

Directional control valves, pilot-operated,
 with electrical position feedback and
 integrated electronics (OBE)

Type 4WRDE

RE 29097

Edition: 2016-05

Replaces: 29093
 (NG10 and
 NG16)



H8092

- ▶ Sizes 10 and 16
- ▶ Component series 6X
- ▶ Maximum operating pressure 350 bar
- ▶ Rated flow 25 ... 220 l/min

Features

- ▶ 4/3-way version
- ▶ 3-stage
- ▶ Precise:
 - Pilot control with 2-stage servo valve type 4WS2EM 6-2X/...
 - Particularly suitable for position, velocity, pressure and force control of high-precision applications
 - High dynamics and response sensitivity
- ▶ Reliable
 - Proven and robust design

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Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
4	WRD	E						-	6X	/			/	24	*

01	4 main ports	4
02	Directional control valve	WRD
03	With integrated electronics (OBE)	E
04	Size 10	10
	Size 16	16
05	Symbols e.g. E, E1, W etc.; possible version see page 3	

Control spool position in de-energized state

06	Not defined	no code
	100% P → A / B → T	P
	100% P → B / A → T	N

Rated flow at 10 bar valve pressure differential (5 bar per control edge)

07	- Size 10	
	25 l/min (only symbol E, W6-, W8- and V with version "L")	25
	50 l/min	50
	90 l/min	100
	- Size 16	
	150 l/min (only symbol V1 with version "L")	150
	200 l/min	200

Flow characteristic

08	Linear	L
	Linear with fine control range	P
09	Component series 60 ... 69 (60 ... 69: unchanged installation and connection dimensions)	6X

Seal material

10	NBR seals	M
	FKM seals	V
	Observe compatibility of seals with hydraulic fluid used! (other seals on request)	

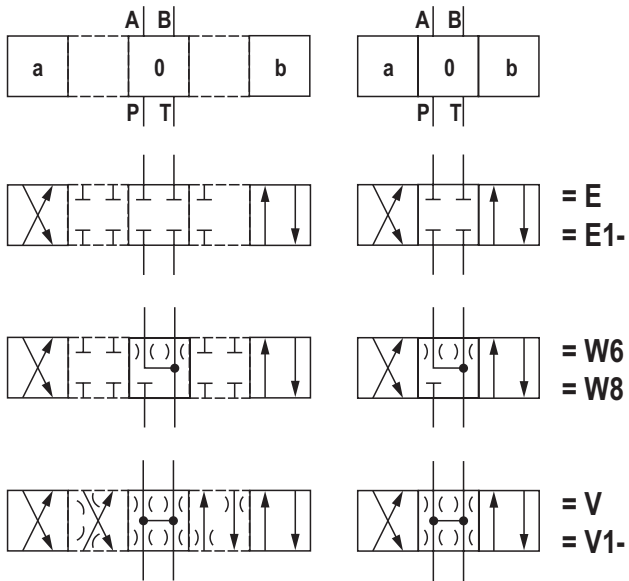
Pilot oil flow

11	External pilot oil supply, external pilot oil return	XY
	Internal pilot oil supply, external pilot oil return	PY
	Internal pilot oil supply, internal pilot oil return	PT
	External pilot oil supply, internal pilot oil return	XT
12	Without sandwich plate shut-off valve	no code
	With sandwich plate shut-off valve, 24 V	WG
13	Supply voltage 24 V	24

Electrical interface

14	Command value ±10 VDC, actual value ±10 VDC (connector 6+PE)	A1
	Command value 4 ... 20 mA, actual value 4 ... 20 mA (connector 6+PE)	F1
	Command value ±10 mA, actual value 4 ... 20 ma (connector 6+PE), only in connection with version "P" and "N" (de-energized control spool position)	C6-972
15	For further information, see the plain text	

Symbols



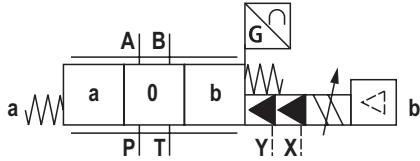
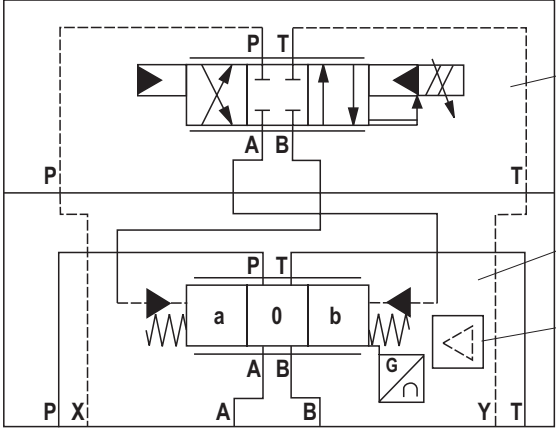
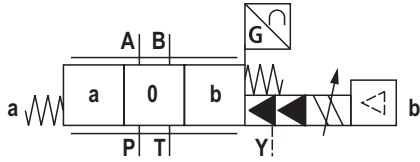

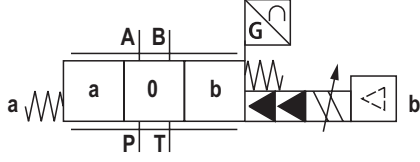

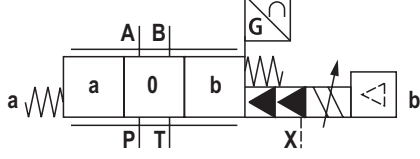
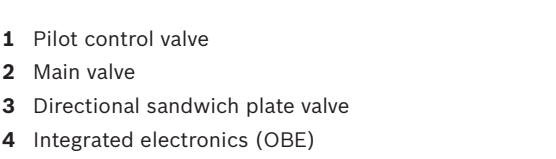
With symbol E1-, W8 and V1-:

P → A: $q_{V \max}$ B → T: $q_{V/2}$
 P → B: $q_{V/2}$ A → T: $q_{V \max}$

Notices:

- Representation according to DIN ISO 1219-1. Hydraulic interim positions are shown by dashes.
- With symbols W6 and W8 there is a connection from A to T and B to T with approx. 3% of the relevant nominal cross-section in zero position.

Symbols

Version	simplified	detailed
"XY"	 <p>The simplified symbol for the XY valve shows a 4-way valve with ports A and B at the top, and P and T at the bottom. It features a solenoid G on the right side and a spring return to the center (0) position. The symbol is labeled with 'a' and 'b' on the left and right sides, and 'Y!' and 'X!' at the bottom right.</p>	 <p>The detailed schematic for the XY valve shows a pilot control valve (1) at the top, a main valve (2) in the middle, and a directional sandwich plate valve (3) at the bottom. The main valve is controlled by the pilot valve. The schematic includes ports P, T, A, B, X, and Y, and a solenoid G. The symbol is labeled with 'a' and 'b' on the left and right sides, and 'Y!' and 'X!' at the bottom right.</p>
"PY"	 <p>The simplified symbol for the PY valve is similar to the XY valve, but it lacks the 'X!' label at the bottom right.</p>	 <p>The detailed schematic for the PY valve is similar to the XY valve, but it lacks the 'X!' label at the bottom right.</p>
"PT"	 <p>The simplified symbol for the PT valve is similar to the XY valve, but it lacks the solenoid G and the 'Y!' label at the bottom right.</p>	 <p>The detailed schematic for the PT valve is similar to the XY valve, but it lacks the solenoid G and the 'Y!' label at the bottom right.</p>
"XT"	 <p>The simplified symbol for the XT valve is similar to the XY valve, but it lacks the solenoid G and the 'Y!' label at the bottom right.</p>	 <p>The detailed schematic for the XT valve is similar to the XY valve, but it lacks the solenoid G and the 'Y!' label at the bottom right.</p>

- 1 Pilot control valve
- 2 Main valve
- 3 Directional sandwich plate valve
- 4 Integrated electronics (OBE)

Function, section

Set-up

3-stage directional control valve of type 4WRDE generally consisting of:

