

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

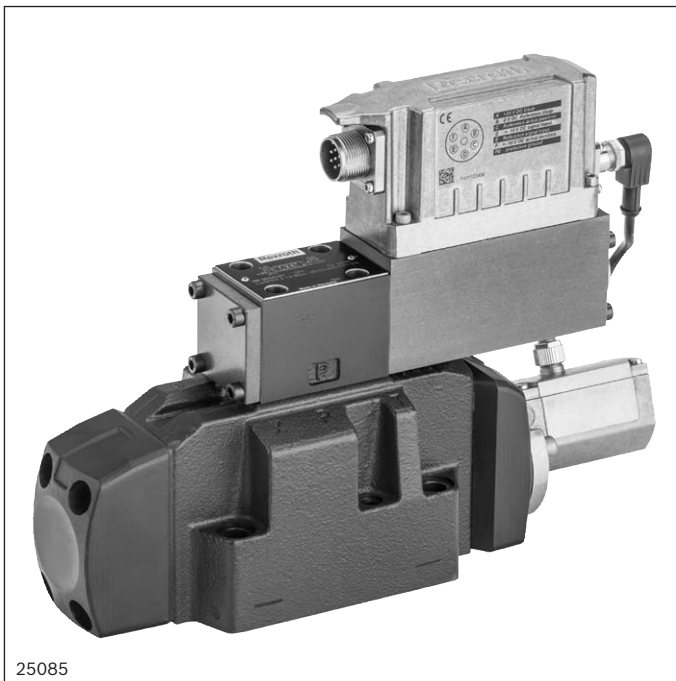
Type 4WRLE

RE 29123

Edition: 2015-02

Replaces: 29088 and
29089

(size 16 ... 27)



25085

- ▶ Size 16 ... 27
- ▶ Component series 4X
- ▶ Maximum operating pressure of 350 bar
- ▶ Rated flow 200 ... 600 l/min ($\Delta p = 10$ bar)



Features

- ▶ Reliable – proven and robust construction
- ▶ Safe
 - Control spool of the pilot control valve in switched-off condition in “fail-safe” position
 - Control spool of the main valve in spring-centered central position or in offset position
- ▶ High quality – control spool and sleeve of the pilot valve in servo quality
- ▶ Flexible – suitable for position, velocity and pressure control
- ▶ Precise – high response sensitivity and low hysteresis

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Ordering codes

01	02	03	04	05	06	07	08	09	10	11	12	13	14			
4	WRL	E				L	J	-	4X	/		/	24	/		*

01	4 main ports	4
02	Directional control valve, pilot operated	WRL
03	With integrated electronics	E
04	Size 16	16
	Size 25	25
	Size 27	27
05	Symbols e.g. E, E1-, W etc.; possible design see page 3	

Rated flow of with 10 bar pressure differential (5 bar/control edge)

06	- Size 16	
	200 l/min (only symbol W6- and W8-)	200
	250 l/min (only symbol E, E1-, V and V1-)	250
	- Size 25	
	350 l/min (only symbol W6- and W8-) ¹⁾	350
	400 l/min (only symbol E, E1-, V and V1-)	400
	- Size 27	
	430 l/min (only symbol W6- and W8-) ¹⁾	430
	600 l/min (only symbol E, E1-, V and V1-)	600

Flow characteristics

07	Linear	L
08	Overlap jump (opening point 5% with covered valve; only symbols E, E1-, W6-, W8-)	J
09	Component series 40 ... 49 (40 ... 49: unchanged installation and connection dimensions)	4X

Seal material

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

Pilot oil guide

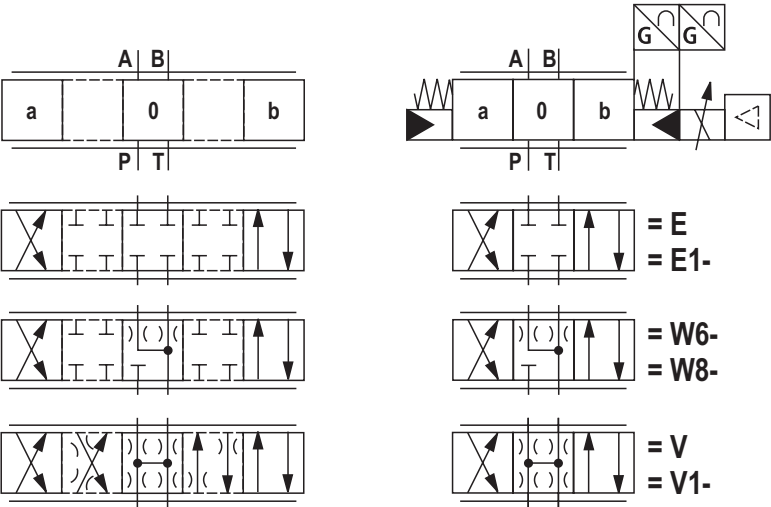
11	Pilot oil supply external, pilot oil return external	XY
	Internal pilot oil supply, external pilot oil return	PY
	Internal pilot oil supply, internal pilot oil return	PT
	Pilot oil supply external, pilot oil return internal	XT
12	Supply voltage 24 V	24

Interfaces of the control electronics

13	Command value input ± 10 V	A1
	Command value input 4 ... (12) ... 20 mA	F1
14	Further details in plain text	*

¹⁾ Higher rated flow on request

Symbols



With symbol E1-, V1- and W8-:
P → A: $q_{V \max}$ B → T: $q_{V/2}$
P → B: $q_{V/2}$ A → T: $q_{V \max}$

Version	simplified	detailed
"XY"		
"PY"		
"PT"		
"XT"		Note: ► Presentation according to DIN ISO 1219-1. Hydraulic interim positions are shown by dashes. ► For information about switch-off behavior, refer to the Technical Data on page 7.

Function, section: Symbol E. and W.

The 4WRLE-type valve is a pilot-operated directional control valve with electrical position feedback and integrated electronics (OBE).

Design

The valve basically consists of 3 main assemblies:

- ▶ Pilot control valve (1) with control spool and sleeve, return spring, control solenoid and inductive position transducer
- ▶ Main valves (2) with centering springs and position feedback
- ▶ Integrated control electronics (OBE) (3)

Function

With switched-off or inactive integrated control electronics (OBE), the control spool of the pilot control valve is spring-actuated in “fail-safe” position. The control spool of the main valve is in its spring-centered central position. The integrated control electronics (OBE) compare the specified command value to the actual position value of the main valve control spool. In the event of control deviation, the respective control solenoid is controlled. By changing the solenoid force, the pilot control spool is misaligned against the corresponding spring. The flow that is released via the control cross-section causes a shift in the main control spool whose stroke/control cross-

section is regulated proportional to the command value.

The pilot oil supply in the pilot control valve takes place either internally via port P or externally via port X. Feeding back to the container can be carried out either internally via port T or externally via port Y.

