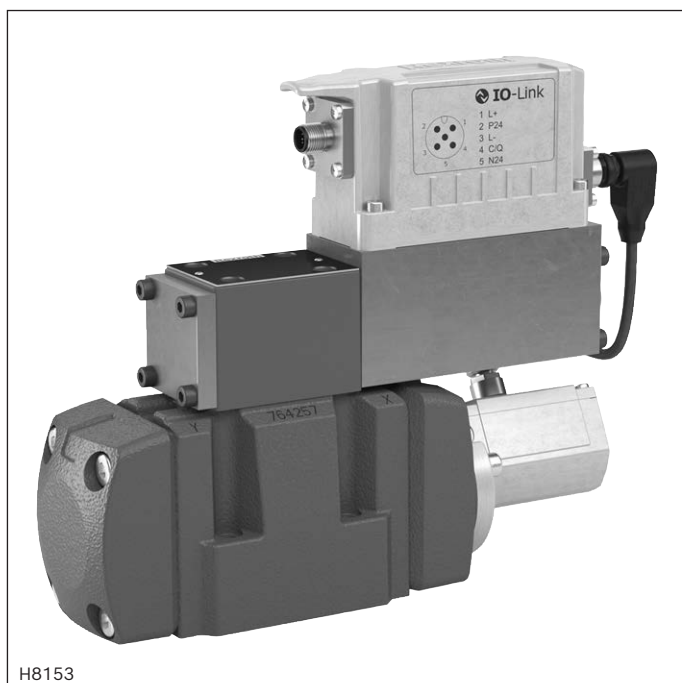


Directional control valves, pilot-operated, with electrical position feedback and integrated electronics (OBE)

Type 4WRLE



- ▶ Size 10 ... 35
- ▶ Component series 4X
- ▶ Maximum operating pressure 350 bar
- ▶ Rated flow 60 ... 1500 l/min
- ▶ Digital interface, IO-Link for I4.0



Features

- ▶ Reliable – proven and robust design
- ▶ Safe
 - The control spool of the pilot control valve is in the "fail safe" position when the unit is switched off
 - The control spool of the main valve is in the spring-centered central position and/or in the offset position
- ▶ High quality – control spool and sleeve of the pilot control valve in servo quality
- ▶ Flexible – suitable for position, velocity and pressure control
- ▶ Precise – high response sensitivity and little hysteresis
- ▶ IO-Link interface, optional. Use of the valve with IO-Link as a shut-off element up to category 3, PL d according to EN 13849-1.

Contents

Features	1
Ordering code	2, 3
Symbols	4
Function, section	5 ... 7
Pilot oil supply	8, 9
Technical data	10 ... 14
Electrical connections and assignment	15
Block diagram/controller function block	16
Characteristic curves	17 ... 34
Dimensions	35 ... 40
Accessories	41
Project planning information	42
Further information	42

Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
4	WRL	E						-	4X	/		/		24	*

01	4 main ports	4
02	Directional control valve, pilot-operated	WRL
03	With integrated electronics (OBE)	E
04	Size 10	10
	Size 16	16
	Size 25	25
	Size 27	27
	Size 35	35
05	Symbols e.g. E, E1-, W6- etc.; possible version see page 4	

Rated flow ($\Delta p = 5$ bar/control edge)

06	- Size 10	
	60 l/min (only symbol E, E1-, W6-, W8-, V, V1-)	60
	100 l/min	100 \diamond
	- Size 16	
	200 l/min (only symbol W6- and W8-)	200 \diamond
	250 l/min (only symbol E, E1-, V, V1- and Q3-)	250 \diamond
	- Size 25	
	350 l/min (only symbol W6- and W8-)	350 \diamond
	400 l/min (only symbol E, E1-, V, V1- and Q3-)	400 \diamond
	- Size 27	
	430 l/min (only symbol W6- and W8-)	430 \diamond
	600 l/min (only symbol E, E1-, V, V1- and Q3-)	600 \diamond
	- Size 35	
	1000 l/min (only symbol E, E1-, V, V1-)	1000
	1200 l/min (only symbol W6- and W8-)	1200 \diamond
1500 l/min (only symbol E, E1-, V, V1- and Q3-)	1500 \diamond	

Flow characteristic

07	Linear	L \diamond
	Linear with fine control range	P
	Progressive with linear fine control (only symbol Q3-)	M
08	Without overlap jump (only symbols V, V1- and Q3-)	no code
	With 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 mounting dimensions)	4X

Seal material (observe compatibility of seals with hydraulic fluid used, see page 12)

10	NBR seals	M \diamond
	FKM seals	V

Pilot oil flow

11	External pilot oil supply, external pilot oil return	XY \diamond
	Internal pilot oil supply, external pilot oil return	PY
	Internal pilot oil supply, internal pilot oil return	PT \diamond
	External pilot oil supply, internal pilot oil return	XT


Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
4	WRL	E						-	4X	/		/		24	*

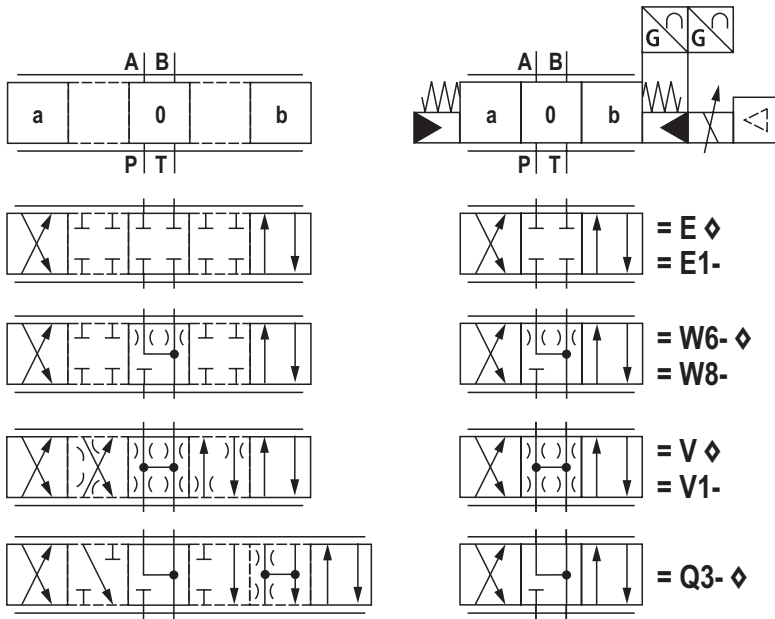
12	Without damping plate	no code \diamond
	With damping plate	D
13	Supply voltage 24 V	24

Interfaces of the control electronics

14	Command value input ± 10 V	A1 \diamond
	Command value input 4 ... 20 mA	F1
	IO-Link interface	L1 \diamond
	Command value ± 10 mA, actual value 4 ... 20 mA, release (connector 6+PE)	C6
15	Without electronics protection membrane	no code \diamond
	With electronics protection membrane	-967
16	Further details in the plain text	*

 **Notice:** \diamond = Preferred type

Symbols



With symbol E1-, V1- and W8-:

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

Notice: \diamond = Preferred type

Version	Simple	Detailed
"XY"		
"PY"		
"PT"		
"XT"		

Notice:

- Representation according to DIN ISO 1219-1. Hydraulic interim positions are shown by dashes.
- For information on the "switch-off behavior", refer to Technical data on page 12.

Function, section: Symbol E. and W.

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

Set-up

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 (optionally with electronics protection membrane (5) and damping plate (4))
- ▶ Main valve (2) with centering spring and position feedback
- ▶ On-board electronics (OBE) (3) with analog (6) or IO-Link interface

Function

When the integrated electronics (OBE) are switched off or inactive, the control spool of the pilot control valve is spring-operated in the "fail-safe" position. The control spool of the main valve is in its spring-centered central position.

The integrated electronics (OBE) compare the specified command value to the position actual value of the main valve control spool. In case of control deviations, the control solenoid will be activated. Due to the changed magnetic force, the pilot control spool is adjusted against the spring.

The flow, which is activated via the control cross-sections, leads to an adjustment of the main control spool. The stroke/control cross-section of the main control spool is regulated proportionally to the command value.

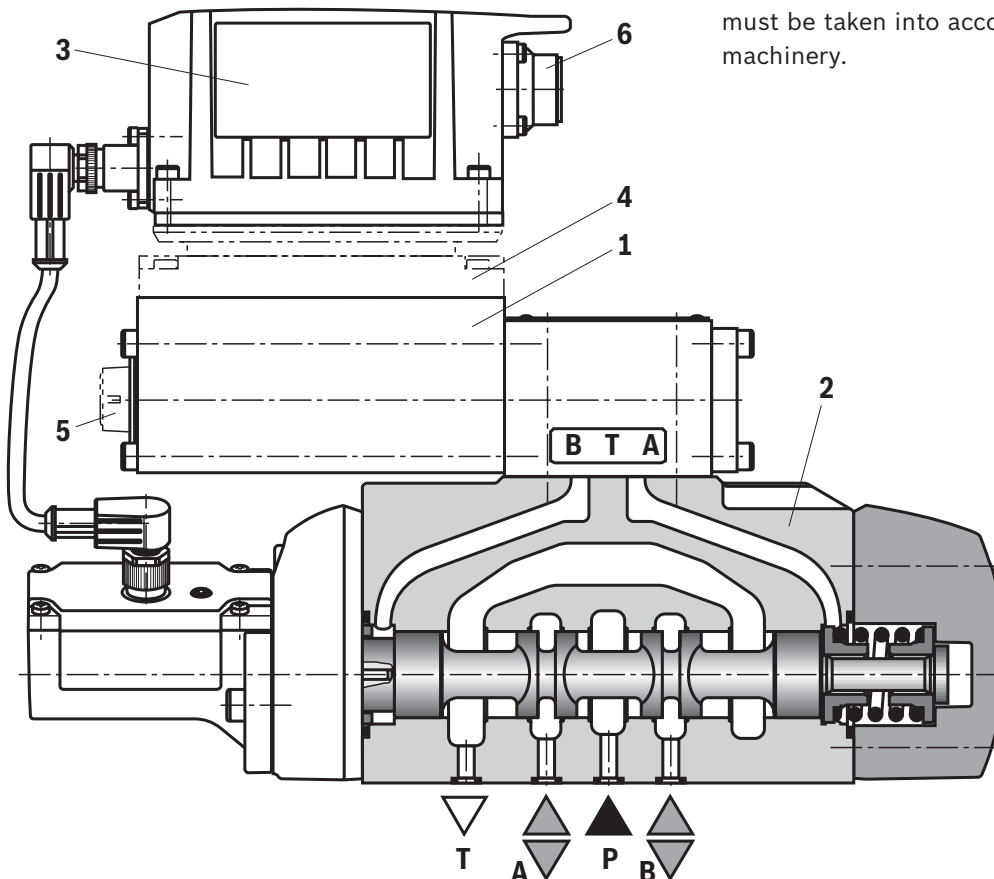
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

Safety function (IO-Link shut-off)

By shutting off the supply voltage at the IO-Link master (Class B-Port), pins 2 and 5, the IO-Link valve can be safely switched off. After shut-off of the supply voltage, the main valve control spool is set to spring-centered central position. In order to also guarantee the hydraulic prerequisite for the safety shut-down, the overlap of control spool must also be considered.