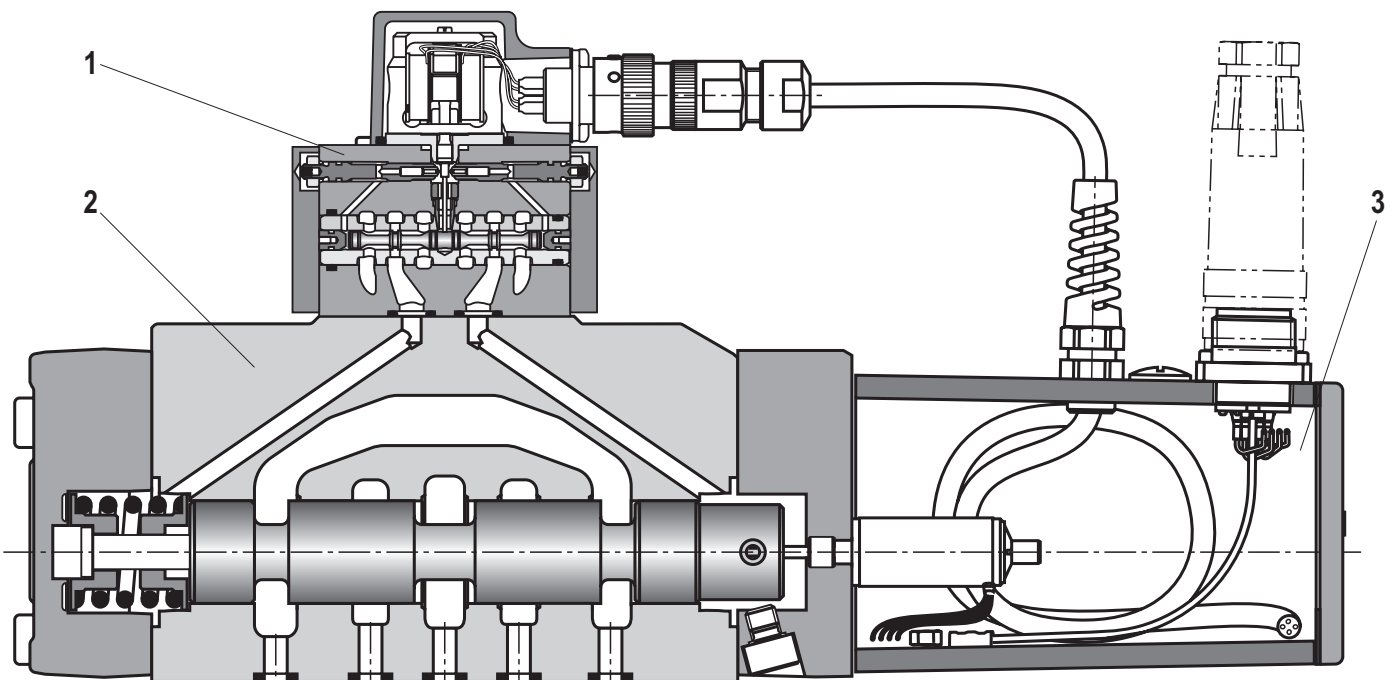
- ▶ Servo pilot control valve, 2-stage, type 4WS2EM6-2X (1)
- ▶ Main stage (2), consisting of housing and main stage control spool
- ▶ Integrated electronics (3) with inductive position transducer of the main stage

Function

In the integrated electronics (OBE), the specified command value is compared with the position actual value of the main stage control spool. In case of a difference (control deviation), the first stage of the pilot control valve is controlled (dry torque motor and nozzle flapper plate system). This way, a deflection of the flapper plate of the nozzle flapper plate system is realized. The distance of the flapper plate to one of the two control nozzles flow-through by pilot oil is reduced and increased to the other one. Through the connecting bore, the resulting flow difference leads to deflection of the control spool in the pilot control valve (2nd stage) similarly to the control signal. The flow released by the pilot control valve leads to deflection of the control spool of the main stage (3rd stage) until its position actual value corresponds to the command value. The stroke of the control spool is controlled proportionally to the command value.

Valve particularities

- ▶ Pilot control valve and integrated electronics (OBE) have to be readjusted after replacement. All adjustments may only be carried out by trained specialists.
- ▶ The valves are factory-set with a dither default setting with the constant frequency of 400 Hz.
- ▶ Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.
- ▶ The pilot control valve may only be maintained by Rexroth employees. An exception is the replacement of the filter and the sealing according to accessories list. It has to be ensured that during the assembly, the sealing is properly seated and the plug screw is tightened. The tightening torque for the plug screw is 30 Nm.



Technical data

(For applications outside these values, please consult us!)

general			
Size	NG	10	16
Weight	kg	7.3	10.3
Installation position	Any (preferably horizontal)		
Ambient temperature range	°C	-20 ... +60 (NBR seals) -20 ... +60 (FKM seals)	
Maximum storage time	Years	1 (if the storage conditions are observed; refer to the operating instructions 07600-B)	
Vibration resistance	▶ Sine test according to DIN EN 60068-2-6	10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes	
	▶ Noise test according to DIN EN 60068-2-64	20 ... 2000 Hz / 10 g _{RMS} / 30 g peak / 30 min. / 3 axes	
	▶ Transport shock according to DIN EN 60068-2-27	15 g / 11 ms / 3 axes	
Maximum relative humidity (no condensation)	%	95	

hydraulic			
Maximum operating pressure	▶ Pilot oil supply external ¹⁾		
	– Port A, B, P	bar	350
	– Port X	bar	10 ... 250
Maximum return flow pressure	▶ Pilot oil supply internal		
	– Port A, B, P	bar	250
Maximum return flow pressure	▶ Pilot oil return, external		
	– Port T	bar	250
Maximum return flow pressure	▶ Pilot oil return, internal		
	– Ports T, Y	bar	Pressure peaks < 100 static < 10 admissible
Rated flow ($\Delta p = 5$ bar per control edge) ¹⁾		l/min	25
			50
			90
			– 125 200
Maximum flow (recommended)		l/min	170
Maximum pilot oil flow at stepped input signal (0 → 100%, pilot pressure 250 bar)		l/min	6.3
Zero flow at pilot control valve (pilot pressure 70 bar)		l/min	0.4
Hydraulic fluid	See table page 7		
Hydraulic fluid temperature range (at the valve working ports)		°C	-20 ... +80; preferably +40 ... +50
Viscosity range	▶ Maximum	mm ² /s	15 ... 380
	▶ Recommended	mm ² /s	30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid; Cleanliness class according to ISO 4406 (c)	Pilot control valve: Class 18/16/13 ²⁾ Main stage: Class 20/18/15 ²⁾		

¹⁾ For perfect system behavior, an external pilot oil supply is recommended for pressures above 210 bar.

²⁾ 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.

For the selection of the filters see www.boschrexroth.com/filter.

Technical data

(For applications outside these values, please consult us!)

Hydraulic fluid	Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils	HL, HLP	NBR, FKM	DIN 51524	90220
Flame-resistant ▶ Containing water	HFC (Fuchs Hydrotherm 46M, Petrofer Ultra Safe 620)	NBR	ISO 12922	90223



Important notices on hydraulic fluids:

- ▶ For more 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 40 K higher than the maximum solenoid surface temperature.

▶ Flame-resistant – containing water:

- Maximum operating pressure 210 bar, otherwise increased cavitation erosion
- Life cycle as compared to operation with mineral oil HL, HLP 30 ... 100%
- Maximum hydraulic fluid temperature 60 °C

static / dynamic			
Hysteresis		%	< 0.2
Response sensitivity		%	< 0.1
Range of inversion		%	< 0.1
Manufacturing tolerance q_{Vmax}		%	10
Zero shift upon change of	▶ Hydraulic fluid temperature	%/10K	< 0.2
	▶ Ambient temperature	%/10K	< 0.2
	▶ Operating pressure	%/100 bar	< 0.5
	▶ Return flow pressure 0 ... 10% of p	%/100 bar	< 0.2
Zero compensation ³⁾			Ex plant ±1%

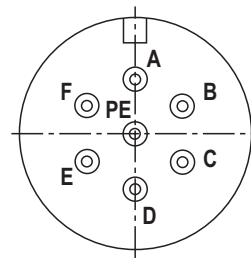
electrical, integrated electronics (OBE)			
Protection class according to EN 60529			IP 65 with mating connector mounted and locked
Supply voltage	▶ Nominal voltage	VDC	24 (full bridge rectification with smoothing capacitor 2200 μF , $I_{max} = 230$ mA)
	▶ Lower limit value	VDC	18
	▶ Upper limit value	VDC	36
Maximum current consumption		mA	< 200
Functional earth and screening			See page 8 (CE-compliant installation)
Adjustment			Calibrated in the factory, see valve characteristic curves page 12 ... 16

³⁾ Related to the pressure-signal characteristic curve (symbol V)