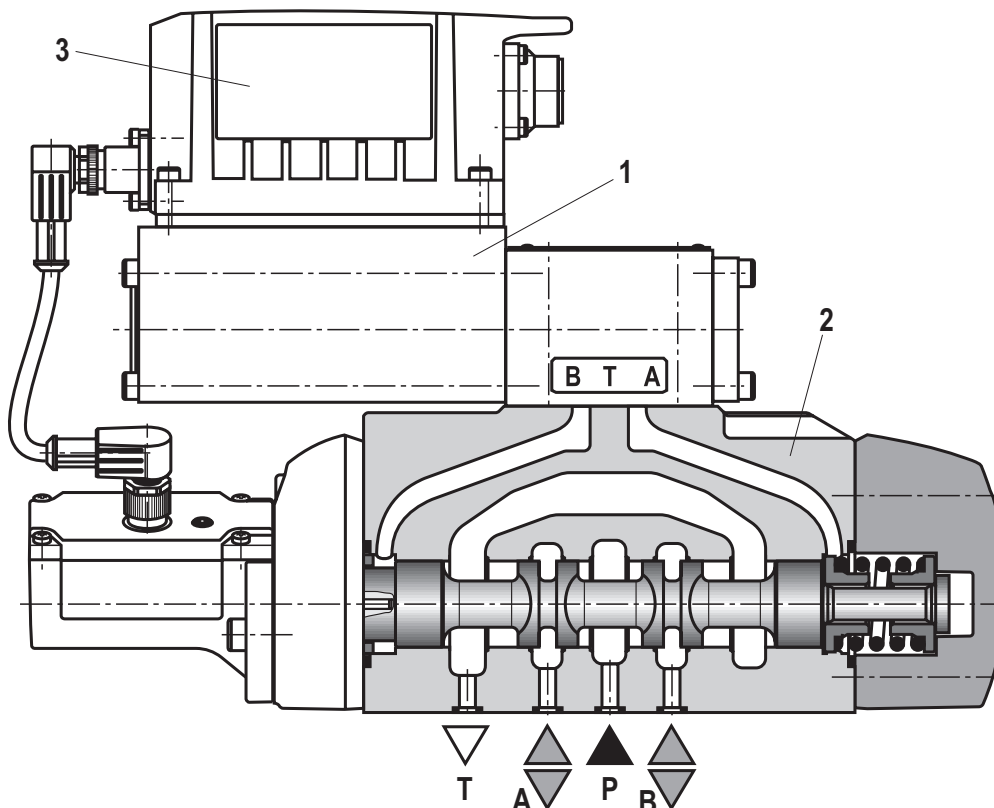
Failure of supply voltage

If the supply voltage fails or there is a cable break, the integrated electronics de-energize the control solenoid, the pilot control spool takes on the “fail-safe” position and unloads the pilot oil chambers of the main valve. The main valve control spool takes on the central position on a spring-actuated basis.

**Note:**

Pilot operated 4/3 directional control valves with positive overlap carry out their task in controlled or regulated axes. The overlap in switched off state is approx. 20% of the control spool stroke.

When the power supply is switched off, the drive can be accelerated briefly in function direction P to B.



Function, section: Symbol V and V1-

The 4WRLE-type valve is a pilot-operated directional control valve with electrical position feedback and integrated electronics (OBE).

Design

The valve basically consists of 3 main assemblies:

- ▶ Pilot control valve (1) with control spool and sleeve, return spring, control solenoid and inductive position transducer
- ▶ Main valve (2) with centering springs and position feedback
- ▶ Integrated control electronics (OBE) (3)

Function

With switched-off or inactive integrated control electronics (OBE), the control spool of the pilot control valve is spring-actuated in “fail-safe” position. In its spring-centered offset position, the control spool of the main valve is in direction P to B/A to T with approx. 6% of the stroke. The integrated control electronics (OBE) compare the specified command value to the actual position value of the main valve control spool. In the event of control deviation, the respective control solenoid is controlled. By changing the solenoid force, the pilot control spool is misaligned against the corresponding spring. The flow that is released via the control cross-section causes a shift in the main control spool whose stroke/control cross-

section is regulated proportional to the command value. With a specified command value of 0 V, the electronics regulate the control spool of the main valve in the center position. The pilot oil supply in the pilot control valve takes place either internally via port P or externally via port X. Feeding back to the container can be carried out either internally via port T or externally via port Y.

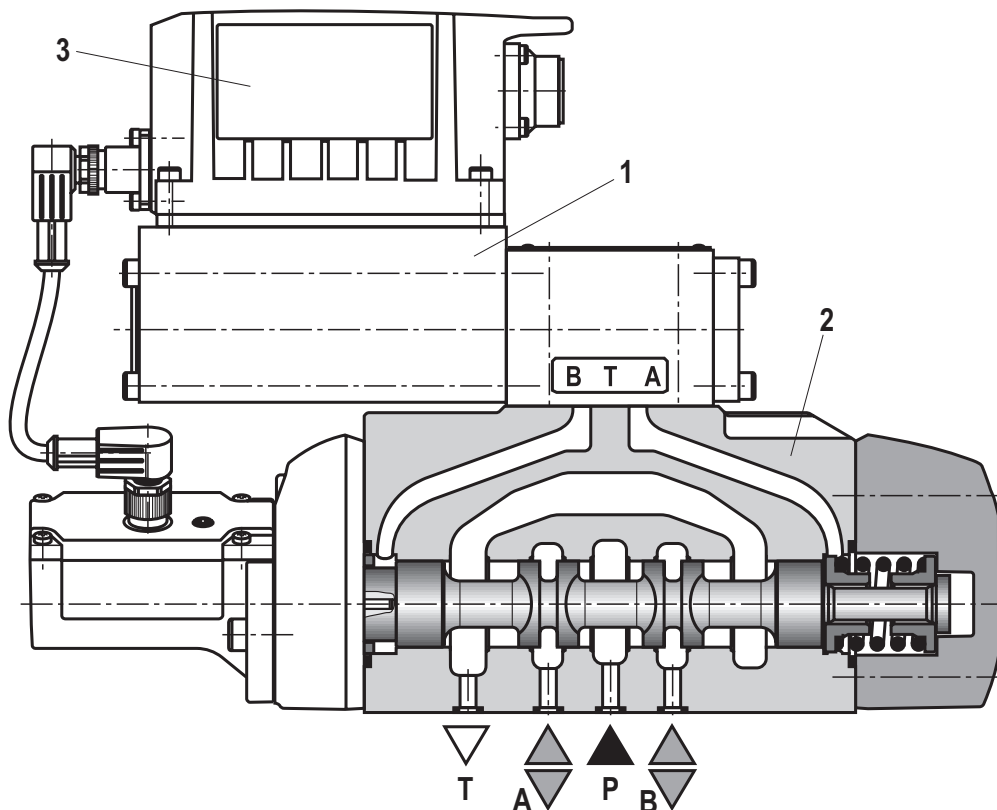
Failure of supply voltage

If the supply voltage fails or there is a cable break, the integrated electronics de-energize the control solenoid, the pilot control spool takes on the “fail-safe” position and unloads the pilot oil chambers of the main valve. The main valve control spool takes on the offset position on a spring-actuated basis (approx. 6% P to B/A to T).

Note:

Pilot-operated 4/3 directional control valves only carry out their task in an active control loop and do not have a blocked basic position when switched off. In many applications, this means that “external check valves” are needed, which must be taken into account with the On/Off switching sequence.

When the power supply is switched off, the drive can be accelerated briefly in function direction P to B.



Technical data

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

General				
Size	Size	16	25	27
Design		Spool valve, pilot operated		
Actuation		Directional control valve size 6 with position control for pilot control and main valve.		
Connection type		Subplate mounting, porting pattern according to ISO 4401		
Installation position		Any		
Ambient temperature range	°C	-20 ... +60		
Storage temperature range under UV protection	°C	+10 ... +40		
Sine test according to DIN EN 60068-2-6		10 ... 2000 Hz / maximum 10 g / 10 cycles / 3 axles		
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 axles		
Weight	kg	11,5	18,2	20
Maximum relative humidity (no condensation)	%	95		
Maximum solenoid surface temperature	°C	120 (individual operation)		
MTTFd-value according to EN ISO 13849	Years	75 (for further details see data sheet 08012)		

Hydraulic					
Maximum operating pressure	▶ Port A, B, P				
	– External pilot oil supply	bar	350	270	
	– Internal pilot oil supply	bar	280	270	
	▶ Port X	bar	280	270	
	▶ Port T, Y	bar	250	210	
Minimum pilot pressure (pilot control valve)		bar	10		
Maximum flow		l/min	800	1250	1850
Rated flow (Δp = 10 bar) ¹⁾		l/min	200/250	350/400	430/600
Pilot oil flow ²⁾	▶ Symbol E	l/min	3,5	7,5	
	▶ Symbol V	l/min	11,5	22	
Leakage flow (inlet pressure 100 bar)	▶ Symbol E, E1-				
	– Main valve	l/min	< 0,13	< 0,15	
	– Main valve + pilot control valve	l/min	< 0,31	< 0,45	
	▶ Symbol W6-, W8-				
	– Main valve	l/min	< 0,25	< 0,3	
	– Main valve + pilot control valve	l/min	< 0,43	< 0,6	
Zero flow (inlet pressure 100 bar)	▶ Symbol V, V1-				
	– Main valve	l/min	< 2,6	< 3,0	
	– Main valve + pilot control valve	l/min	< 2,9	< 3,5	
Hydraulic fluid			see table on page 7		
Viscosity range	▶ recommended	mm ² /s	30 ... 45		
	▶ Maximum admissible	mm ² /s	20 ... 380		
Hydraulic fluid temperature range (flow through)		°C	-20 ... +70		
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 ³⁾		

1) Flow with deviating Δp (valve pressure differential):

$$q_x = q_{Vnom} \times \sqrt{\frac{\Delta p_x}{10}}$$

2) On port X and Y with stepped input signal of 0 ... 100% (100 bar)

3) The cleanliness classes stated for the components need to be maintained in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

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

Technical data

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

Hydraulic fluid	Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils	HL, HLP, HLPD, HVLP, HVLDP	NBR, FKM	DIN 51524	90220
Bio-degradable	► Insoluble in water	HETG	ISO 15380	90221
		HEES		
	► Soluble in water	HEPG	ISO 15380	
Flame-resistant	► Water free	HFDU, HFDR	ISO 12922	90222
	► Containing water	HFC (Fuchs Hydrotherm 46M, Petrofer Ultra Safe 620)	ISO 12922	on request



Important information on hydraulic fluids:

- For more information and data about the use of other hydraulic fluids, refer to data sheets above or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.)!
- The flash point of the hydraulic fluid used must be 40 K higher than the maximum solenoid surface temperature.