Observe $MTTF_D$ values (data sheet 08012) and operating instructions 29118-B.

The safe shut-off is not part of the IO-Link valve and must be taken into account for the safe design of the machinery.



Function, section: Symbol E. and W.**Control solenoid shut-off**

In case of the following errors, the control solenoids are de-energized by the integrated electronics (OBE), the pilot control spool is set to its "fail-safe" position and unloads the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the central position.

- ▶ Falling below the minimum supply voltage ≤ 15 V (restarting ≥ 17.5 V).
- ▶ Only at interface "F1":
 - Falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop)).
- ▶ Only at interface "L1":
 - Enable inactive, communication interruption (watchdog)
 - In case of internal IO-Link error
- ▶ Only at interface "C6":
 - Additionally, release inactive

Damping plate "D"

The damping plate (4) reduces the acceleration amplitudes on the on-board electronics (frequencies > 300 Hz).


 **Notice:**

Using the damping plate is not recommended for applications with mainly low-frequency excitation < 300 Hz.

Electronics protection membrane "-967"

To prevent condensate formation in the housing of the integrated electronics (OBE), an electronics protection membrane (5) can be used.

Recommended for use outside industry-standard conditions with high ambient air humidity and significant cyclic temperature changes (e.g. outdoors).

 **Notice:**

- ▶ Pilot-operated 4/3 directional control valves with positive overlap are functional in controlled or regulated axes. The overlap in the de-energized state is approx. 20% of the control spool stroke.
- ▶ 4/3 directional control valves do not have a leakage-free basic locking when deactivated. Leakage must be considered when designing the drive.
- ▶ When using the valve with IO-Link interface in compliance with category 3 according to EN 13849-1, adequate cyclic diagnosis or monitoring of the valve function outside of the valve by the control system must be implemented by the machine integrator. Without suitable diagnostic measures, only category B or 1 according to EN 13849-1 can be achieved.

For sectional drawing see page 5.

Function, section: Symbol V and V1-

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

Set-up

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 (optionally with electronics protection membrane (5) and damping plate (4))
- ▶ Main valve (2) with centering spring and position feedback
- ▶ On-board electronics (OBE) (3) with analog (6) or IO-Link interface

Function

When the integrated electronics (OBE) are switched off or inactive, the control spool of the pilot control valve is spring-operated in the "fail-safe" position.

The control spool of the main valve is in its spring-centered offset position at approx. 6% of the stroke in direction P→B, A→T.

The integrated electronics (OBE) compare the specified command value to the position actual value of the main valve control spool. In case of control deviations, the control solenoid will be activated. Due to the changed magnetic force, the pilot control spool is adjusted against the spring.

The flow, which is activated via the control cross-sections, leads to an adjustment of the main control spool. The stroke/control cross-section of the main control spool is regulated proportionally to the command value. In case of a command value presetting of 0 V, the electronics adjust the control spool of the main valve to central position.

The pilot oil supply in the pilot control valve is either internal via port P or external via port X.

The feedback can be internal via port T or external via port Y to the tank.

Control solenoid shut-off

In case of the following errors, the control solenoids are de-energized by the integrated electronics (OBE), the pilot control spool is set to its "fail-safe" position and unloads the pilot oil chambers of the main valve.

Operated by the spring, the main valve control spool will move to the offset position (approx. 6% P→B, A→T).

- ▶ Falling below the minimum supply voltage ≤ 15 V (restarting ≥ 17.5 V).
- ▶ Only at interface "F1":
 - Falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop)).
- ▶ Only at interface "L1":
 - Enable inactive, communication interruption (watchdog)
 - In case of internal IO-Link error
- ▶ Only at interface "C6":
 - Additionally, release inactive

Damping plate "D" and electronics protection membrane "-967" see page 6.

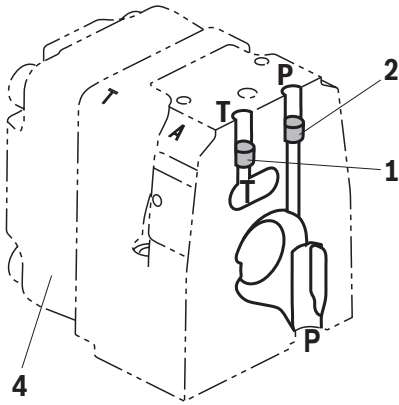
Notice:

Pilot-operated 4/3 directional control valves with zero overlap are only functional in the active control loop and do not have a locking basic position when deactivated. Consequently "external isolation valves" are required in many applications and must be taken into account regarding the switch-on/switch-off order. While the electrical supply voltage is switching off, the drive may be accelerated for a short time in functional direction P to B.

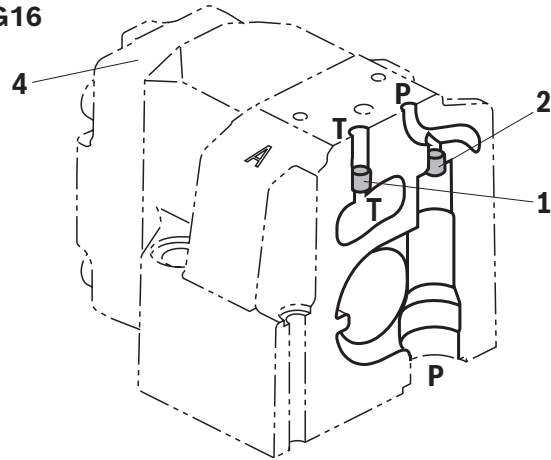
For sectional drawing see page 5.

Pilot oil supply (schematic illustration)

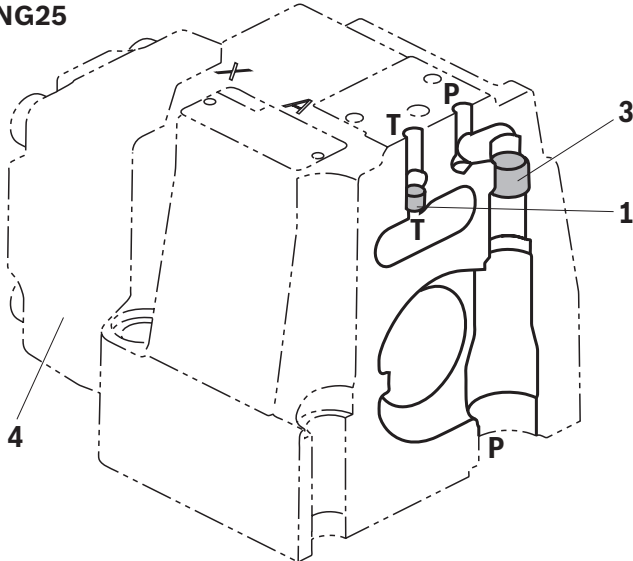
NG10



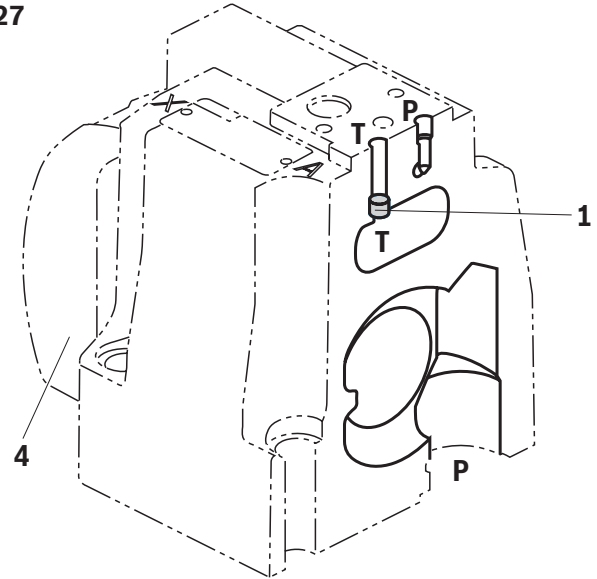
NG16



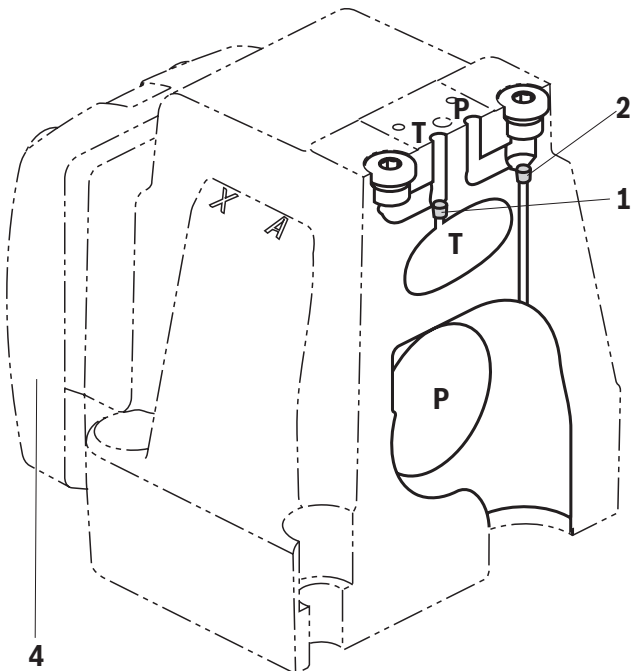
NG25



NG27



NG35



- 1 Plug screw M6 according to DIN 906, SW3
– pilot oil return
- 2 Plug screw M6 according to DIN 906, SW3
– pilot oil supply
- 3 Plug screw M12 x 1.5 according to DIN 906, SW6
– pilot oil supply
- 4 Housing cover main stage (position transducer side)

Pilot oil supply

external: 2, 3 closed
internal: 2, 3 open

Pilot oil return

external: 1 closed
internal: 1 open

Further explanations on page 9.