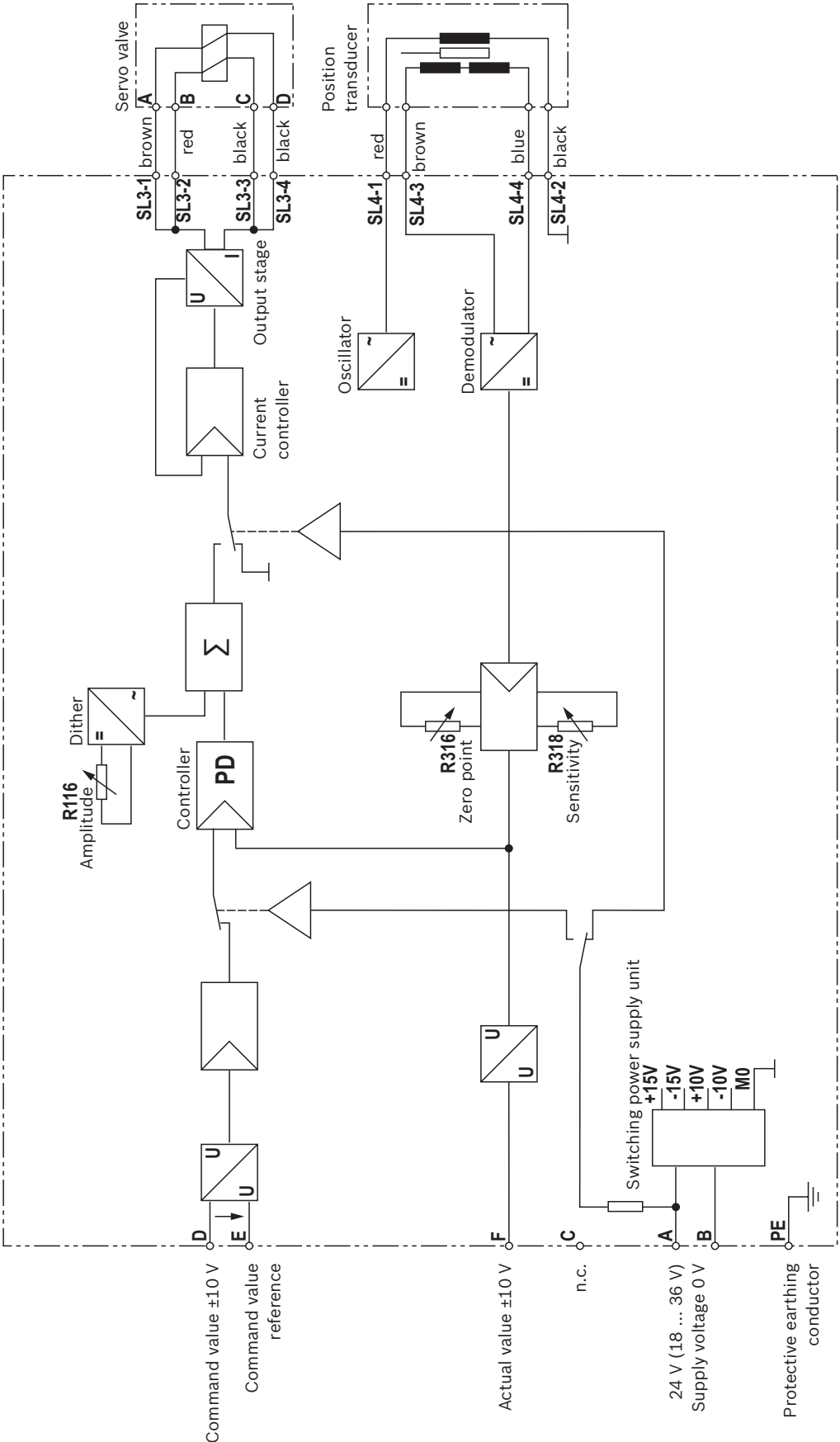
Electrical connections, assignment

Contact	Interface assignment		
	"A1" (6 + PE)	"F1" (6 + PE)	"C6-972" (6 + PE)
A	24 VDC supply voltage		
B	GND		
C	n.c.	n.c. (not to be connected)	Enable input 24 VDC (high ≥ 8.5 V; low ≤ 6.5 V) ¹⁾
D	Command value ± 10 V ²⁾ ($R_e > 100$ k Ω)	Command value 4 ... 20 mA ³⁾ ($R_e = 100$ Ω)	Command value ± 10 mA ²⁾ ($R_e = 200$ Ω)
E	Reference potential command value	Reference potential command value	Reference potential command value
F	Actual value ± 10 V ($R_i \approx 1$ k Ω)	Actual value 4 ... 20 mA (load max. 500 Ω)	Actual value 4 ... 20 mA (load max. 500 Ω)
PE	Functional earth (directly connected to the valve housing)		

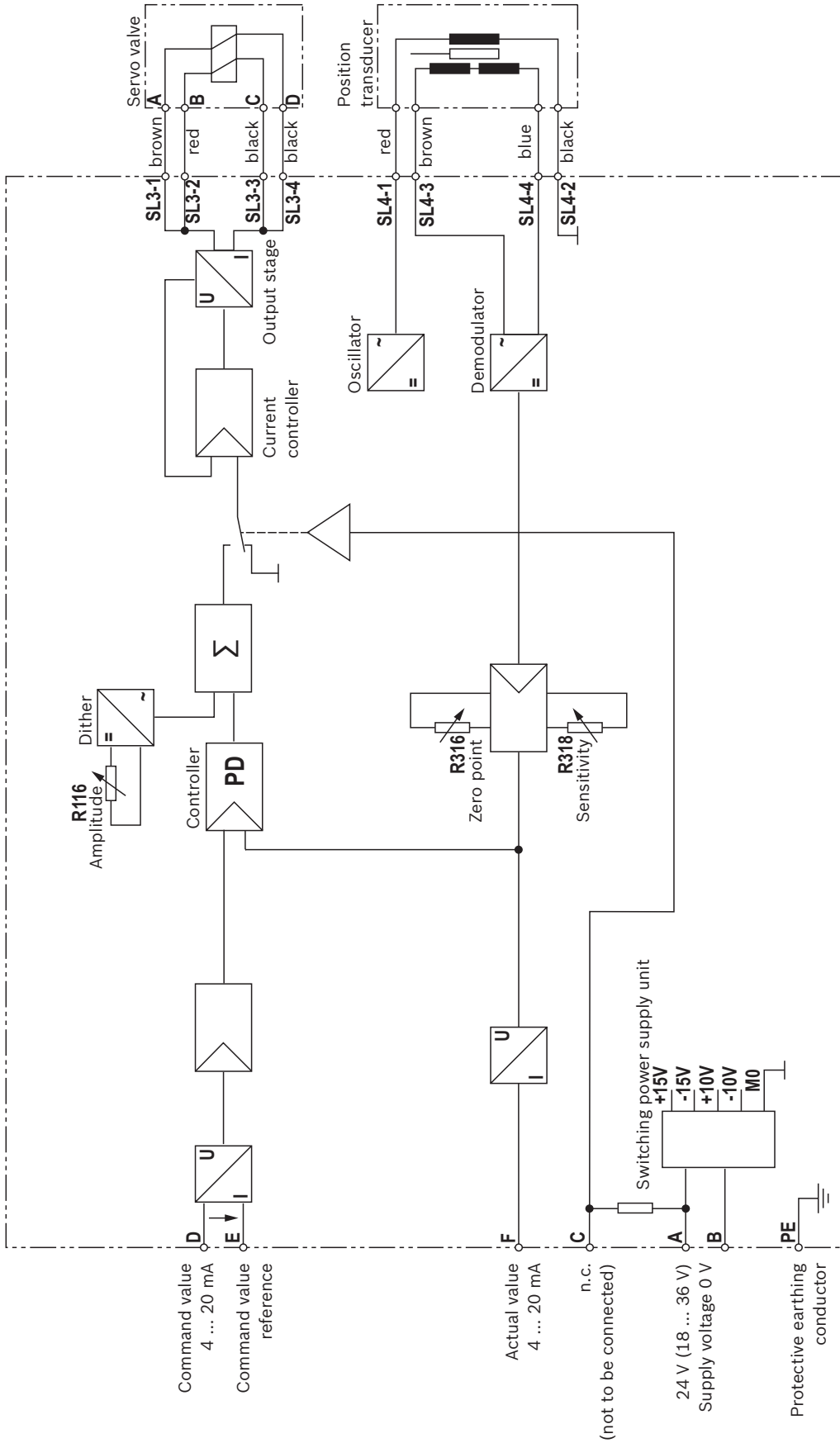
- ¹⁾ At active hydraulic pressure and "low" enable signal, the control spool of the main stage is in a regulated central position (preferred position adjustable by $\pm 20\%$).
If a directional sandwich plate valve (version "WG") is used between pilot control valve and main stage, the control chambers are unloaded from the pilot control valve to the main stage control spool. With symbols E, E1., W6- and W8-, the centering springs set the main stage control spool in central position, symbols V- and V1 are switched to preferred direction P \rightarrow B and A \rightarrow T in a tolerance range of 1% to 11% of the control spool stroke. As a consequence, the cylinder axis leaves its position at minimum velocity.
- ²⁾ Differential command value input: Positive command value at D compared to E results in flow from P \rightarrow A and B \rightarrow T at the main stage.
- ³⁾ Differential command value input: Command value of 12 ... 20 mA at D compared to E results in flow from P \rightarrow A and B \rightarrow T at the main stage.