- **Flame-resistant – containing water:** The maximum pressure differential per control edge is 175 bar. Pressure pre-loading at the tank port > 20% of the pressure differential; otherwise, increased cavitation. Life cycle as compared to operation with mineral oil HL, HLP 50% to 100%.

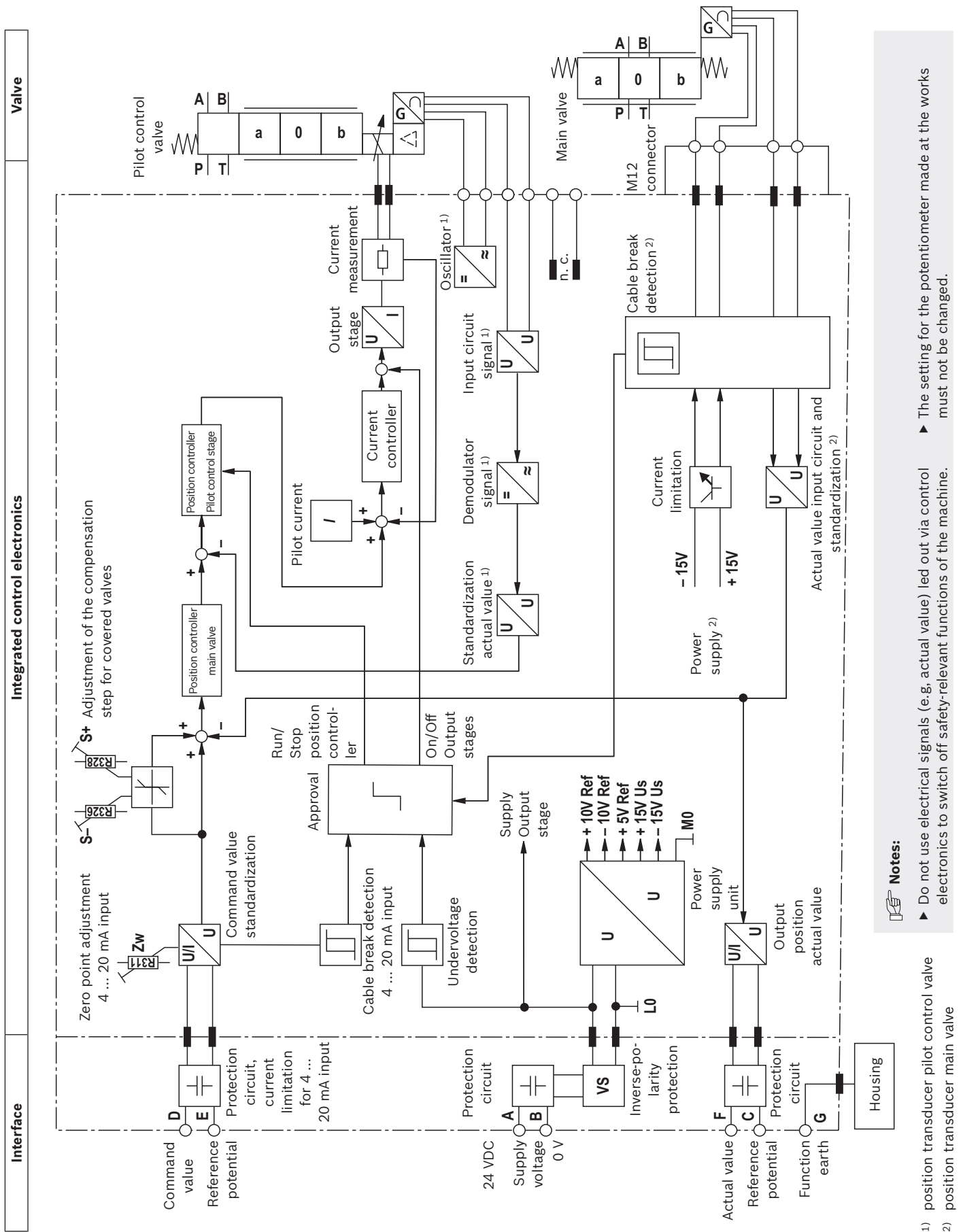
static / dynamic				
Size	Size	16	25	27
Hysteresis	%	< 0,1		
Response sensitivity	%	< 0,05		
Range of inversion	%	< 0,08		
Manufacturing tolerance q_{Vmax}	%	≤ 10		
Switch-off behavior (after electrical shut-off)	► Symbol E, E1-, W6-, W8-	Pilot control valve in “fail-safe” position, main valve takes on the covered spring-centered central position		
	► Symbol V, V1-	Pilot control valve in failsafe position, main valve takes on spring-centered offset position (approx. 6%, P-B/A-T)		
Temperature drift (temperature range 20 °C ... 80 °C)	%/10 °C	Zero shift < 0,25		
Zero compensation		Ex factory ±1%		

Technical data

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

electrical, integrated electronics (OBE)		
Relative duty cycle	%	100 (continuous operation)
Protection class according to EN 60529		IP 65 with mounted and locked plug-in connectors
Supply voltage	VDC	24
▶ Terminal A	VDC	min. 19 / max. 36
▶ Terminal B	VDC	0
Maximum admissible residual ripple	V _{pp}	2,5
Maximum power consumption	VA	40
Fuse protection, external	A _T	2,5 (time-lag)
Input, version "A1"		Differential amplifier, $R_i = 100\text{ k}\Omega$
▶ Terminal D (U_E)	VDC	0 ... ± 10
▶ Terminal E	VDC	0
Input, version "F1"		Load, $R_{sh} = 200\ \Omega$
▶ Terminal D (I_{D-E})	mA	4 ... (12) ... 20
▶ Terminal E (I_{D-E})		Current loop I_{D-E} feedback
Maximum voltage for the differential inputs compared to 0 V		D → B; E → B (max. 18 V)
Test signal, version "A1"		LVDT
▶ Terminal F (U_{test})	V	0 ... ± 10
▶ Terminal C		Reference 0 V
Test signal, version "F1"		LVDT signal 4 ... (12) ... 20 mA on external load 200 ... 500 Ω maximum
▶ Terminal F (I_{F-C})	mA	4 ... (12) ... 20
▶ Terminal C (I_{F-C})		Current loop I_{F-C} feedback
Function earth and screening		see page 10 (CE-compliant installation)
Adjustment		calibrated in the factory, see valve characteristic curve page 11 ... 16
Conformity		CE according to EMC Directive 2004/108/EC tested according to EN 61000-6-2 and EN 61000-6-3

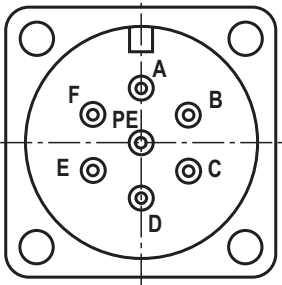
Block diagram/controller function block



Electrical connections and assignment

Connector pin assignment

Pin	Signal	Assignment interface A1	Assignment interface F1
A	Supply voltage	24 VDC	
B		0 V	
C	Reference potential actual value	Reference potential actual value - Pin F	
D	Differential amplifier input	Command value ±10 V	Command value 4 ... (12) ... 20 mA
E		Reference potential command value - Pin D	
F	Measuring output (actual value)	Actual value ±10 V	Actual value 4 ... (12) ... 20 mA
PE		Function earth (directly connected to the valve housing)	



Command value:	► Positive command value (0 ... 10 V or 12 ... 20 mA) at D and reference potential at E result in flow from P → A and B → T.
	► Negative command value (0 ... -10 V or 12 ... 4 mA) at D and reference potential at E result in flow from P → B and A → T.
Connection cable (recommendation):	► Up to 20 m cable length type LiYCY 7 x 0,75 mm ²
	► Up to 40 m cable length type LiYCY 7 x 1,0 mm ²
	Only connect the screening to PE on the supply side



Note:

Mating connectors, separate order, see page 20 and data sheet 08006.