Pilot oil supply

Version "XY"

External pilot oil supply

External pilot oil return

In this version, the pilot oil is supplied from a separate control circuit (external).

The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).

Version "PY"

Internal pilot oil supply

External pilot oil return

With this version, the pilot oil is supplied from channel P of the main valve (internal).

The pilot oil return is not directed into channel T of the main valve but is separately directed to the tank via port Y (external).

In the subplate, port X is to be closed.

Version "PT"

Internal pilot oil supply

Internal pilot oil return

With this version, the pilot oil is supplied from channel P of the main valve (internal).

The pilot oil is directly returned to channel T of the main valve (internal).

In the subplate, ports X and Y are to be closed.

Version "XT"

External pilot oil supply

Internal pilot oil return

In this version, the pilot oil is supplied from a separate control circuit (external).

The pilot oil is directly returned to channel T of the main valve (internal).

In the subplate, port Y is to be closed.



Notice:

The modification of the pilot oil supply may only be performed by authorized specialists or at the factory. The maximum admissible operating parameters must be observed, see page 11.

Technical data

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

General						
Size	NG	10	16	25	27	35
Type of connection	Subplate mounting					
Porting pattern	ISO 4401					
Weight	kg	9	12	19	21	80
Installation position	Any					
Ambient temperature range	°C	-20 ... +60				
Storage temperature range	°C	+5 ... +40				
Maximum storage time	Years	1 (if the storage conditions are observed, refer to the operating instructions 07600-B)				
Maximum relative humidity (no condensation)	%	95				
Protection class according to EN 60529	IP65 (if suitable and correctly mounted mating connectors are used)					
Maximum surface temperature	°C	120 (individual operation)				
MTTF _D value according to EN ISO 13849	Years	75 (for further details see data sheet 08012)				
Can be used up to category according to EN ISO 13849	▶ Version "A1", "F1"	1 (up to PL c); as switch-off element				
	▶ Version "L1"	3 (up to PL d); as switch-off element				
Sine test according to DIN EN 60068-2-6	▶ Without damping plate	10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes				
	▶ With damping plate ¹⁾	10 ... 2000 Hz / maximum of 10 g / 10 cycles / 3 axes				
Noise test according to DIN EN 60068-2-64	▶ Without damping plate	20 ... 2000 Hz / 10 g _{RMS} / 30 g peak / 30 min. / 3 axes				
	▶ With damping plate ¹⁾	20 ... 2000 Hz / 10 g _{RMS} / 30 g peak / 24 h / 3 axes				
Transport shock according to DIN EN 60068-2-27	▶ Without damping plate	15 g / 11 ms / 3 shocks / 3 axes				
	▶ With damping plate ¹⁾	15 g / 11 ms / 3 shocks / 3 axes				
Shock according to DIN EN 60068-2-27	▶ With damping plate ¹⁾	35 g / 6 ms / 1000 shocks / 3 axes				
Conformity	▶ CE according to EMC directive 2014/30/EU, tested according to	EN 61000-6-2 and EN 61000-6-3				
	▶ RoHS directive	2011/65/EU ²⁾				

¹⁾ Not recommended for applications with mainly low-frequency excitation < 300 Hz

²⁾ The product fulfills the substance requirements of the RoHS directive 2011/65/EU.

Technical data

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

Hydraulic							
Size	NG	10	16	25	27	35	
Maximum operating pressure	▶ Ports A, B, P						
	– External pilot oil supply	bar		350		270	350
	– Internal pilot oil supply	bar		280		270	280
	▶ Port X	bar		280		270	280
	▶ Port T ³⁾						
	– External pilot oil return	bar		250		210	350
	– Internal pilot oil return	bar		250		210	250
▶ Port Y	bar		250		210	250	
Hydraulic fluid		See table page 12					
Hydraulic fluid temperature range (flown-through)	°C	-20 ... +70					
Viscosity range	▶ Recommended	mm ² /s	20 ... 100				
	▶ Maximum	mm ² /s	10 ... 800				
Maximum admissible degree of contamination of the hydraulic fluid; cleanliness class according to ISO 4406 (c)		Class 18/16/13 ⁴⁾					
Rated flow ($\Delta p = 5$ bar/control edge) ⁵⁾	l/min	60/100	200/250	350/400	430/600	1000/1200/1500	
Maximum flow	l/min	300	800	1250	1850	4700	
Maximum leakage flow (inlet pressure 100 bar)	▶ Symbol E, E1-						
	– Main valve	l/min	0.10	0.17	0.19	0.83	
	– Main valve + pilot control valve	l/min	0.16	0.28	0.36	1.11	
	▶ Symbol W6-, W8-						
	– Main valve	l/min	0.21	0.35	0.38	1.67	
	– Main valve + pilot control valve	l/min	0.26	0.45	0.56	1.95	
Maximum zero flow (inlet pressure 100 bar)	▶ Symbol V, V1-						
	– Main valve	l/min	1.7	2.3	2.8	3.3	7.2
	– Main valve + pilot control valve	l/min	1.85	2.6	3.2	3.7	7.65
	▶ Symbol Q3-						
	– Main valve	l/min	0.4	1.6	1.8	2.2	1.6
	– Main valve + pilot control valve	l/min	0.55	1.9	2.2	2.6	2.05
Minimum pilot pressure (pilot control valve)	bar	10					
Pilot flow ⁶⁾	▶ Symbol E, W	l/min	3	4	10	26	
	▶ Symbol V, Q3-	l/min	4	11	19	29	

³⁾ Observe project planning information, see page 42.

⁴⁾ 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.

⁵⁾ Flow for deviating Δp (per control edge):

$$q_x = q_{Vnom} \times \sqrt{\frac{\Delta p_x}{5}}$$

⁶⁾ At port X and Y with stepped input signal from 0 ... 100% (pilot pressure 100 bar)

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
Bio-degradable	▶ Insoluble in water	HETG	ISO 15380	90221
		HEES		
	▶ Soluble in water	HEPG	ISO 15380	
Flame-resistant	▶ Water-free	HFDU (glycol base)	ISO 12922	90222
		HFDU (ester base)		
		HFDR		
	▶ Containing water	HFC (Fuchs: Hydrotherm 46M, Fuchs Renosafe 500; Petrofer: Ultra Safe 620; Houghton: Safe 620; Union: Carbide HP5046)	ISO 12922	90223

**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 50 K higher than the maximum surface temperature.
- ▶ **Bio-degradable and flame-resistant – containing water:**
If components with galvanic zinc coating (e.g., version "J3" or "J5") or parts containing zinc are used, small amounts of dissolved zinc may get into the hydraulic system and cause accelerated aging of the hydraulic fluid. Zinc soap may form as a chemical reaction product, which may clog filters, nozzles and solenoid valves – particularly in connection with local heat input.

▶ Flame-resistant – containing water:

- Due to the increased cavitation tendency with HFC hydraulic fluids, the life cycle of the component may be reduced by up to 30% as compared to the use with mineral oil HLP. In order to reduce the cavitation effect, it is recommended – if possible specific to the installation – backing up the return flow pressure in ports T to approx. 20% of the pressure differential at the component.
- Dependent on the hydraulic fluid used, the maximum ambient and hydraulic fluid temperature must not exceed 50 °C. In order to reduce the heat input into the component, the command value profile is to be adjusted for proportional and high-response valves.

Static/dynamic						
Size	NG	10	16	25	27	35
Hysteresis	%	<0.1				
Range of inversion	%	<0.08				
Response sensitivity	%	<0.05				
Manufacturing tolerance q_{Vmax}	%	≤10				
Temperature drift (temperature range 20 ... 80 °C)	%/10 °C	Zero shift < 0.25				
Zero point calibration	%	±1 (ex works)				
Step response time for 0 ... 100% at X = 210 bar	ms	25	37	36	36	55
Switch-off behavior (after electrical shut-off)	▶ Symbol E, E1-	Pilot control valve in fail-safe position, main valve moves to overlapped spring-centered central position				
	▶ Symbol W6-, W8-	Pilot control valve in "fail-safe" position, main valve moves to spring-centered central position (P blocked, A/B to port T open).				
	▶ Symbol V, V1-	Pilot control valve in fail-safe position, main valve moves to spring-centered "offset position" (approx. 6%, P → B/A → T)				
	▶ Symbol Q3	Pilot control valve in "fail-safe" position, main valve moves to spring-centered "offset position" (P blocked, A/B to port T open)				