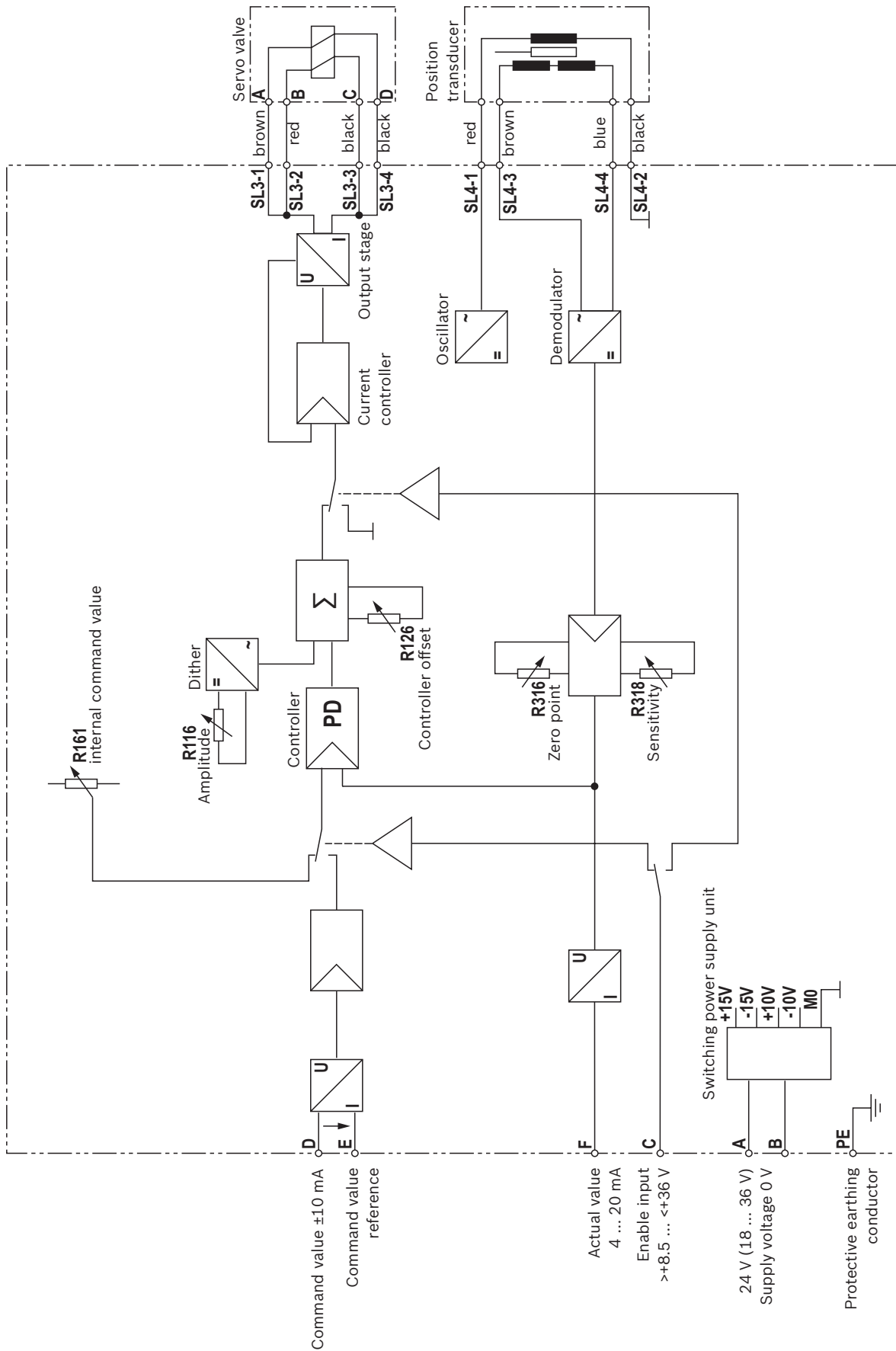
Block diagram/controller function block: Version "A1"



Block diagram/controller function block: Version "F1"



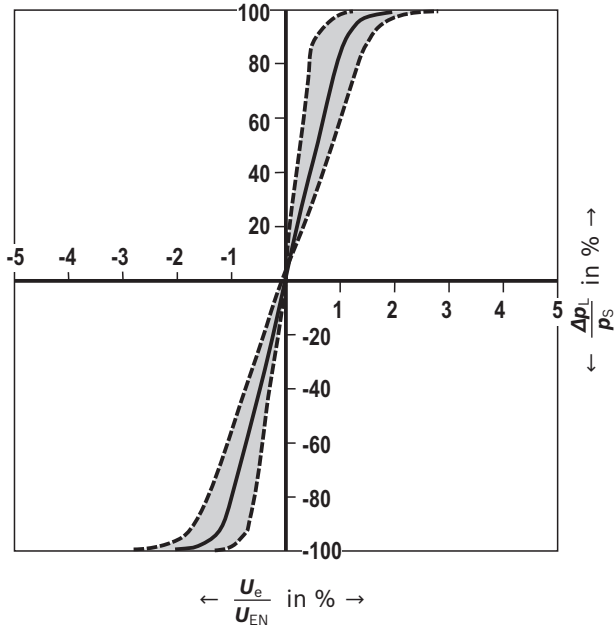
Block diagram/controller function block: Version "C6-972"



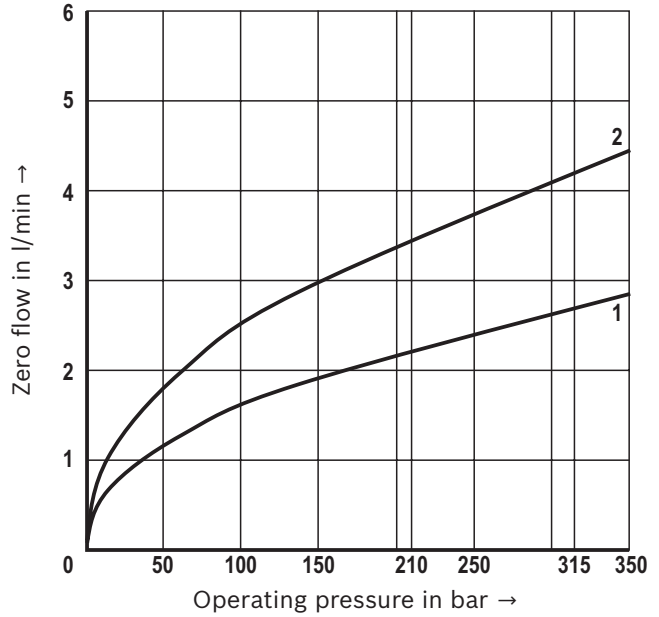
Characteristic curves

(measured with HLP46, $v = 32 \text{ mm}^2/\text{s}$ and $\vartheta_{\text{Oil}} = 40 \pm 5 \text{ }^\circ\text{C}$)

Pressure-signal characteristic curve
(symbol V; measured with $p_s = 100 \text{ bar}$)



Zero flow of the main stage (symbol V),
without pilot control valve

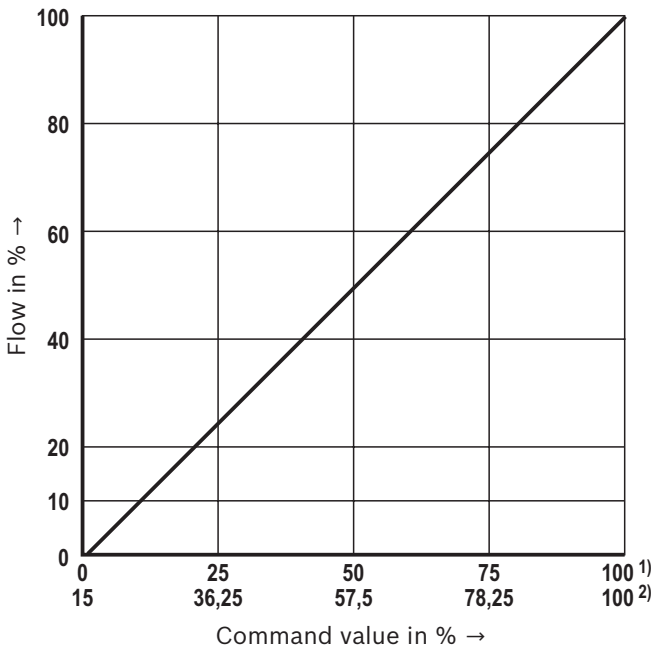


- 1 Size 10
- 2 Size 16

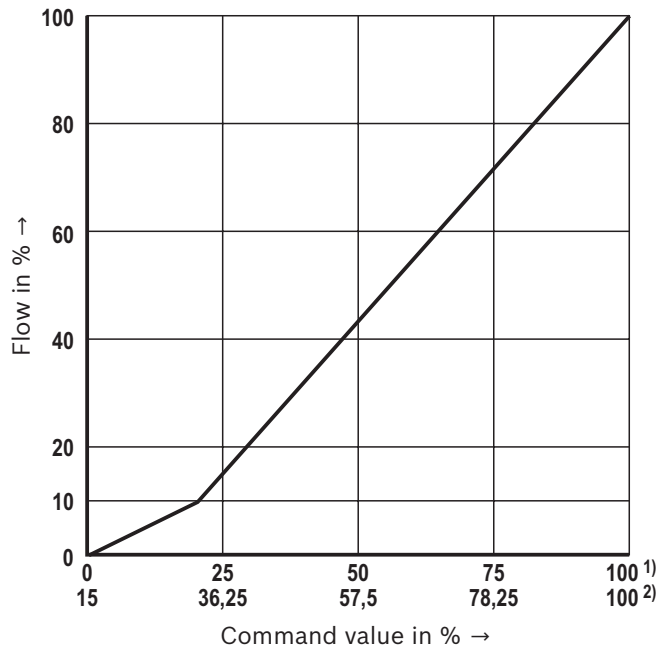
Flow command value function

(at e.g. P → A / B → T and 10 bar valve pressure differential or P → A or A → T and 5 bar per control edge)