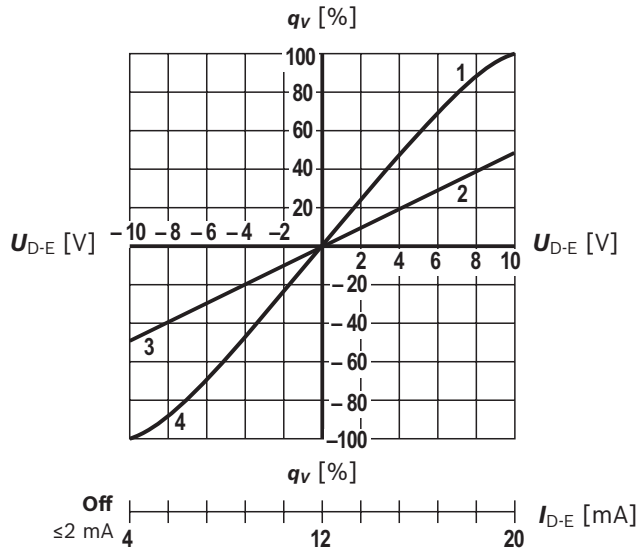
Characteristic curves

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

Flow/signal function

Symbol V, V1-

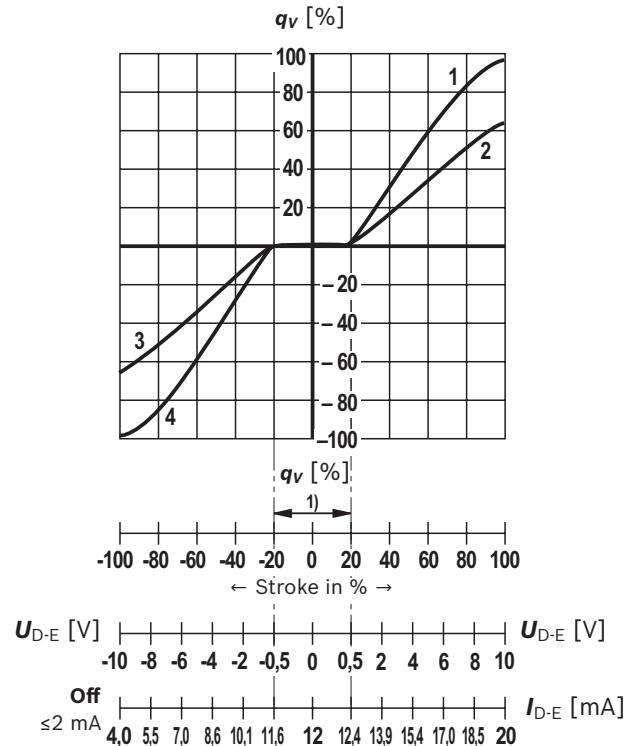
(flow characteristics "L")



- 1 P-A; B-T (1:1)
- 2 B-T (2:1)
- 3 P-B (2:1)
- 4 P-B; A-T (1:1)

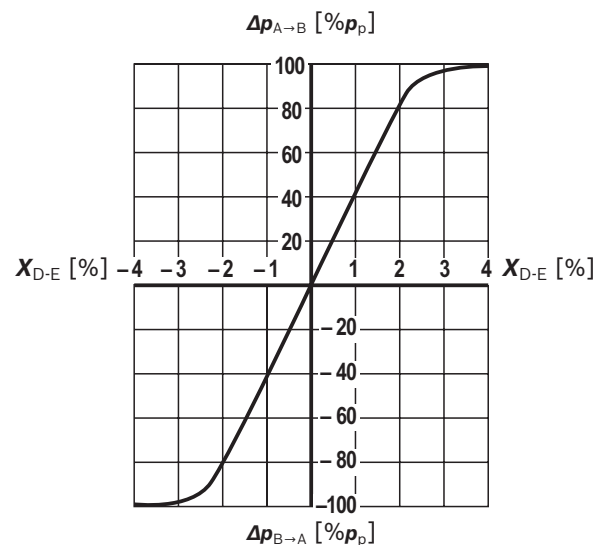
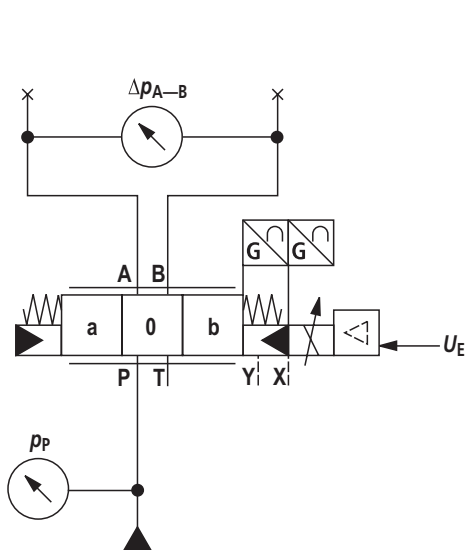
Symbol E, E1-, W6-, W8-

(flow characteristics "L")