Technical data

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

Electrical, integrated electronics (OBE) – Interface "A1"			
Supply voltage	▶ Nominal value	VDC	24
	▶ Minimum	VDC	19
	▶ Maximum	VDC	36
	▶ Maximum residual ripple	V _{pp}	2.5
	▶ Maximum power consumption	VA	40
	▶ Fuse protection, external	A _T	2.5 (time-lag)
Relative duty cycle time according to VDE 0580		%	S1 (continuous operation)
Functional ground and screening		See page 15 (EMC-compliant installation)	
Maximum voltage of the differential inputs against 0 V		D→B; E→B (max. 18 V)	
Command value (differential amplifier)	▶ Measurement range	V	±10
	▶ Input resistance	kΩ	>100
Actual value (test signal)	▶ Output range	V	±10
	▶ Minimum load impedance	kΩ	>1

Electrical, integrated electronics (OBE) – Interface "F1"			
Supply voltage	▶ Nominal value	VDC	24
	▶ Minimum	VDC	19
	▶ Maximum	VDC	36
	▶ Maximum residual ripple	V _{pp}	2.5
	▶ Maximum power consumption	VA	40
	▶ Fuse protection, external	A _T	2.5 (time-lag)
Relative duty cycle time according to VDE 0580		%	S1 (continuous operation)
Functional ground and screening		See page 15 (EMC-compliant installation)	
Maximum voltage of the differential inputs against 0 V		D→B; E→B (max. 18 V)	
Command value	▶ Input current range	mA	4 ... 20
	▶ Input resistance	Ω	200
Actual value (test signal)	▶ Output range	mA	4 ... 20
	▶ Maximum load	Ω	500

Electrical, integrated electronics (OBE) – Interface "C6"			
Supply voltage (U_B)	▶ Nominal value	VDC	24
	▶ Minimum	VDC	19
	▶ Maximum	VDC	36
	▶ Maximum residual ripple	V _{pp}	2.5
	▶ Maximum power consumption	VA	40
	▶ Fuse protection, external	A _T	2.5 (time-lag)
Relative duty cycle time according to VDE 0580		%	S1 (continuous operation)
Functional ground and screening		See page 15 (EMC-compliant installation)	
Command value	▶ Input current range	mA	±10
	▶ Input resistance	Ω	200
Actual value (test signal)	▶ Output range	mA	4 ... 20
	▶ Maximum load	Ω	500
Enable	▶ Low level range	V	-3 ... 5
	▶ High level range	V	11 ... U_B
	▶ Maximum current consumption at high level	mA	7.25 ($U_B = 24$ V); 11 ($U_{B \max}$)

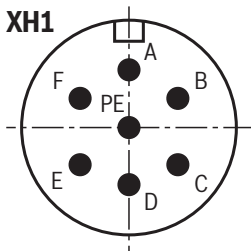
Technical data

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

Electrical, integrated electronics (OBE) - Interface "L1"		
Supply voltage	▶ Valve amplifiers	
	- Nominal value	VDC 24
	- Minimum	VDC 18
	- Maximum	VDC 30
	- Maximum residual ripple	Vpp 1.3
	- Maximum power consumption	VA 40
	▶ IO-Link interface	
	- Nominal value	VDC 24
	- Minimum	VDC 18
	- Maximum	VDC 30
	- Maximum residual ripple	Vpp 1.3
	- Maximum power consumption	VA 1.2
Relative duty cycle time according to VDE 0580	%	S1 (continuous operation)
Functional ground and screening		Provide via valve block
Bit rate COM3	kBaud (kbit/s)	230.4
Required master port class		Class B
Directive		IO-Link Interface and System Specification Version 1.1.2

Electrical connections and assignment

Contact	Interface assignment		
	"A1" (6 + PE)	"F1" (6 + PE)	"C6" (6 + PE)
A	Supply voltage	Supply voltage	Supply voltage
B	GND	GND	GND, reference potential actual value/enable
C	Reference potential actual value	Reference potential actual value	Enable input
D	Command value	Command value	Command value
E	Reference potential command value	Reference potential command value	Reference potential command value
F	Actual value	Actual value	Actual value
FE	Functional ground (directly connected to the valve housing)		

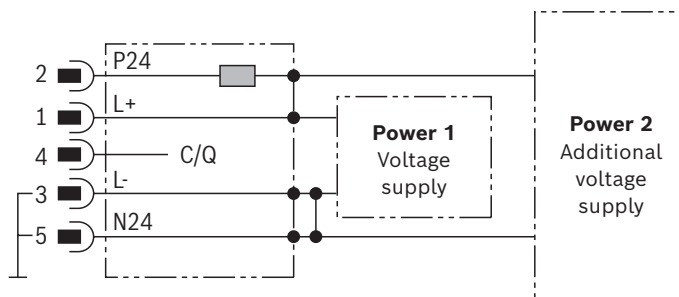
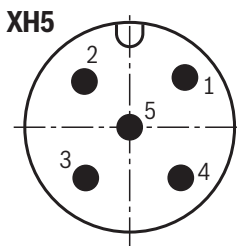


Command value	▶ Command value 0 ... +10 V or 12 ... 20 mA at D and reference potential at E: Flow from P→A and B→T.
	▶ Command value 0 ... -10 V or 12 ... 4 mA at D and reference potential at E: Flow from P→B and A→T.
Actual value	▶ Actual value 0 ... +10 V or 12 ... 20 mA at F and reference potential at C: Flow from P→A and B→T.
	▶ Actual value 0 ... -10 V or 12 ... 4 mA at F and reference potential at C: Flow from P→B and A→T.
Connection cable	▶ 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
	▶ EMC-compliant installation:
	<ul style="list-style-type: none"> - Apply screening to both line ends - Use metal mating connector (see page 41)
Connection cable	▶ Alternatively up to 30 m cable length admissible
	<ul style="list-style-type: none"> - Apply screening on supply side - Plastic mating connector (see page 41) can be used

Notice:

Mating connectors, separate order, see page 41 and data sheet 08006.

Connector pin assignment "L1" (M12-5, A-coded, class B)



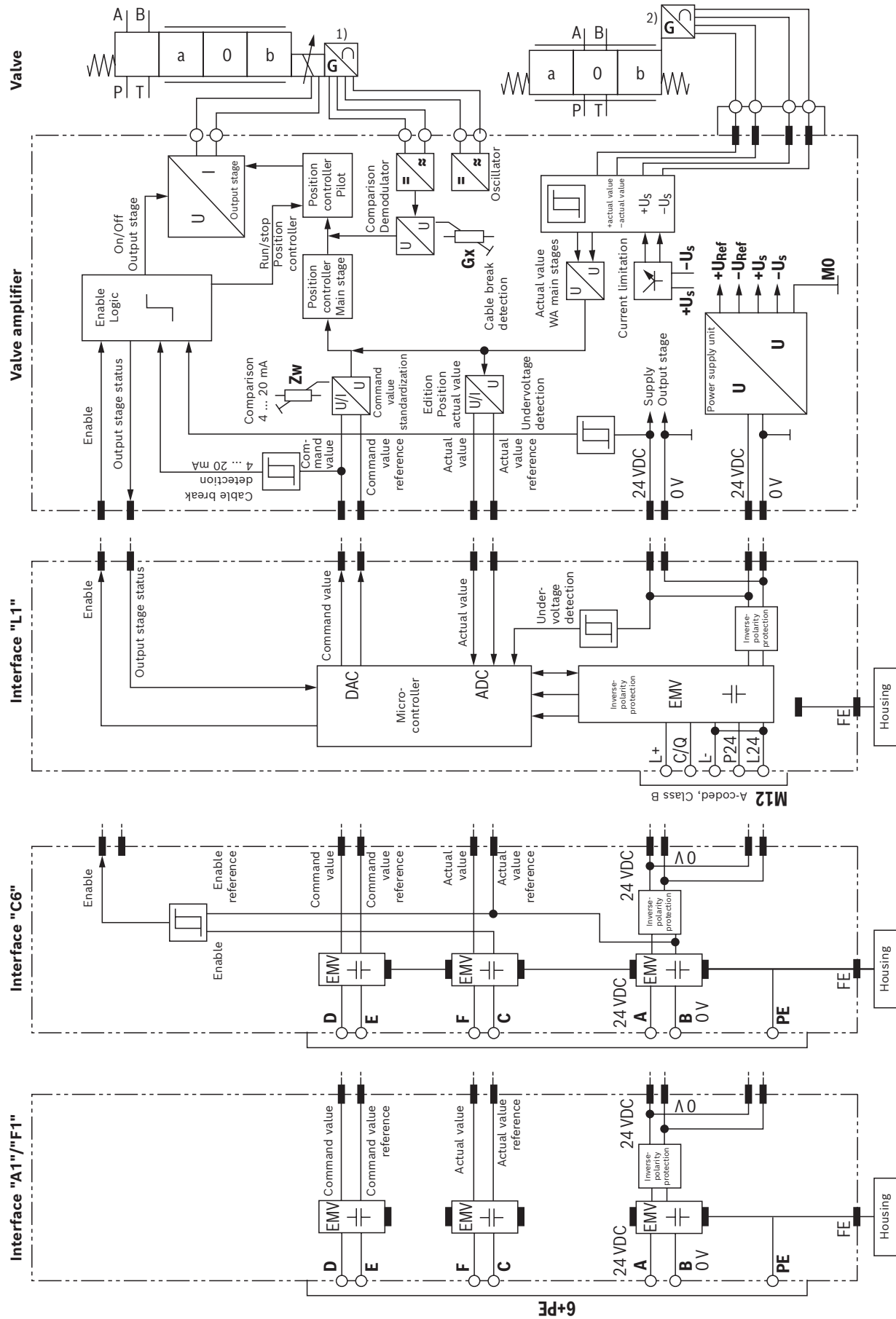
Notice:

- ▶ M12 sensor/actuator connection line, 5-pole; M12 connector/bush, A-coded, without shield, maximum cable length 20 m. Observe the voltage drop over the cable. Wire cross-section at least 0.34 mm².
- ▶ Mating connectors, separate order, see page 41 and data sheet 08006.
- ▶ For the communication and parameter description see data sheet 29400-PA

Pin	Signal	Allocation interface "L1"
1	L+	Voltage supply IO-Link
2	P24	Voltage supply valve electronics and power part (current consumption 2 A)
3	L-	Reference potential pin 1 ¹⁾
4	C/Q	Data line IO-Link (SDCI)
5	N24	Reference potential pin 2 ¹⁾

¹⁾ Pin 3 and 5 are linked with each other in the valve electronics. The reference potentials L- and N24 of the two supply voltages must also be linked with each other on the power supply unit side.