Version "L" (symbols E, W and V)



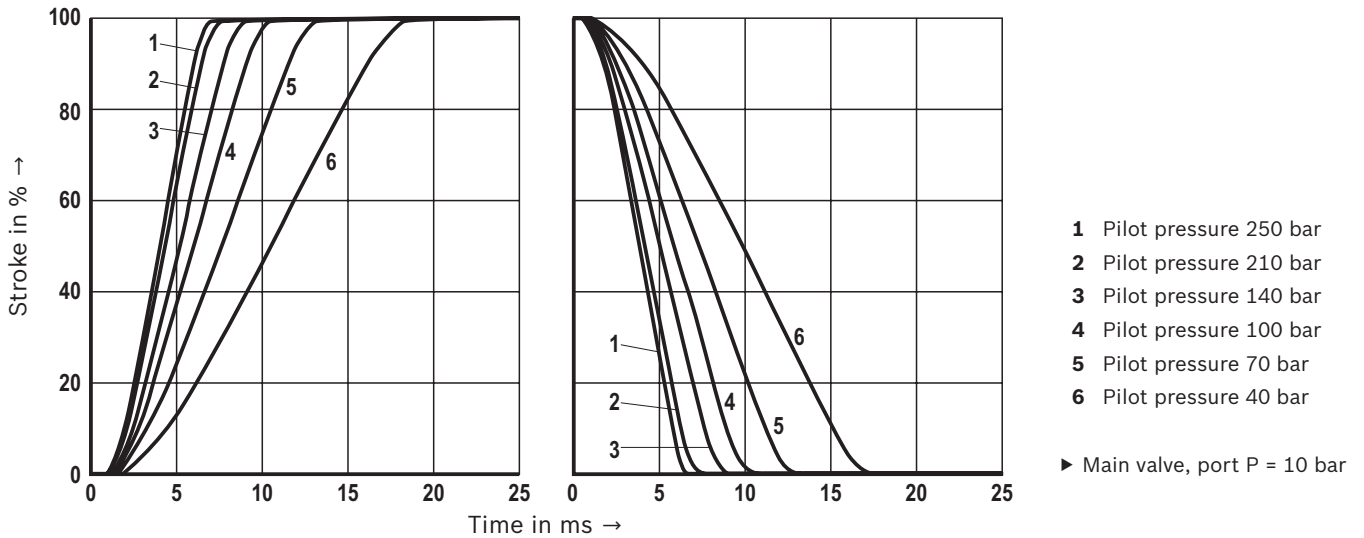
Version "P" (symbols E, W and V)



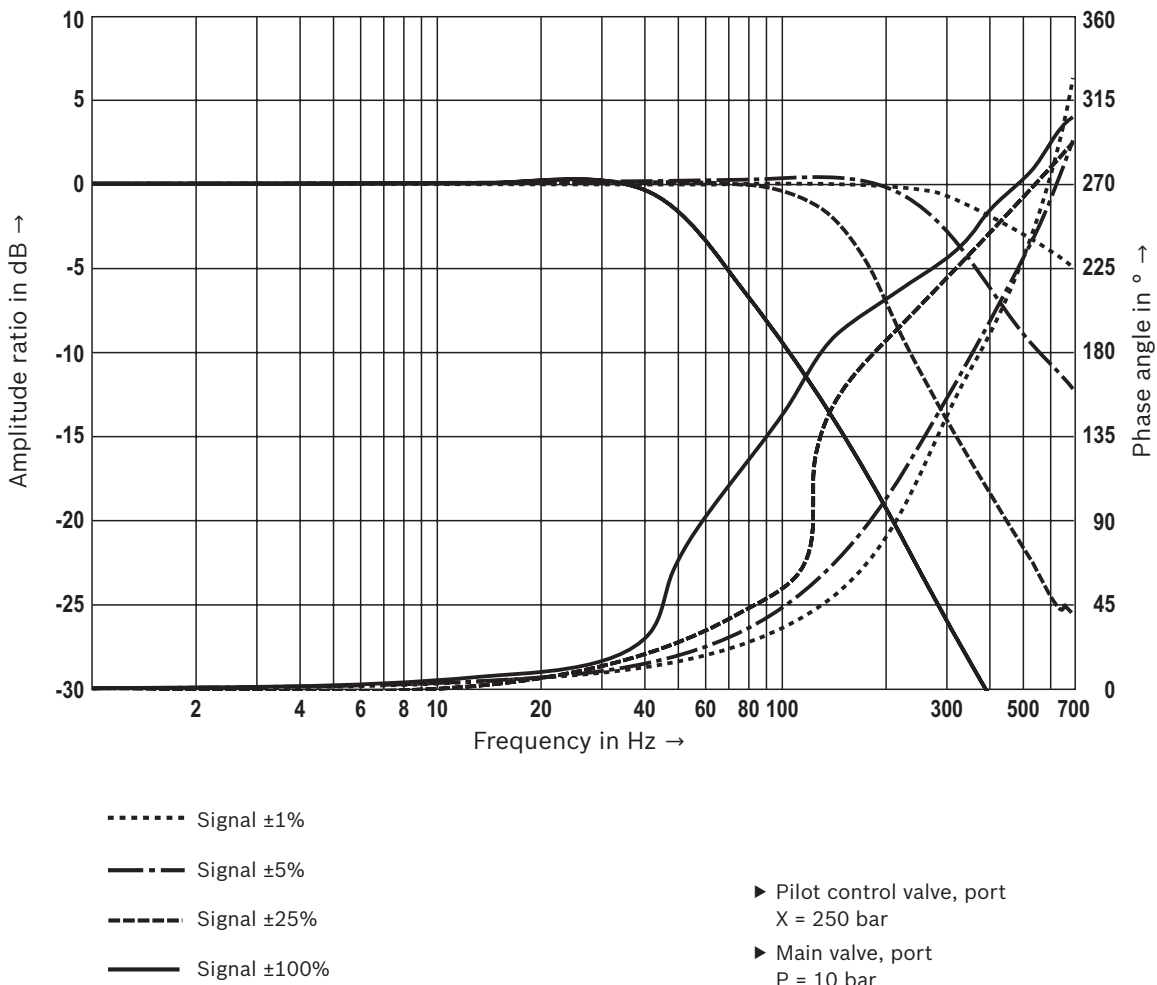
- 1) Positive overlap 0 ... 0.5% at symbol V
- 2) Positive overlap 15% at symbols E and W

Characteristic curves: Size 10
 (measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Transition function with stepped electric input signals