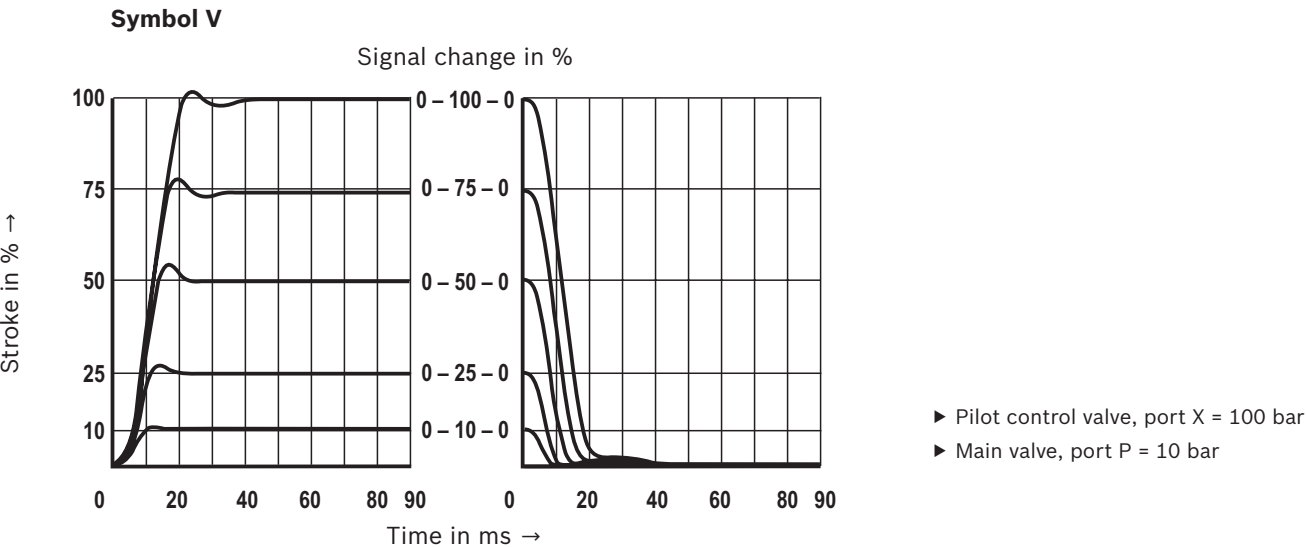
1) Step compensation

Pressure amplification

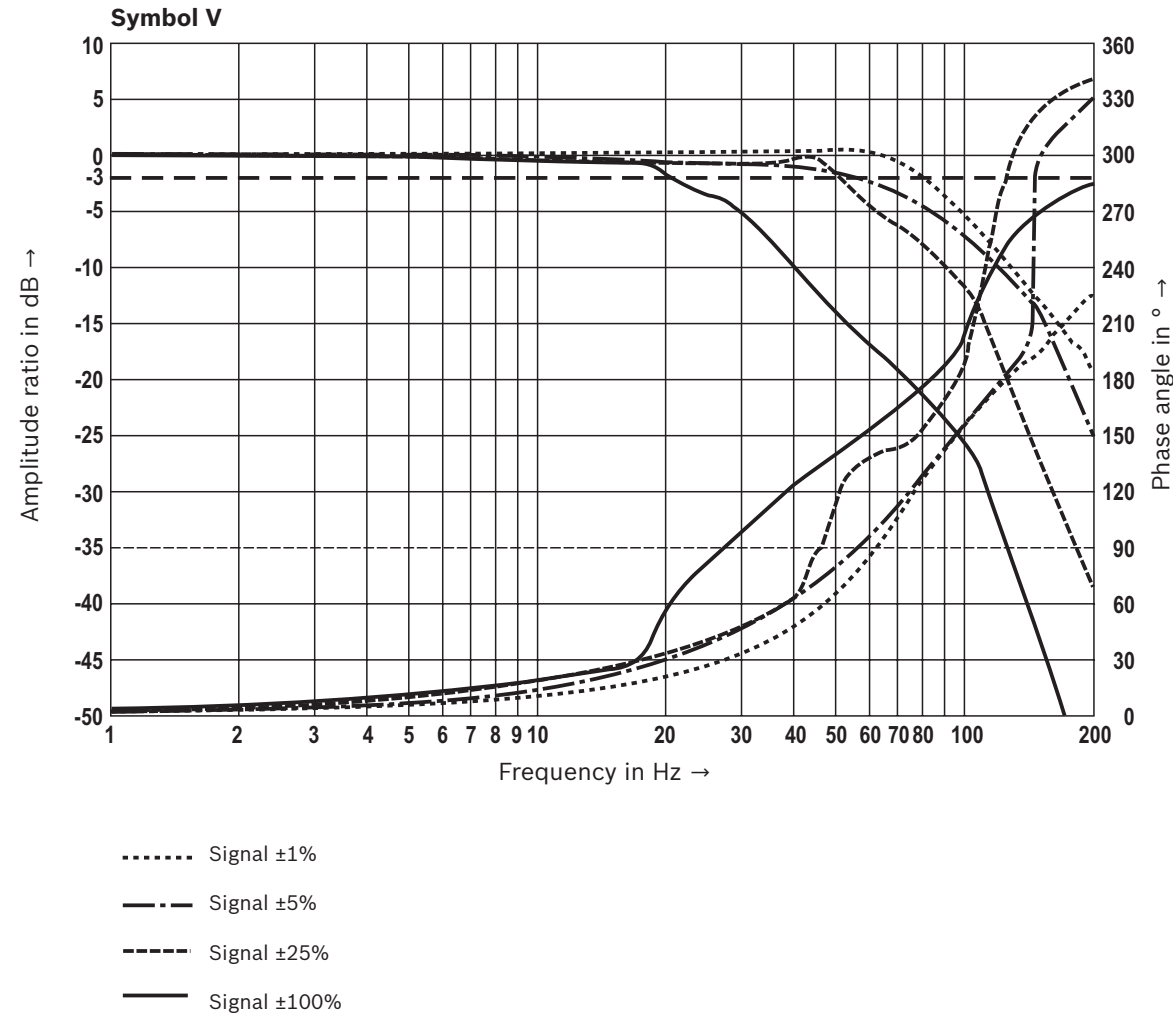


Characteristic curves: Size 16
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^{\circ}\text{C}$)

Transition function with stepped electric input signals

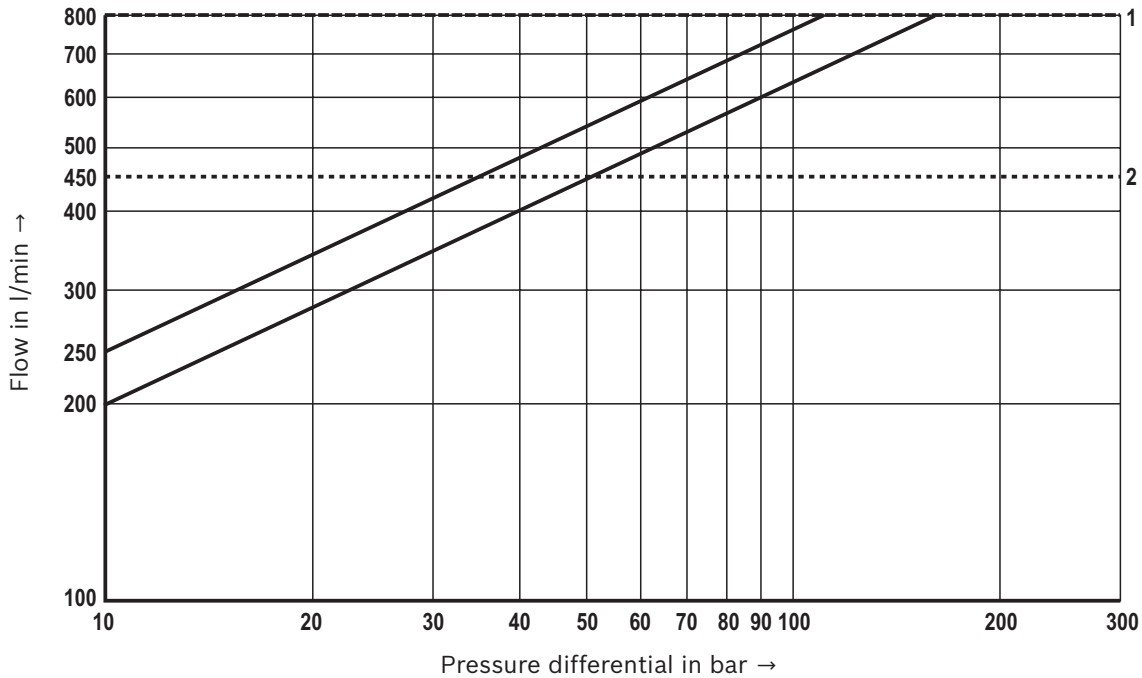


Frequency response characteristic curves



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

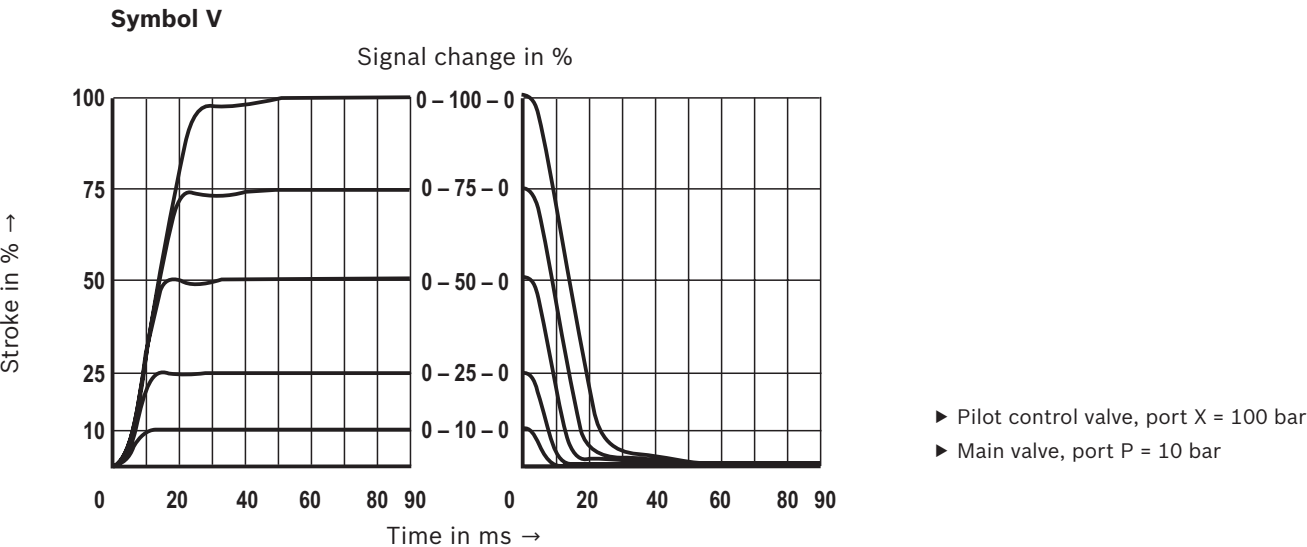
Flow/load function (with maximum valve opening; tolerance $\pm 10\%$)