Block diagram/controller function block



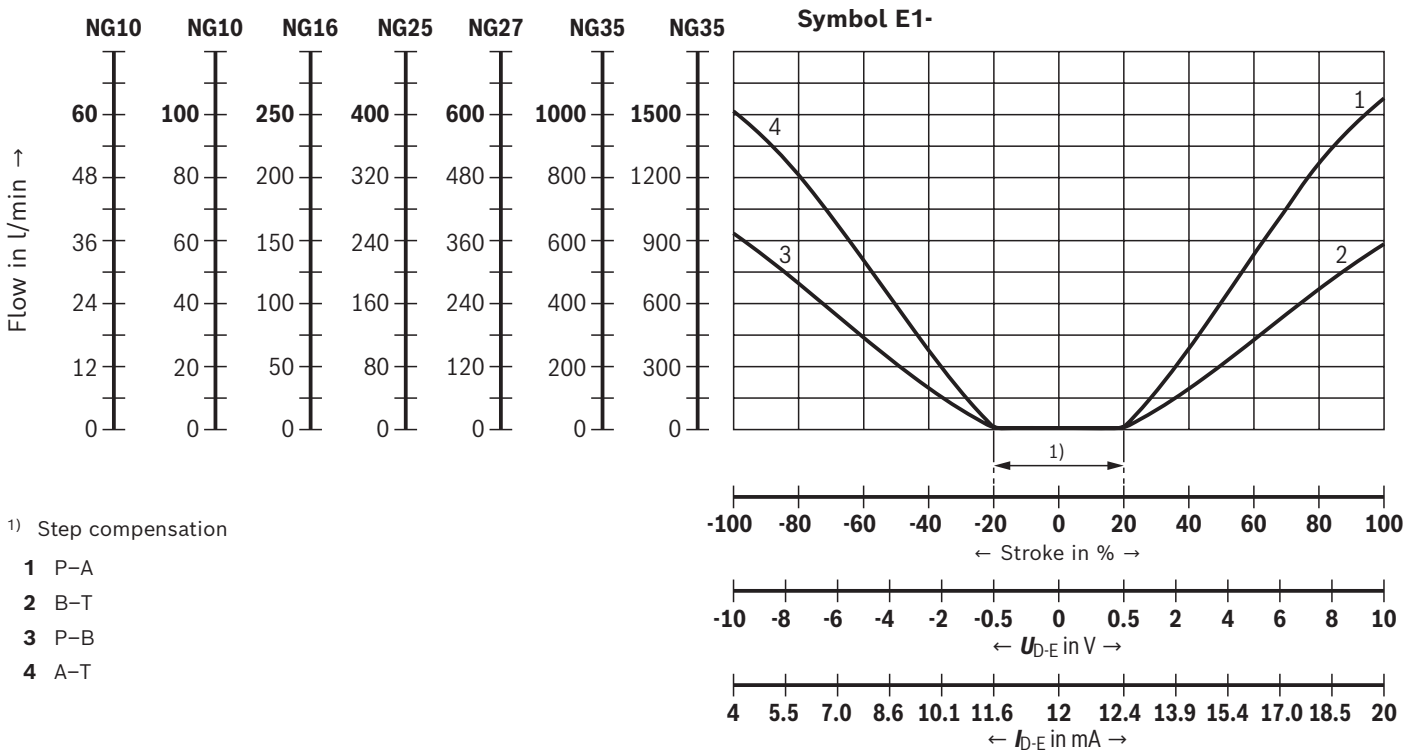
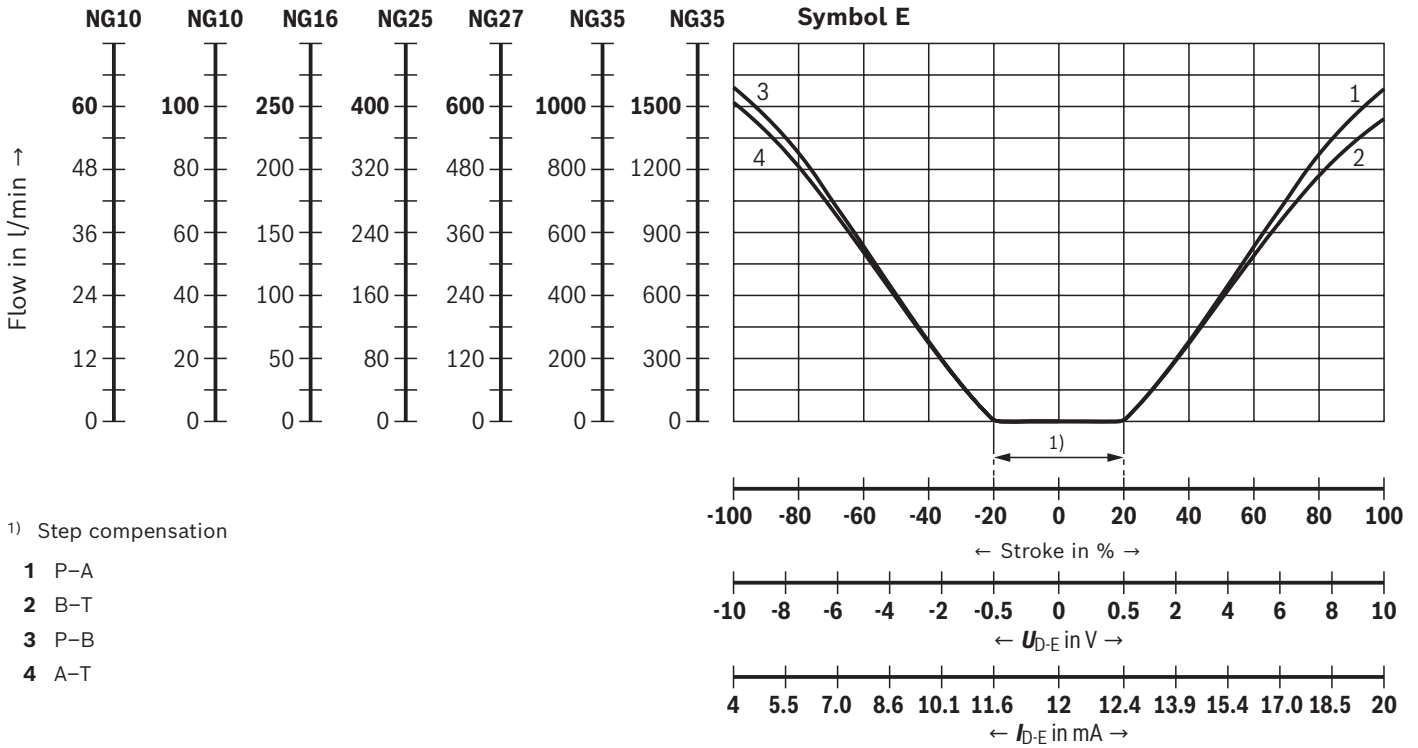
Notice:

- ▶ Electrical signals provided via control electronics (e.g. actual value) must not be used for switching off safety-relevant machine functions.
- ▶ The setting of the potentiometer at the factory must not be changed.

- 1) Position transducer, pilot control valve
- 2) Position transducer, main valve

Characteristic curves: Flow characteristic "L"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