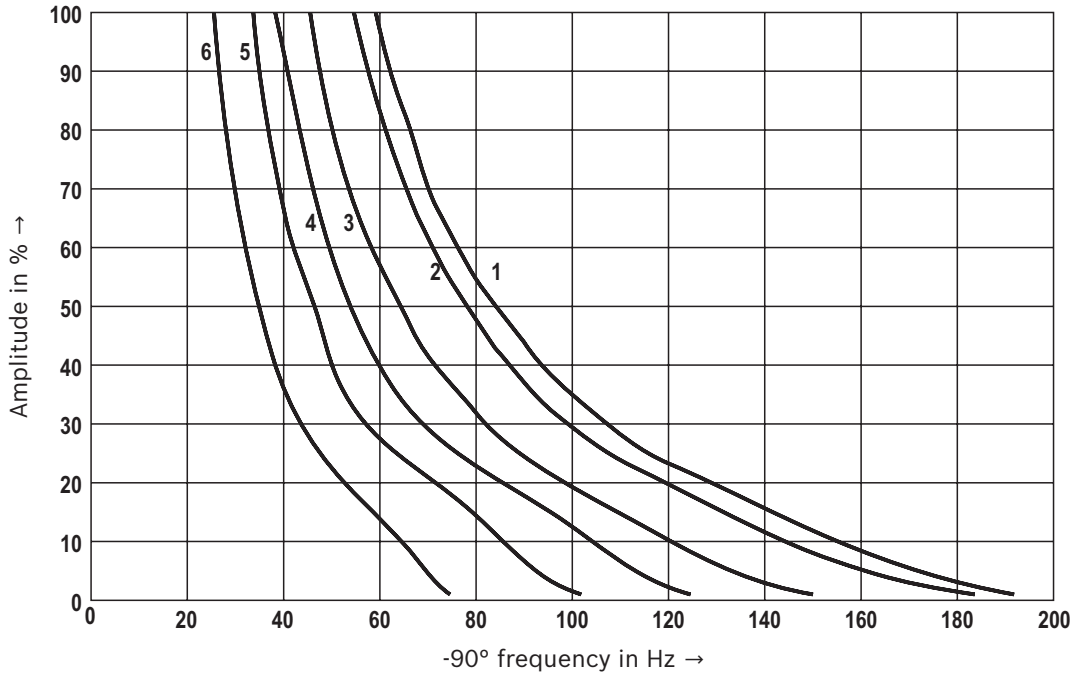


Frequency response characteristic curves



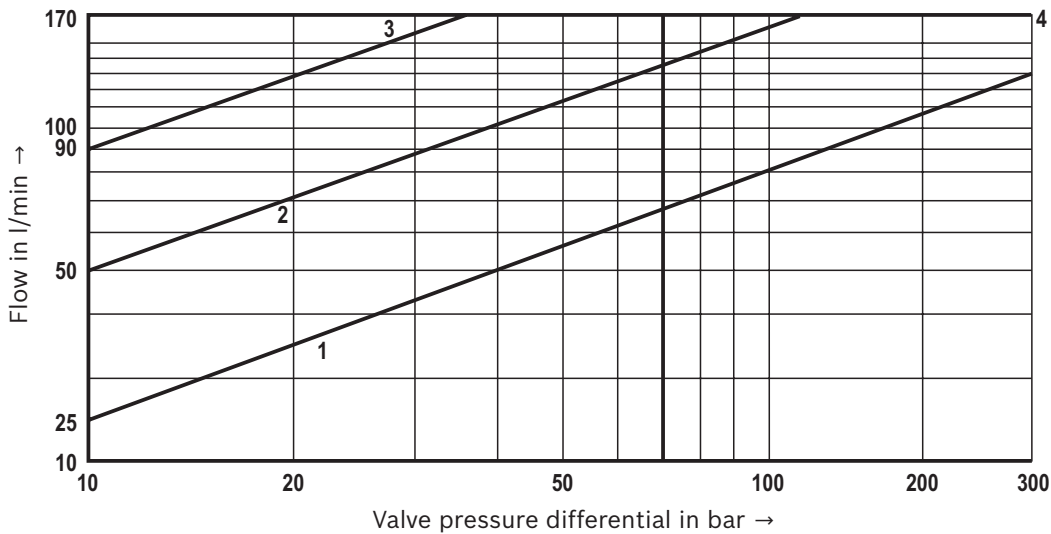
Characteristic curves: Size 10
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Dependency -90° frequency / pilot pressure



- 1 Pilot pressure 250 bar
- 2 Pilot pressure 210 bar
- 3 Pilot pressure 140 bar
- 4 Pilot pressure 100 bar
- 5 Pilot pressure 70 bar
- 6 Pilot pressure 40 bar

Flow/load function with maximum valve opening (tolerance $\pm 10\%$)



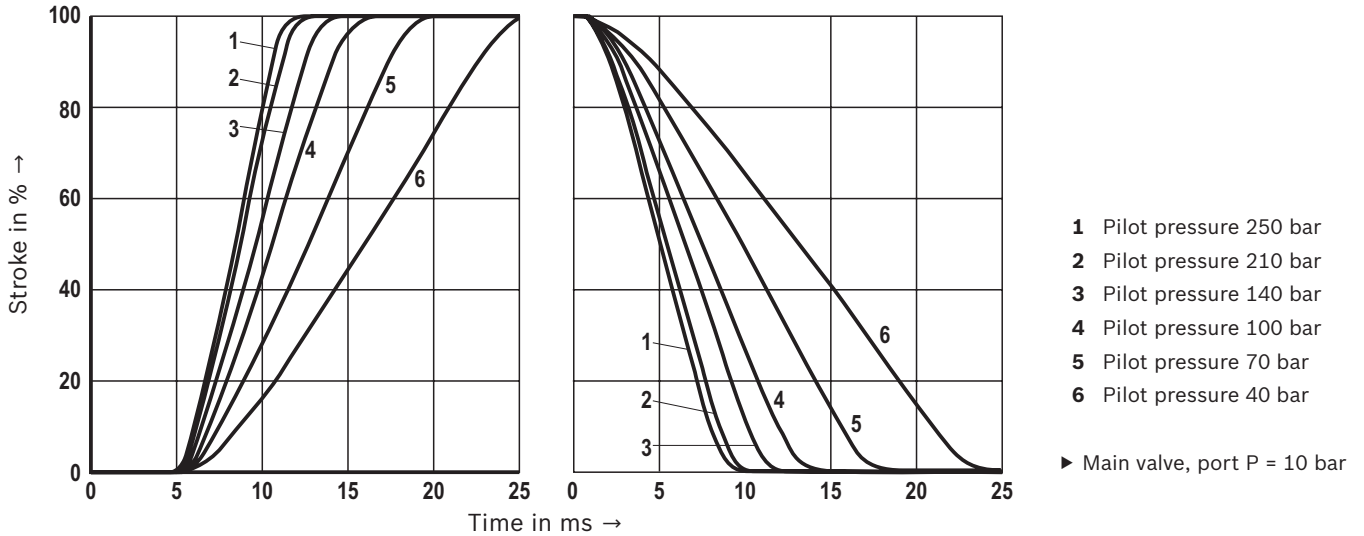
- 1 Rated flow 25 l/min
- 2 Rated flow 50 l/min
- 3 Rated flow 100 l/min
- 4 Recommended flow limitation (flow velocity 30 m/s)

$$\Delta p = p_P - p_L - p_T$$

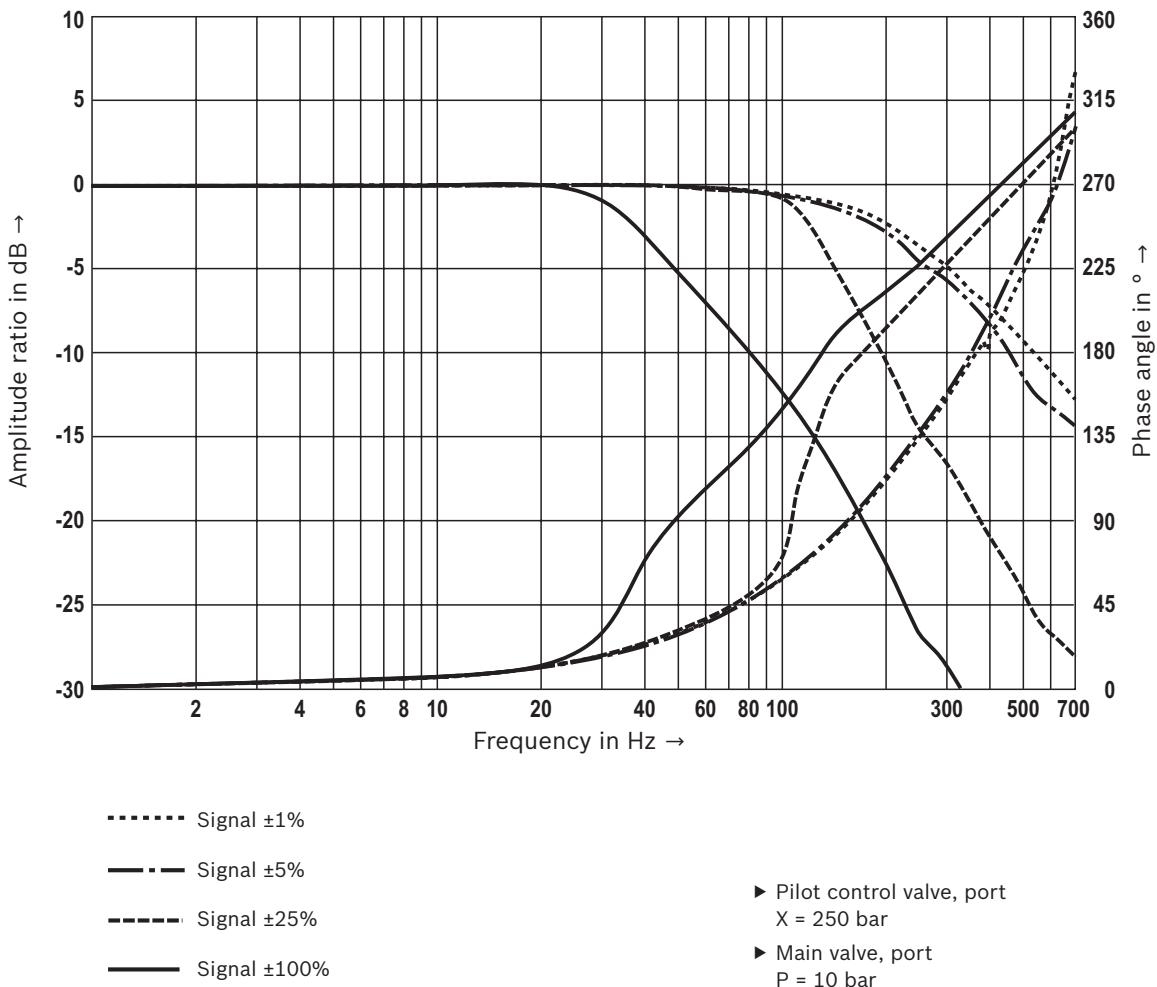
- Δp Valve pressure differential
- p_P Inlet pressure
- p_L Load pressure
- p_T Return flow pressure

Characteristic curves: Size 16
 (measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