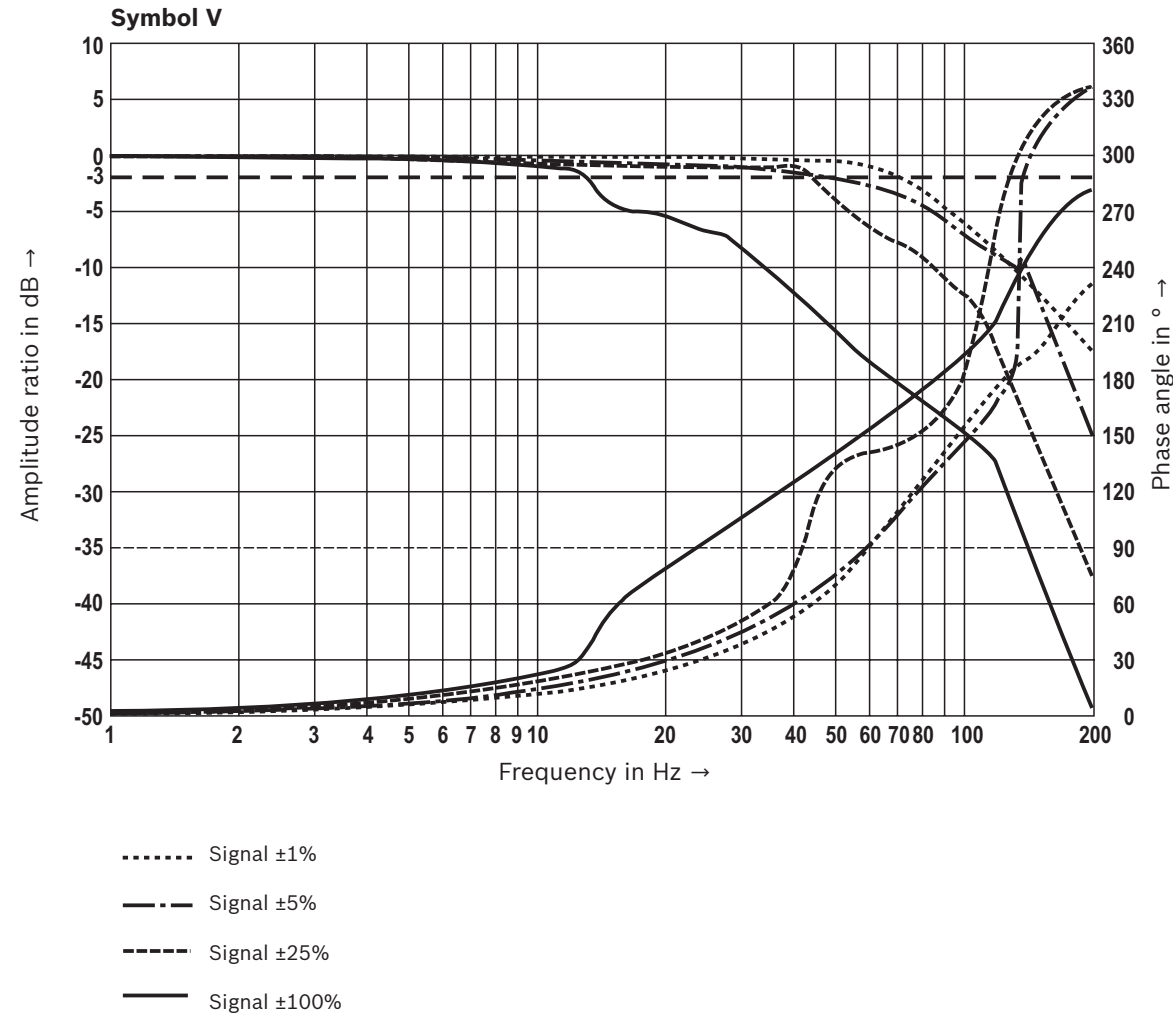
- 1** Maximum admissible flow
- 2** Recommended flow limitation
(flow velocity 30 m/s)

Characteristic curves: Size 25
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^{\circ}\text{C}$)

Transition function with stepped electric input signals

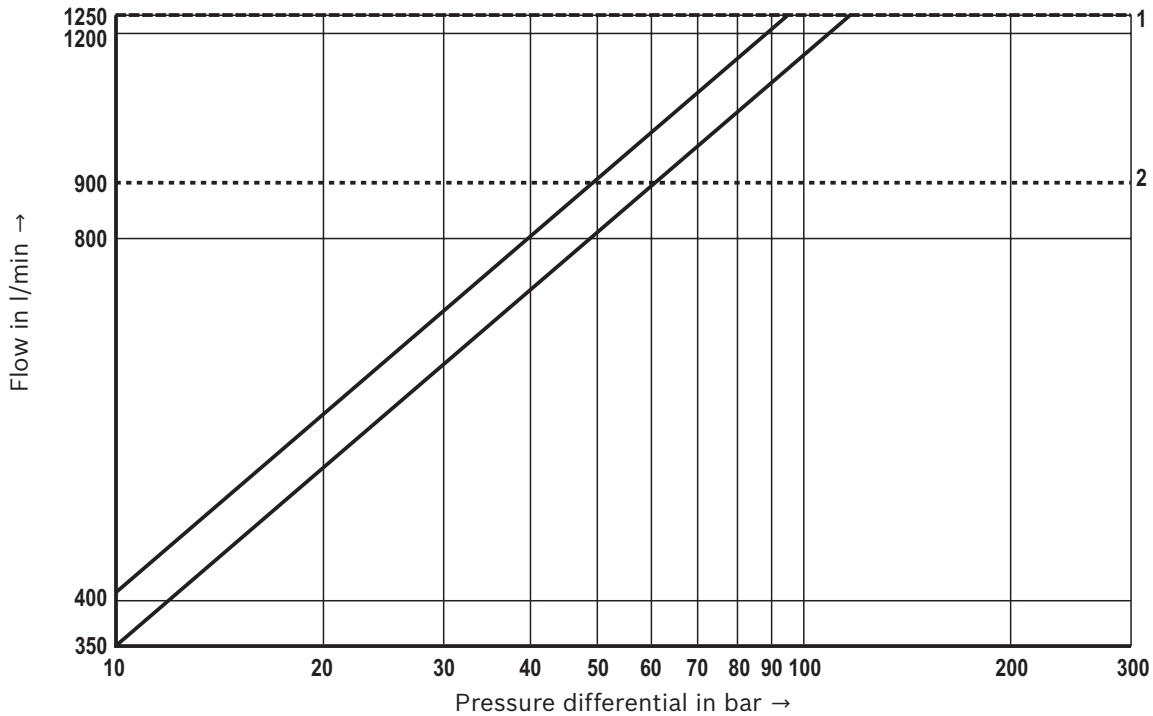


Frequency response characteristic curves



Characteristic curves: Size 25
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^{\circ}\text{C}$)

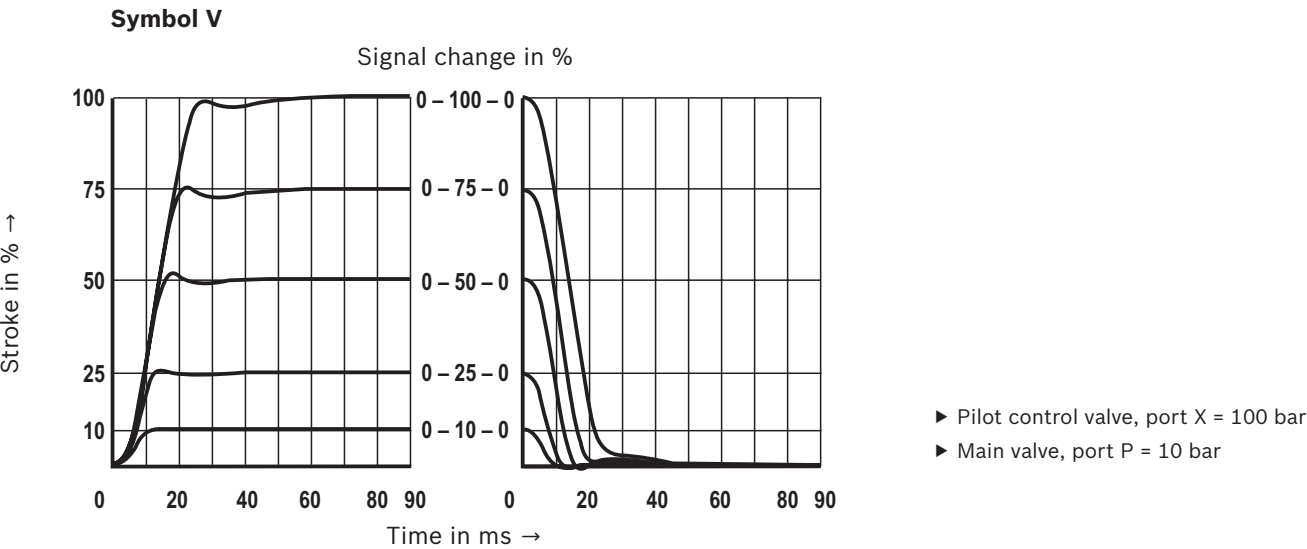
Flow/load function (with maximum valve opening; tolerance $\pm 10\%$)



