery)**



### Notice

Before assembly and operation, please observe the information in the 29564-XN-B operating instructions.

## Further information

### Subplates

Hydraulic fluids on mineral oil basis  
 Environmentally compatible hydraulic fluids  
 Flame-resistant, water-free hydraulic fluids  
 Flame-resistant hydraulic fluids - containing water (HFAE, HFAS, HFB, HFC)  
 Directional servo valve with mechanical position feedback  
 Selection of filters  
 Information on available spare parts

Data sheet 45100

Data sheet 90220

Data sheet 90221

Data sheet 90222

Data sheet 90223

Operating instructions 29564-XN-B

[www.boschrexroth.com/filter](http://www.boschrexroth.com/filter)

[www.boschrexroth.com/spc](http://www.boschrexroth.com/spc)

## Notes

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