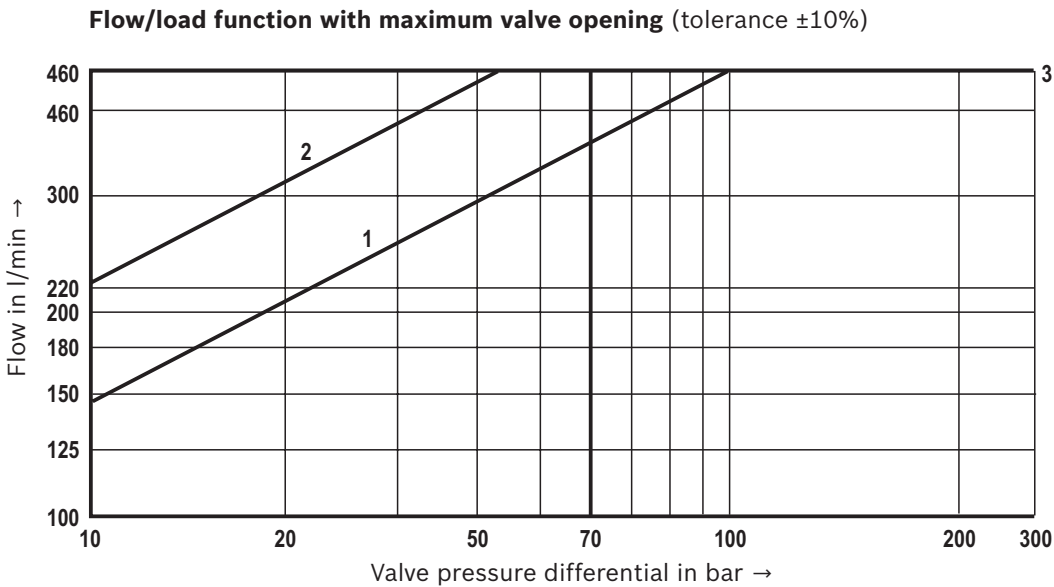
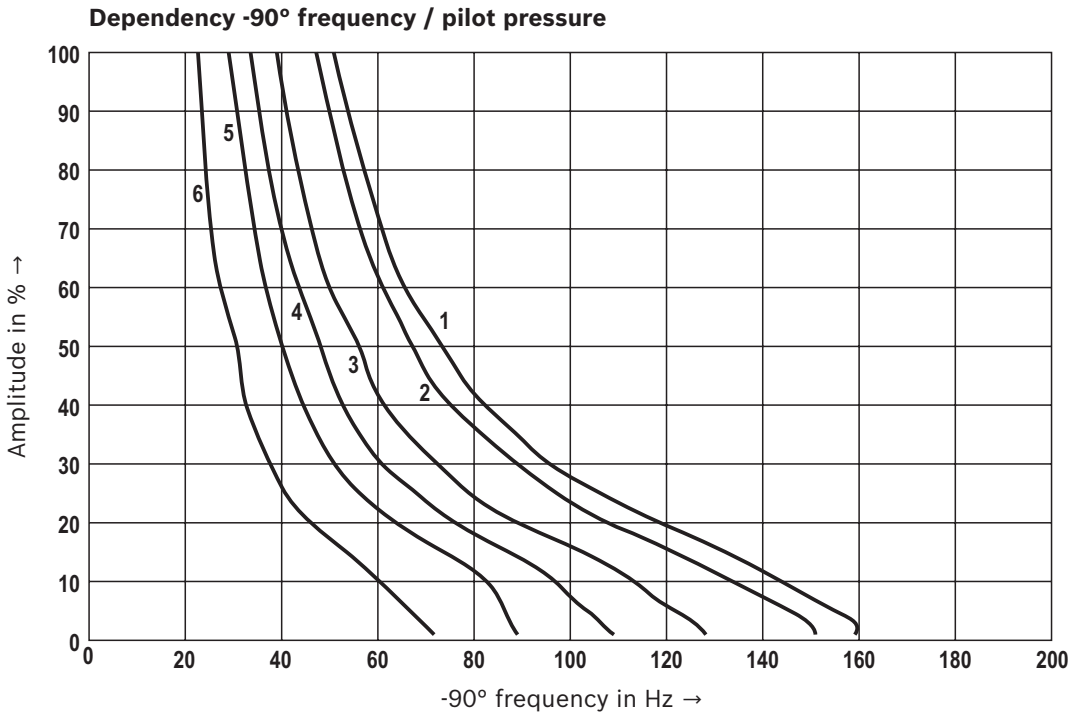
Transition function with stepped electric input signals



Frequency response characteristic curves



Characteristic curves: Size 16
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ } ^\circ\text{C}$)



1 Rated flow 150 l/min

2 Rated flow 220 l/min

3 Recommended flow limitation (flow velocity 30 m/s)

$$\Delta p = p_P - p_L - p_T$$

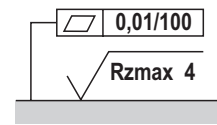
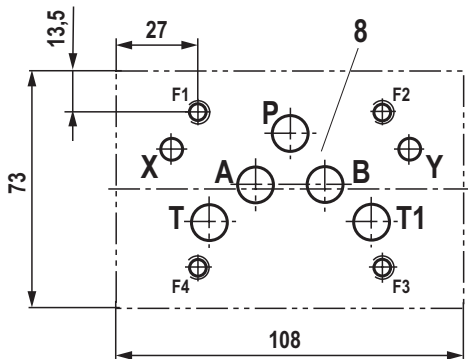
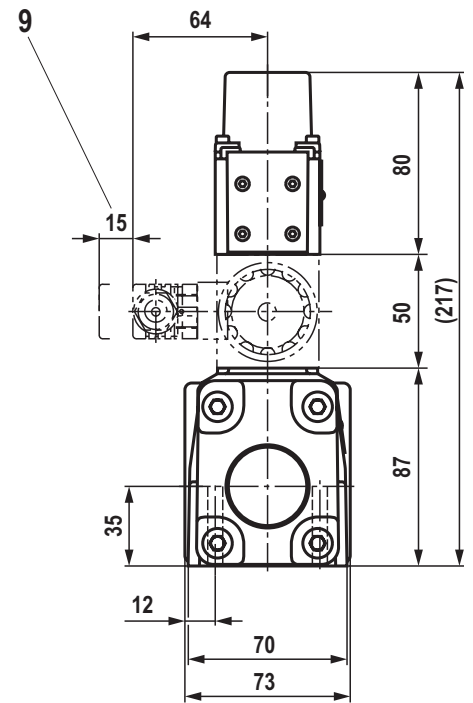
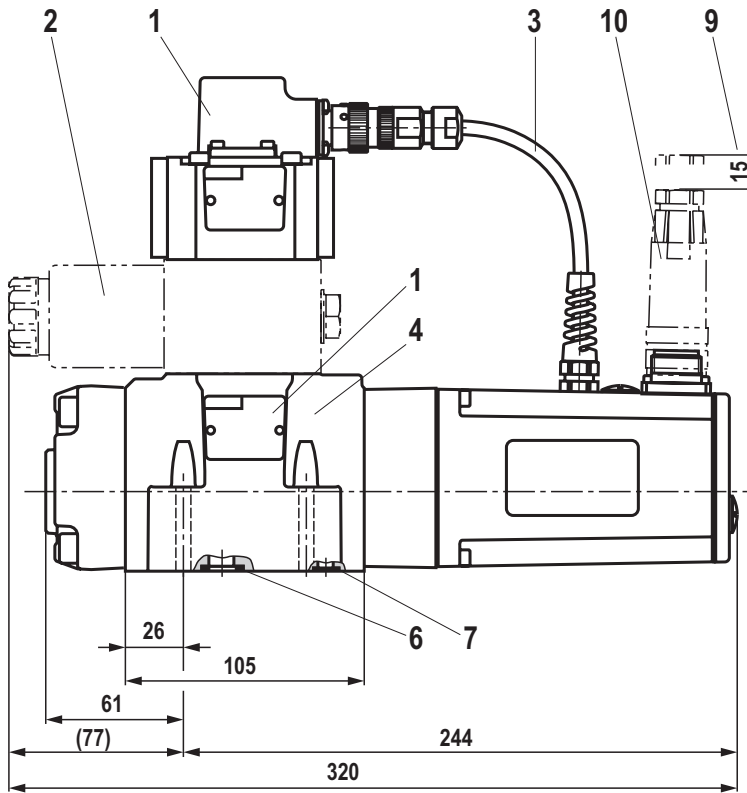
Δp Valve pressure differential

p_P Inlet pressure

p_L Load pressure

p_T Return flow pressure

Dimensions: Size 10
(dimensions in mm)



Required surface quality of the valve contact surface

- 1 Pilot control valve
- 2 Directional sandwich plate valve (only included with version "WG")
- 3 Cabling
- 4 Main stage
- 5 Name plate
- 6 Identical seal rings for ports A, B, P, T and T1
- 7 Identical seal rings for ports X and Y
- 8 Machined valve contact surface; porting pattern according to ISO 4401-05-05-0-05 (ports X and Y as required)
- 9 Space required to remove the mating connectors
- 10 Mating connector, separate order, see page 19