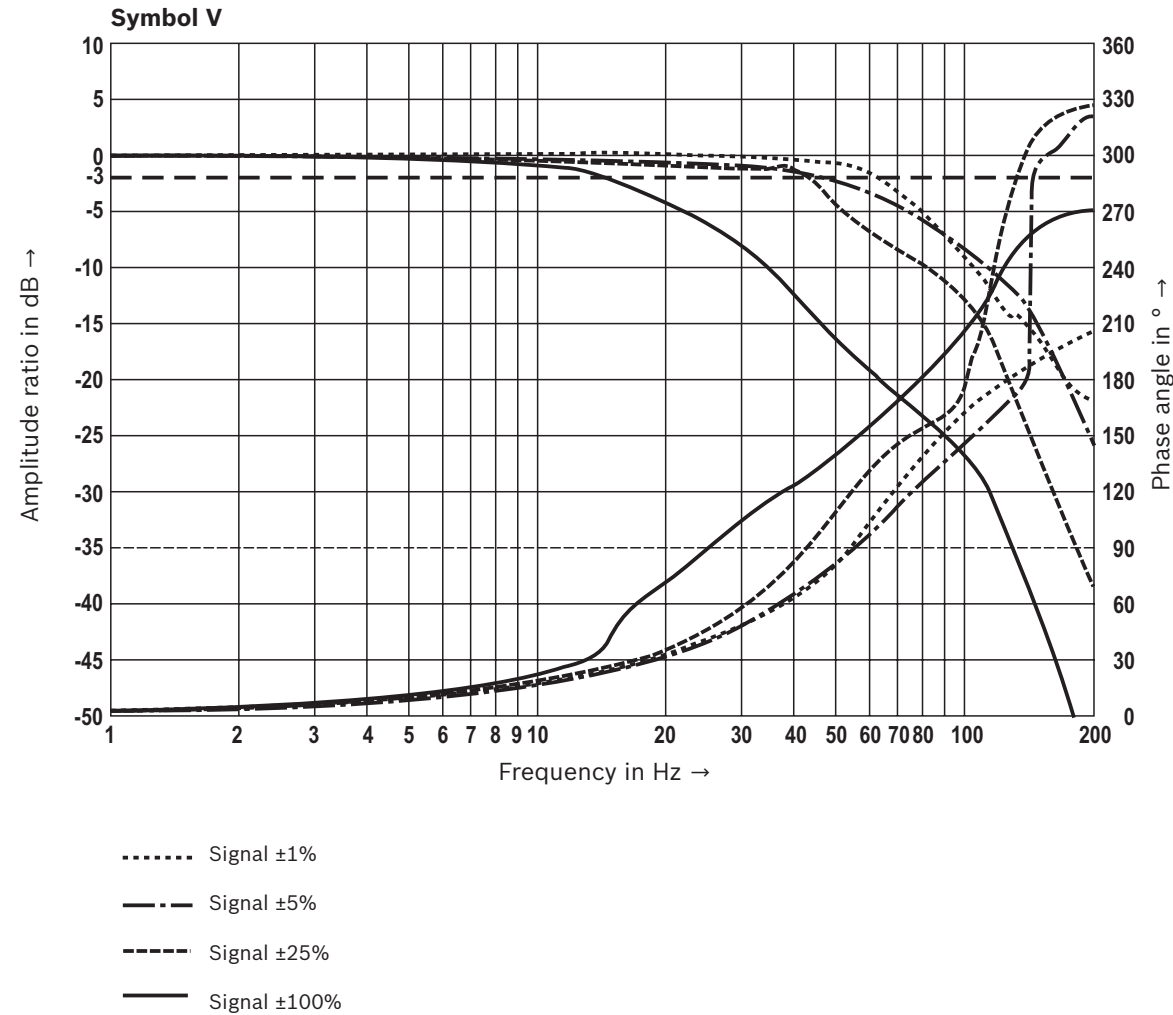
- 1** Maximum admissible flow
- 2** Recommended flow limitation
(Flow velocity 30 m/s)

Characteristic curves: Size 27
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^{\circ}\text{C}$)