Flow/signal function

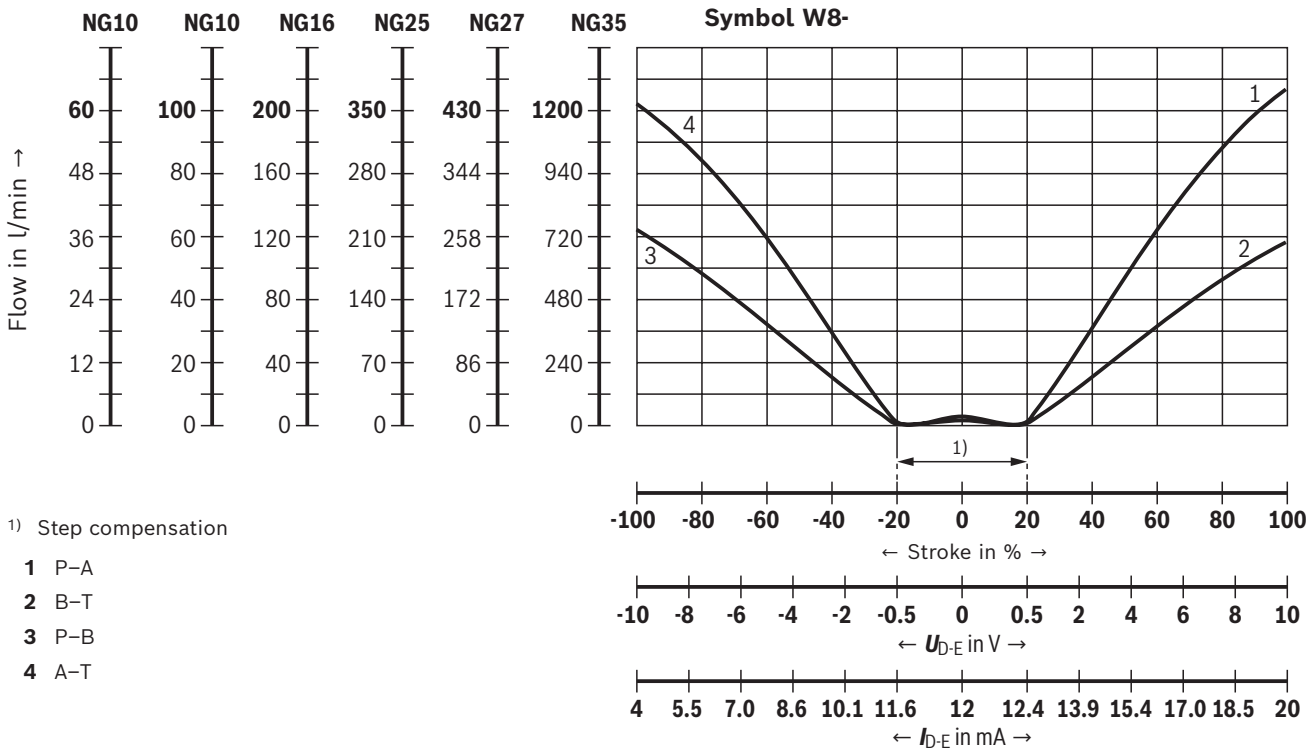
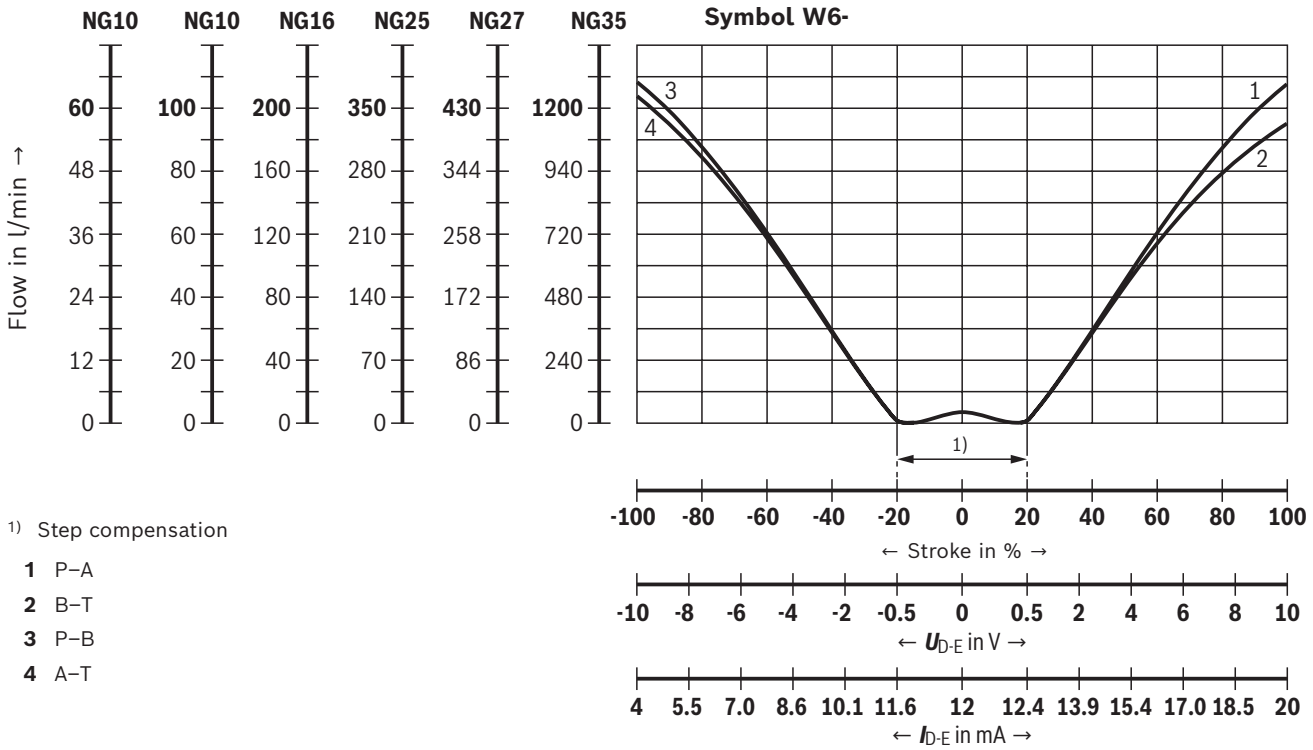


Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Flow characteristic "L"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

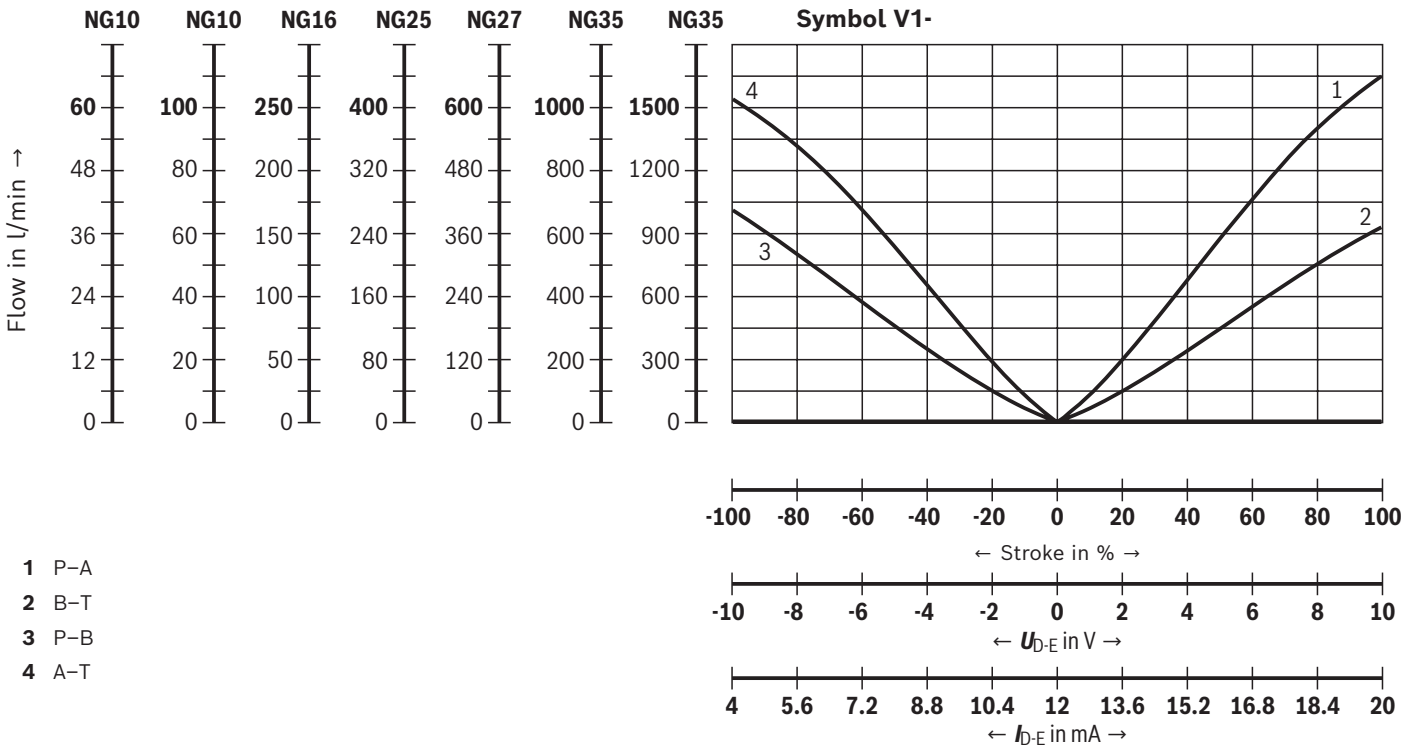
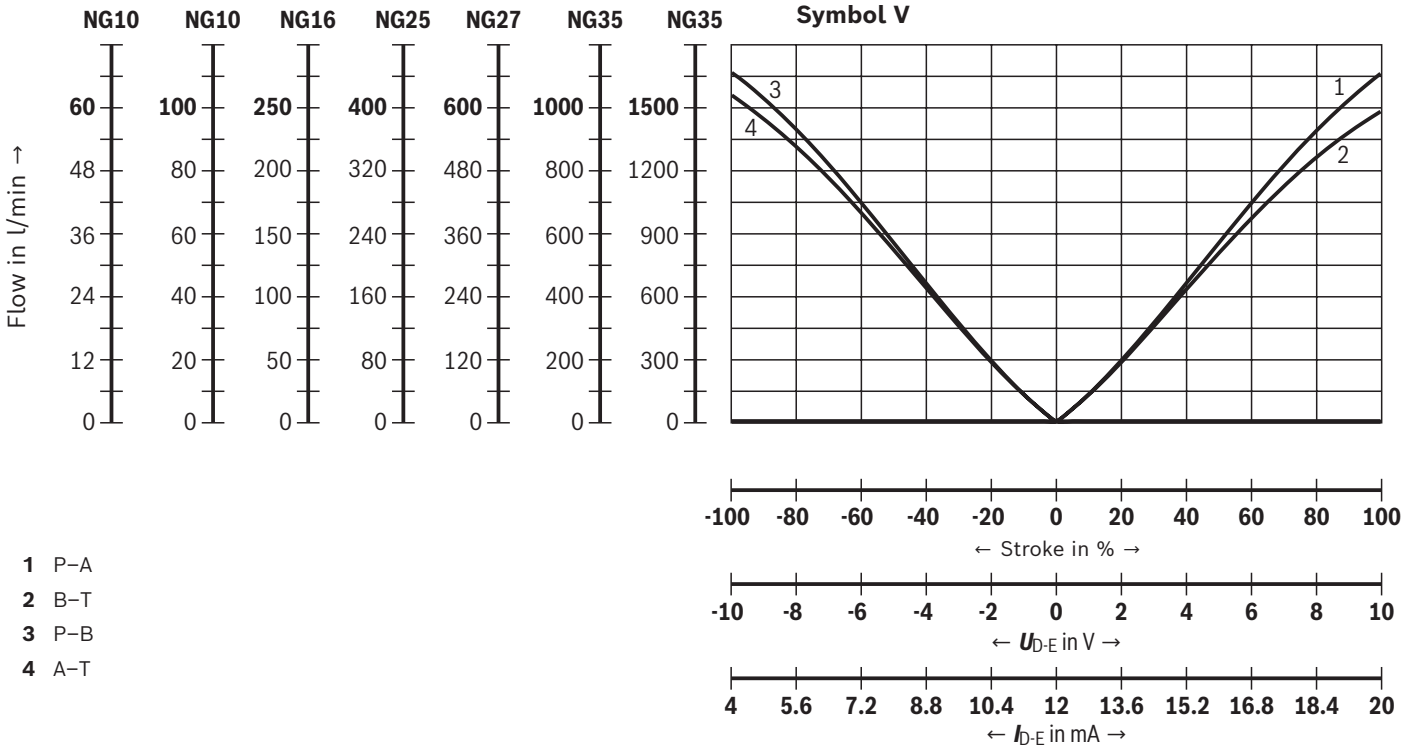
Flow/signal function