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

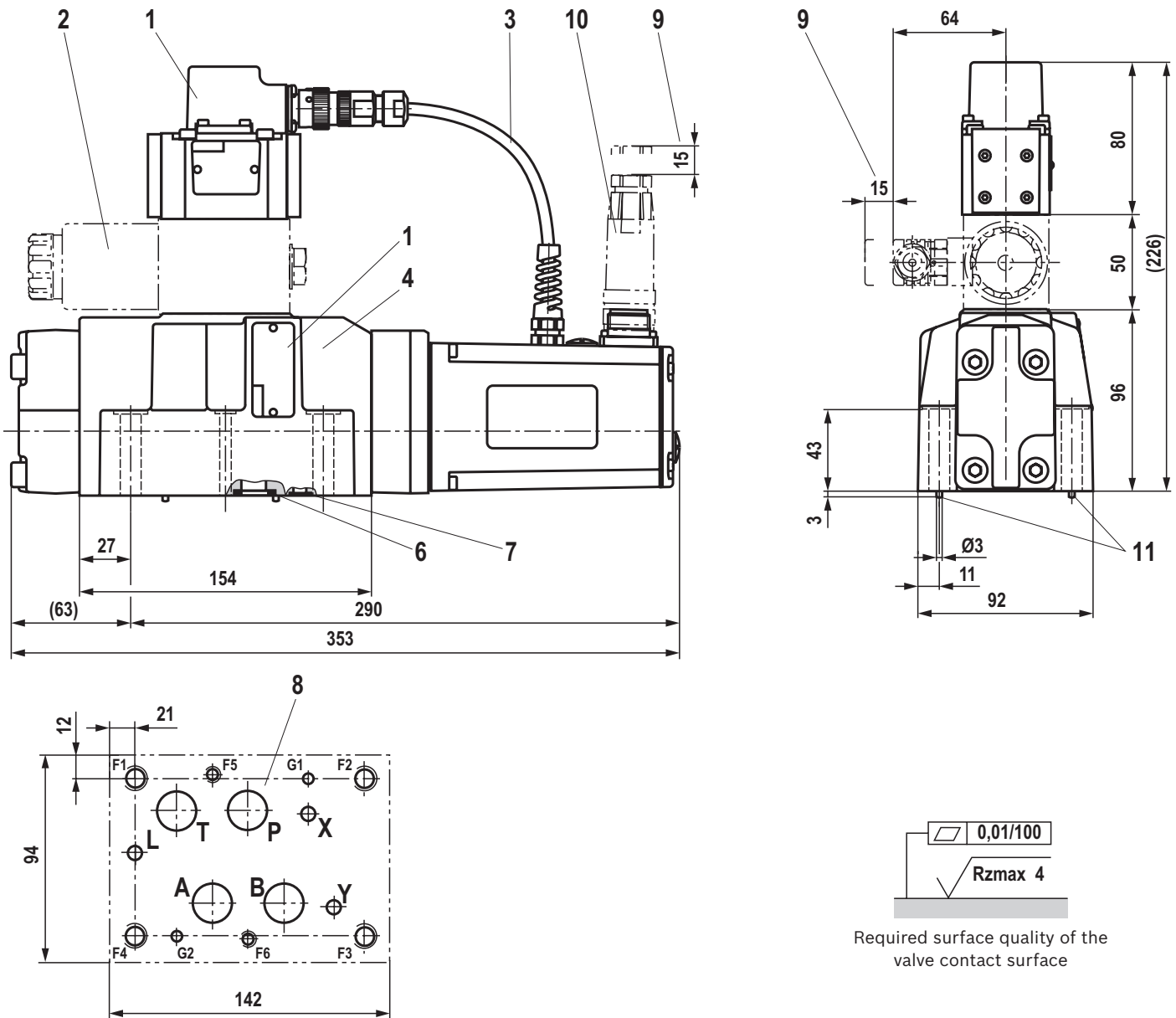


Notice:

The dimensions are nominal dimensions which are subject to tolerances.

Valve mounting screws see page 19.

Dimensions: Size 16
(dimensions in mm)



- 1 Pilot control valve
- 2 Directional sandwich plate valve (only included with version "WG")
- 3 Cabling
- 4 Main stage
- 5 Name plate
- 6 Identical seal rings for ports A, B, P, T
- 7 Identical seal rings for ports X, Y, and L
- 8 Machined valve contact surface; porting pattern according to ISO 4401-07-07-0-05 (ports X, Y and L as required)
- 9 Space required to remove the mating connectors
- 10 Mating connector, separate order, see page 19
- 11 Locking pin

Subplates (separate order) with porting pattern according to ISO 4401-07-07-0-05 see data sheet 45100.

Notice:


The dimensions are nominal dimensions which are subject to tolerances.

Valve mounting screws see page 19.

Dimensions

Valve mounting screws (separate order)

Size	Quantity	Hexagon socket head cap screws	Material number
10	4	ISO 4762 - M6 x 45 - 10.9-fIZn-240h-L tightening torque $M_A = 13.5 \text{ Nm} \pm 10\%$	R913000258
16	2	ISO 4762 - M6 x 60 - 10.9-fIZn-240h-L tightening torque $M_A = 12.2 \text{ Nm} \pm 10\%$	R913000115
	4	ISO 4762 - M10 x 60 - 10.9-fIZn-240h-L tightening torque $M_A = 58 \text{ Nm} \pm 20\%$	R913000116

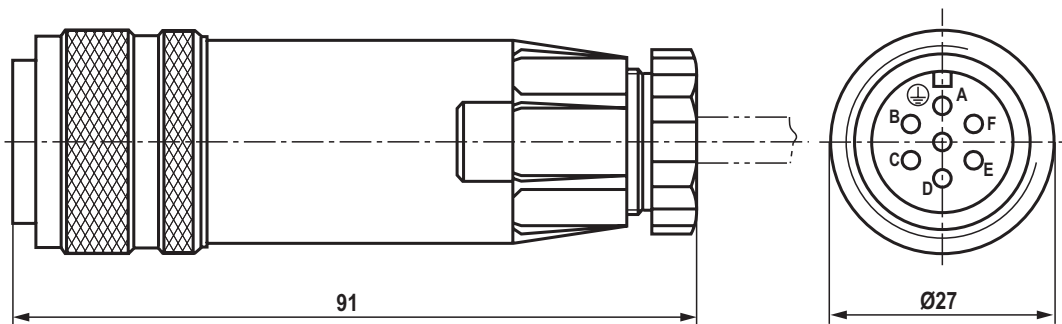
 **Notice:**

For reasons of stability, exclusively these valve mounting screws may be used. The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.

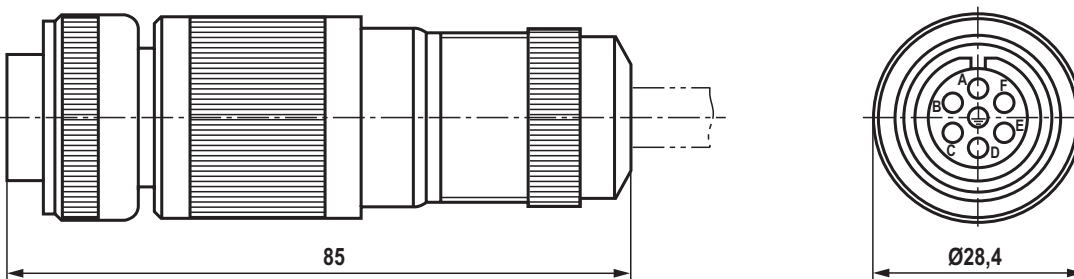
Accessories (separate order)

Directional control valve

Mating connector	Version	Material number
Round connector according to EN 175201-804 (7-pole, plastic variant)	Mating connector (assembly kit) for a cable diameter of 6.5 ... 11 mm	R900021267
	Mating connector with 3 m cable, 7 x 0.75 mm ² , assembled	R901420483
	Mating connector with 5 m cable, 7 x 0.75 mm ² , assembled	R901420491
	Mating connector with 10 m cable, 7 x 0.75 mm ² , assembled	R901420496



Round connector according to EN 175201-804 (7-pole, metal design)	Mating connector (assembly kit) for a cable diameter of 8.0 ... 13.5 mm	R900223890
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Accessories (separate order)**Sandwich plate valve**

Mating connectors	Data sheet	Material number
Mating connector according to DIN EN 175301-803, ISO 4400	08006	e.g. R901017011 (plastic)

Miscellaneous

	Material number
Filter element and seal	R961001949

Further information

- ▶ Directional servo valve with mechanical position feedback Data sheet 29564
- ▶ Subplates Data sheet 45100
- ▶ Hydraulic fluids on mineral oil basis Data sheet 90220
- ▶ Flame-resistant hydraulic fluids - containing water (HFAE, HFAS, HFB, HFC) Data sheet 90223
- ▶ Reliability characteristics according to EN ISO 13849 Data sheet 08012
- ▶ Hexagon socket head cap screw, metric/UNC Data sheet 08936
- ▶ General product information on hydraulic products Data sheet 07008
- ▶ Installation, commissioning and maintenance of servo valves and high-response valves Data sheet 07700
- ▶ Hydraulic valves for industrial applications Data sheet 07600-B
- ▶ Assembly, commissioning and maintenance of hydraulic systems Data sheet 07900
- ▶ Selection of filters www.boschrexroth.com/filter
- ▶ Information on available spare parts www.boschrexroth.com/spc

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