Transition function with stepped electric input signals

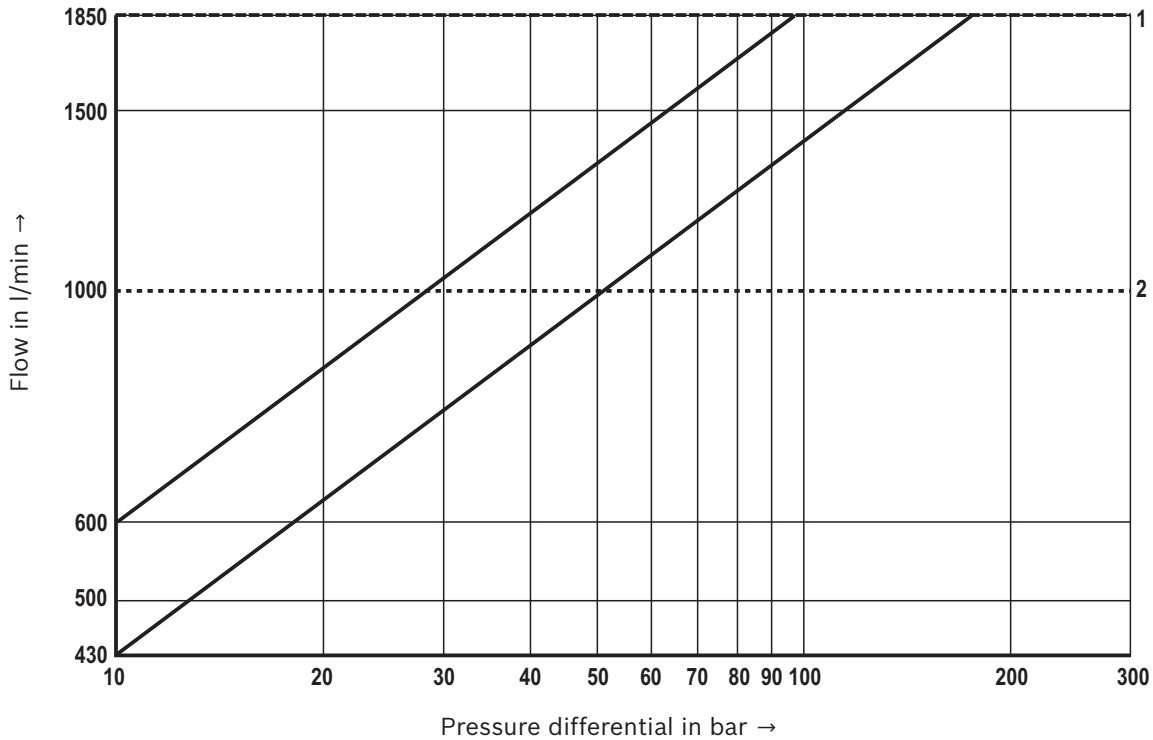


Frequency response characteristic curves



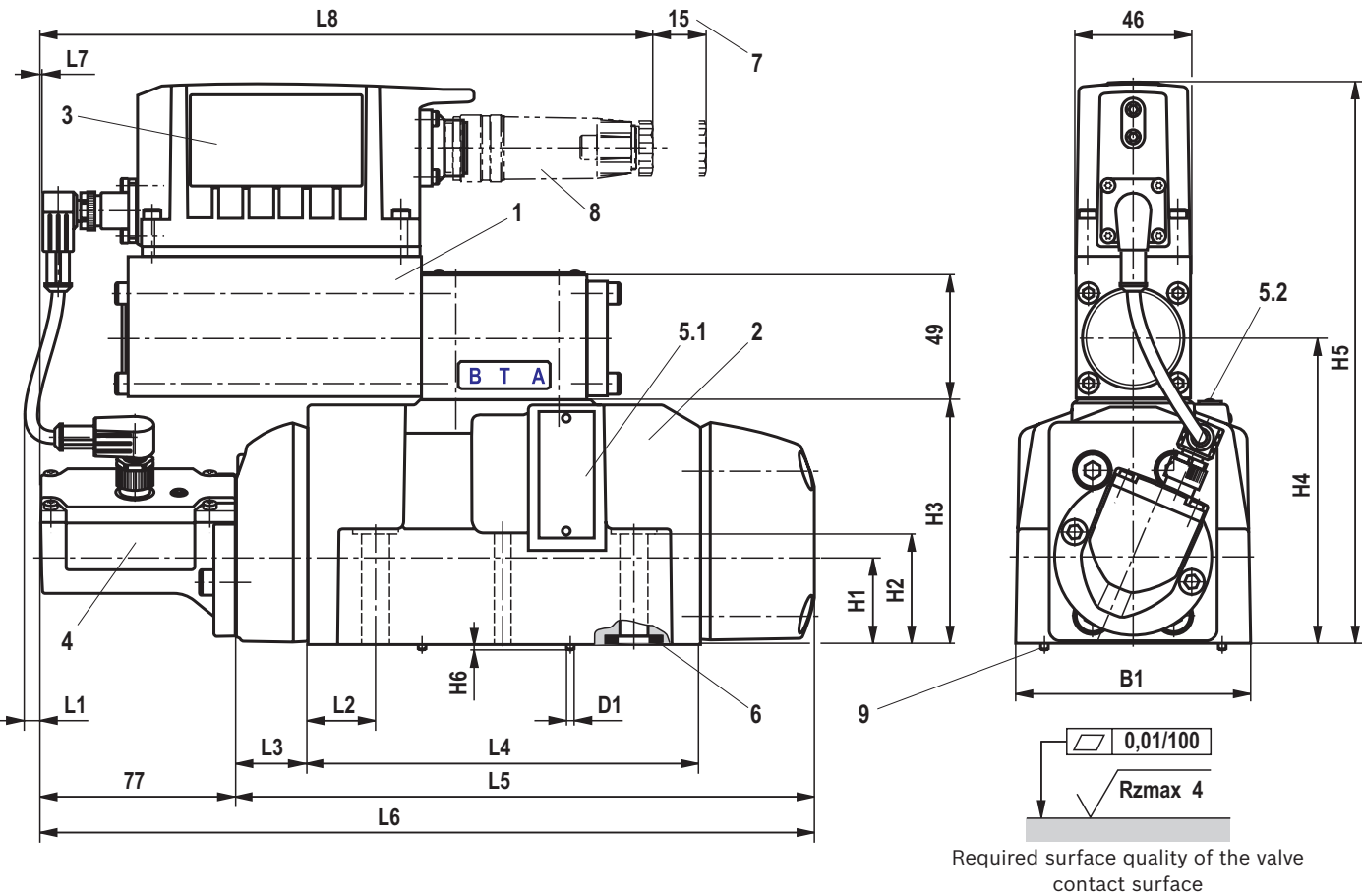
Characteristic curves: Size 27
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ °C}$)

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



- 1 Maximum admissible flow
- 2 Recommended flow limitation
(Flow velocity 30 m/s)

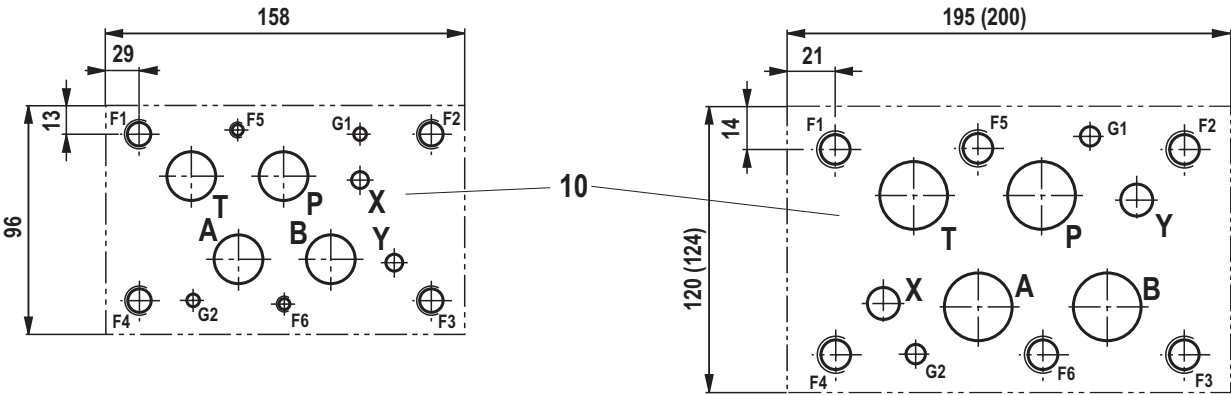
Dimensions
(dimensions in mm)



Size	L1	L2	L3	L4	L5	L6	L7	L8	H1	H2	H3	H4	H5	H6	B1	ØD1
16	7	27	28	154	227	304	1	241	34	43	96	121	222	3	93	3
25	7	19	42	191	287	364	33	274	46	41	126	151	252	4	118	6
27	7	20.5	42	198	294	371	37	277	50	41	140	165	266	4	120	6

Size 16

Size 25 and (27)



Notes:
The dimensions are nominal dimensions which are subject to tolerances.

Item explanations, valve mounting screws and subplates see page 19.

Dimensions

- 1 Pilot control valve
 - 2 Main valve
 - 3 Integrated electronics (OBE)
 - 4 Inductive position transducer (main valve)
 - 5.1 Name plate size 16
 - 5.2 Name plate size 25 and 27
 - 6 Identical seal rings for ports P, A, B, T;
Identical seal rings for ports X, Y
 - 7 Space required to remove the mating connector
 - 8 Mating connectors, separate order, see page 20
and data sheet 08006.
 - 9 Locking pin
 - 10 Machined valve contact surface, porting pattern according to
 - Size 16: ISO 4401-07-07-0-05
 - Size 25 and 27: ISO 4401-08-08-0-05
- Deviating from the standard:
- Size 16: Ports P, A, B, T – Ø 20 mm
 - Size 25: Ports X, Y – Ø 14 mm
 - Size 27: Ports P, A, B, T – Ø 32 mm
- Minimum screw-in depth:
- Ferrous metal: 1,5 x Ø
 - Non-ferrous metal: 2,0 x Ø

Valve mounting screws (separate order)

Size	Quantity	Hex socket head cap screws	Material number
16	2	ISO 4762 - M6 x 60 - 10.9-flZn-240h-L Tightening torque $M_A = 12,2 \text{ Nm} \pm 10\%$	R913000115
	4	ISO 4762 - M10 x 60 - 10.9-flZn-240h-L Tightening torque $M_A = 58, \text{Nm} \pm 20\%$	R913000116
	or		
	2	ISO 4762 - M6 x 60 - 10.9 Tightening torque $M_A = 15,5 \text{ Nm} \pm 10\%$	Not in the Rexroth product range
	4	ISO 4762 - M10 x 60 - 10.9 Tightening torque $M_A = 75 \text{ Nm} \pm 20\%$	
25, 27	6	ISO 4762 - M12 x 60 - 10.9-flZn-240h-L Tightening torque $M_A = 100 \text{ Nm} \pm 20\%$	R913000121
	or		
	6	ISO 4762- M12 x 60 - 10.9 Tightening torque $M_A = 130 \text{ Nm} \pm 20\%$	Not in the Rexroth product range



Note:

The tightening torque of the hexagon socket-head screws refers to the maximum operating pressure.

Subplates (separate order)

Size	Data sheet	Material number
16	45056	–
25, 27	45058	–

Accessories (separate order)

		Data sheet	Material number
Mating connectors	Round connector according to EN 175201-804, 6-pin + PE as well as 6-pin, compatible with VG 95328	08006	e.g. R900021267 (plastic) e.g. R900223890 (metal)
Test and service devices	Service case with test device for proportional valves with integrated electronics (OBE)	29685	–

Further information

► Subplates	Data sheets 45056, 45058
► Mineral oil-based hydraulic fluids	Data sheet 90220
► Environmentally compatible hydraulic fluids	Data sheet 90221
► Flame-resistant, water-free hydraulic fluids	Data sheet 90222
► Reliability characteristics according to EN ISO 13849	Data sheet 08012
► Hexagon socket-head screws 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
► Filter range	www.boschrexroth.com/filter

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