Notice:
 Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Flow characteristic "L"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

Flow/signal function

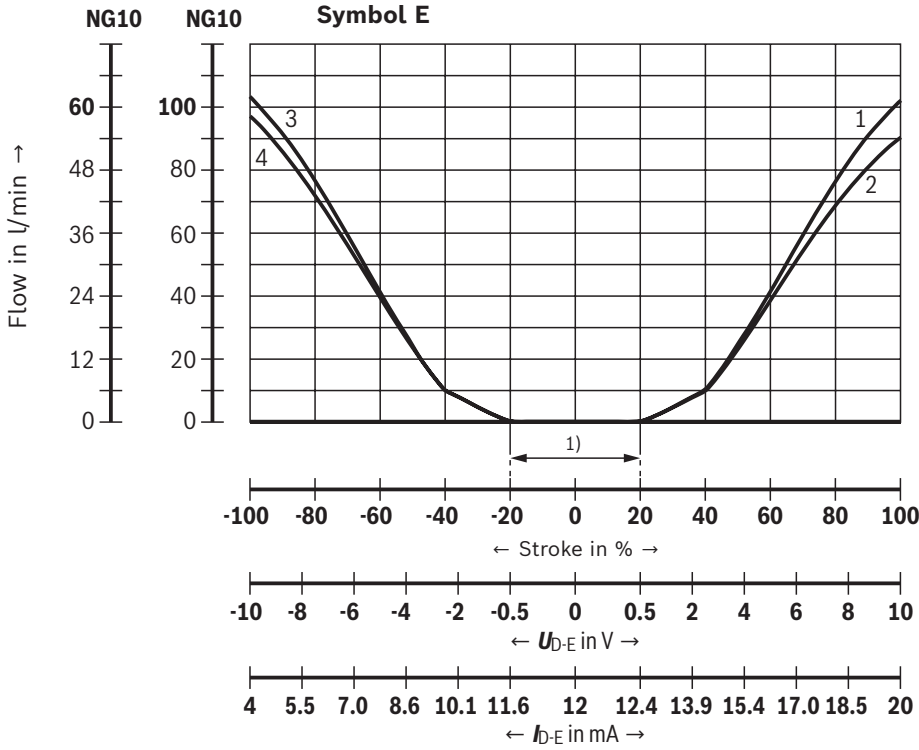


Notice:

Typical characteristic curves which are subject to tolerance variations.

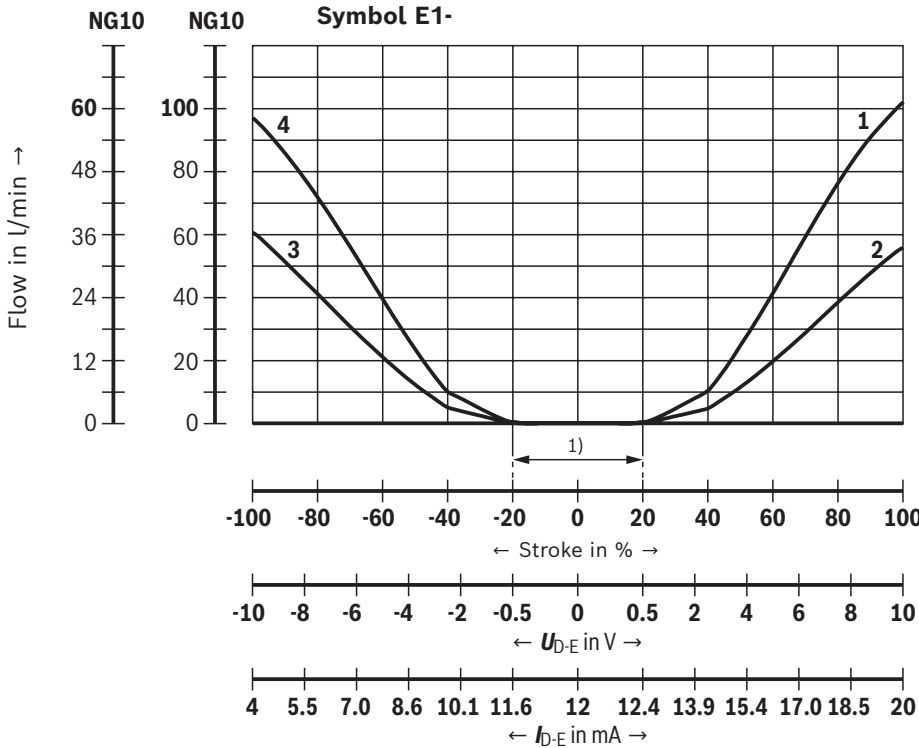
Characteristic curves: Flow characteristic "P"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

Flow/signal function



1) Step compensation

- 1 P-A
- 2 B-T
- 3 P-B
- 4 A-T



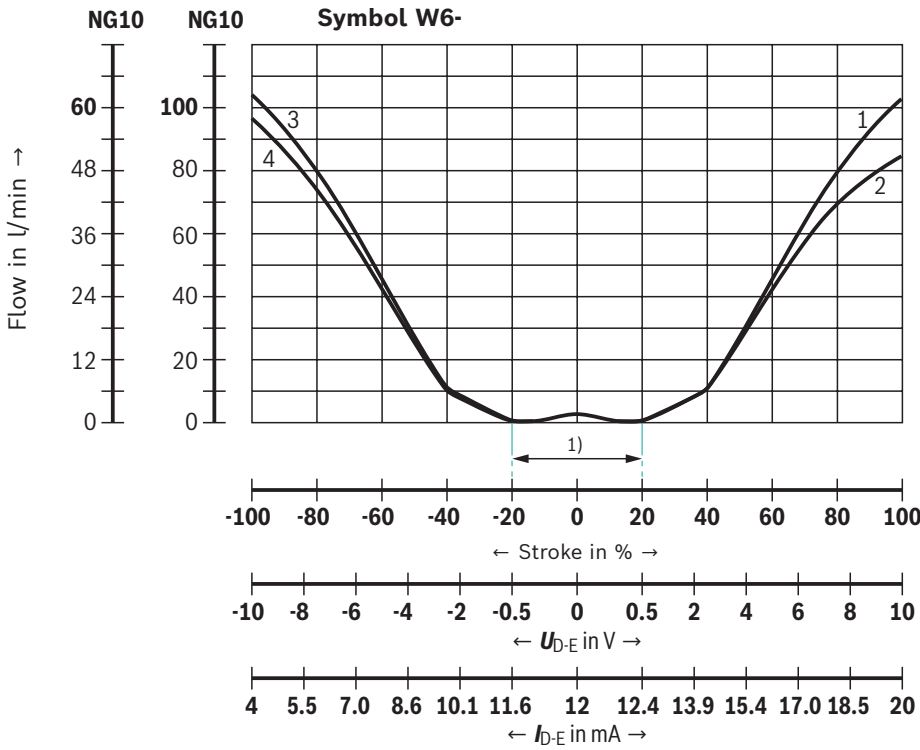
1) Step compensation

- 1 P-A
- 2 B-T
- 3 P-B
- 4 A-T

Notice:
 Typical characteristic curves which are subject to tolerance variations.

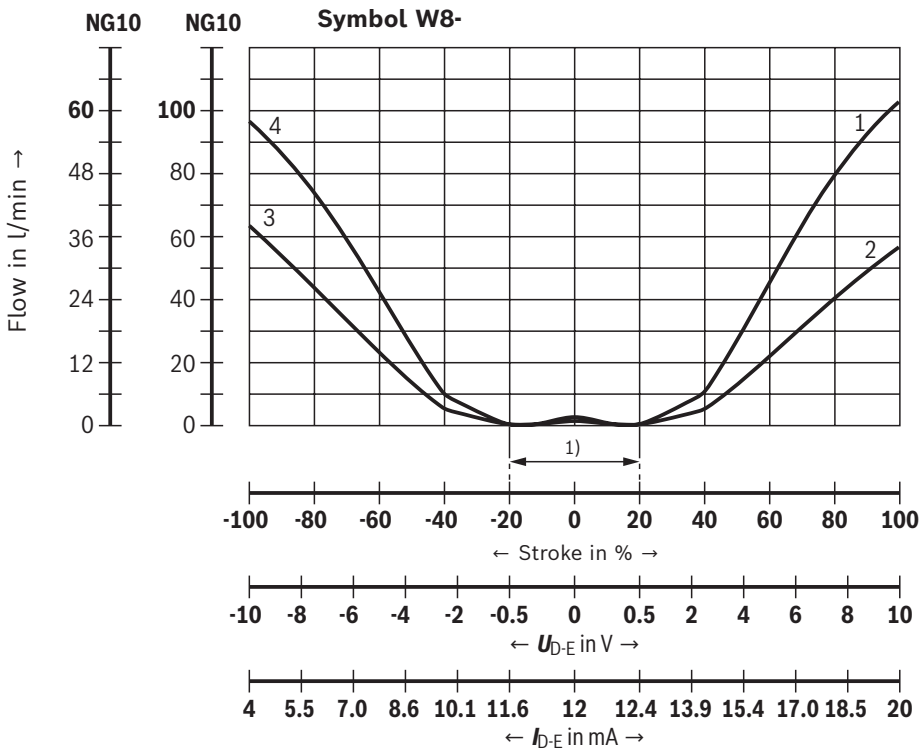
Characteristic curves: Flow characteristic "P"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

Flow/signal function



1) Step compensation

- 1 P-A
- 2 B-T
- 3 P-B
- 4 A-T



1) Step compensation

- 1 P-A
- 2 B-T
- 3 P-B
- 4 A-T

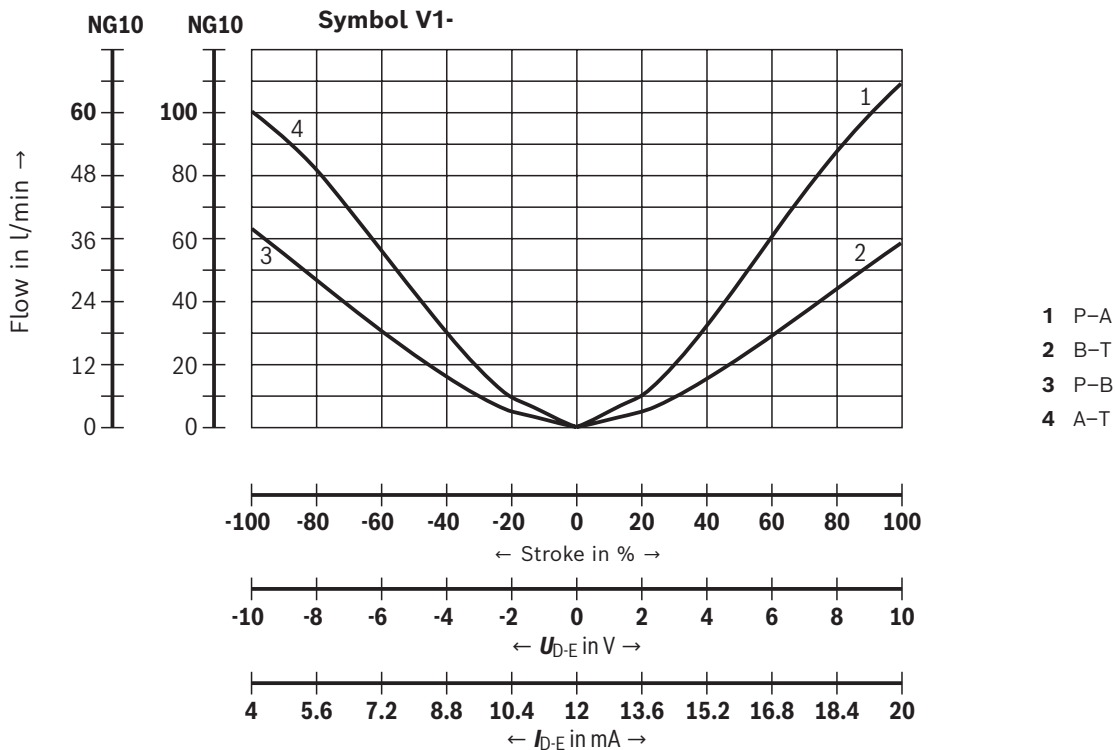
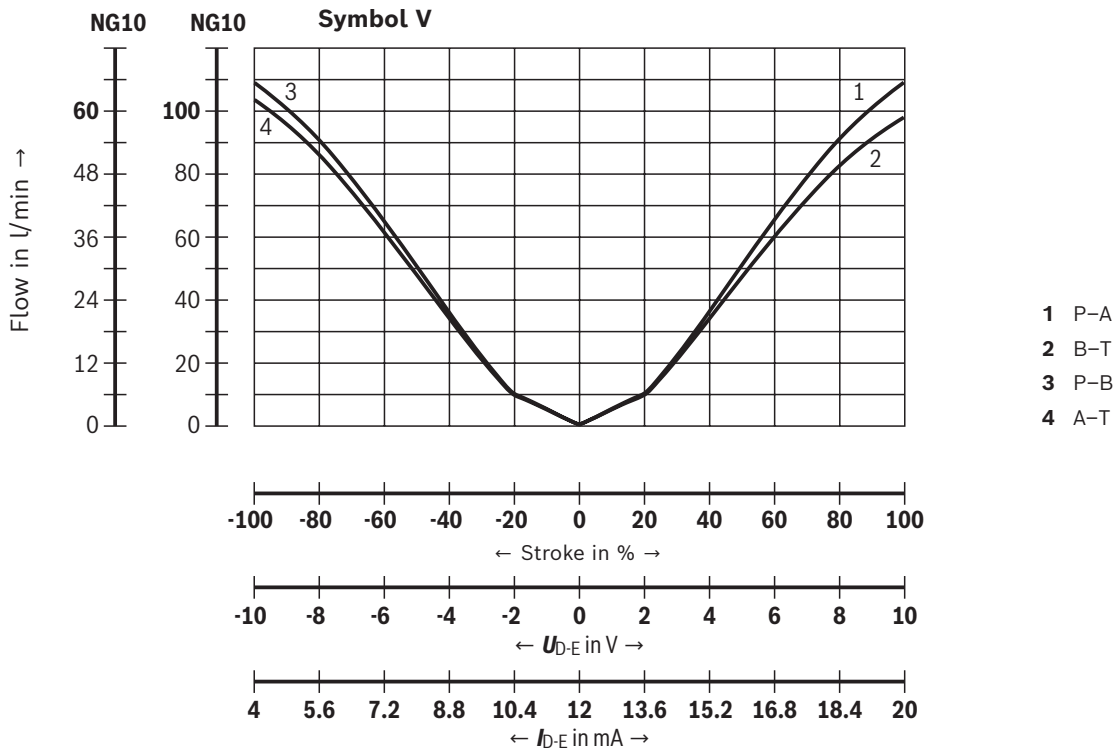


Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Flow characteristic "P"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

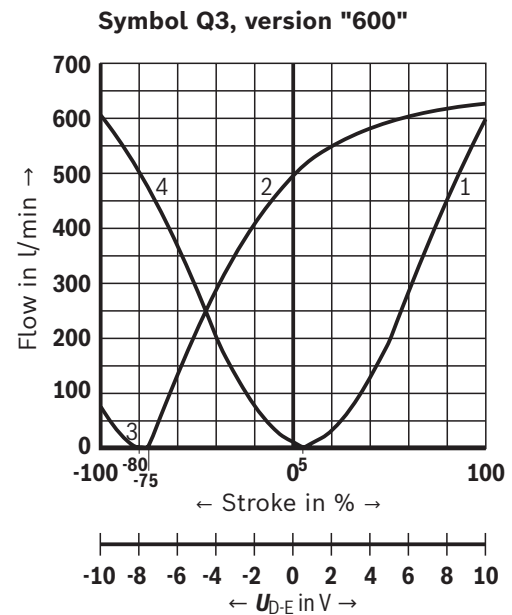
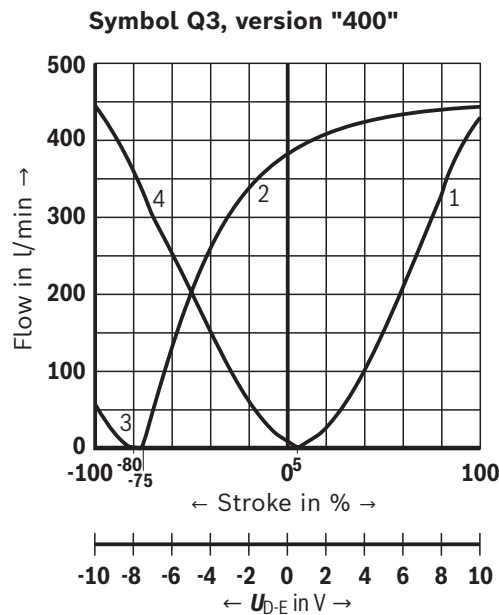
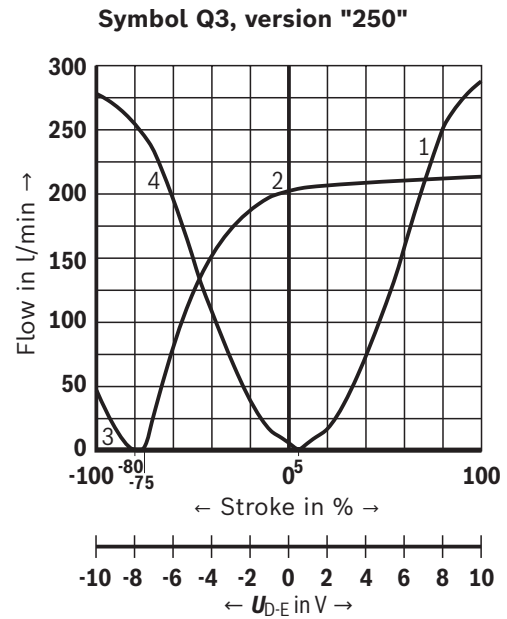
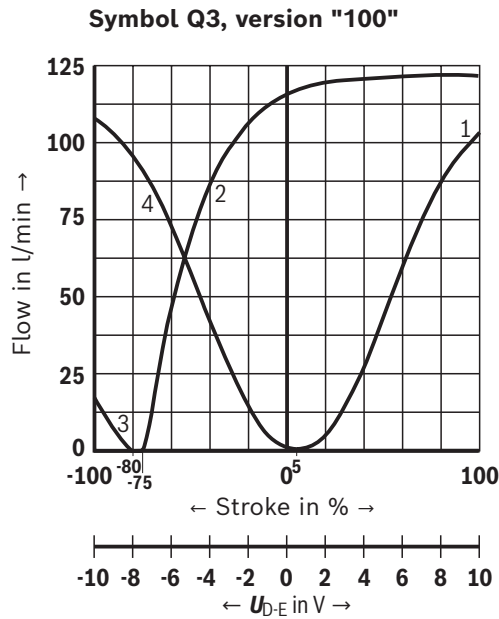
Flow/signal function



Notice:
 Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Flow characteristic "M"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

Flow/signal function

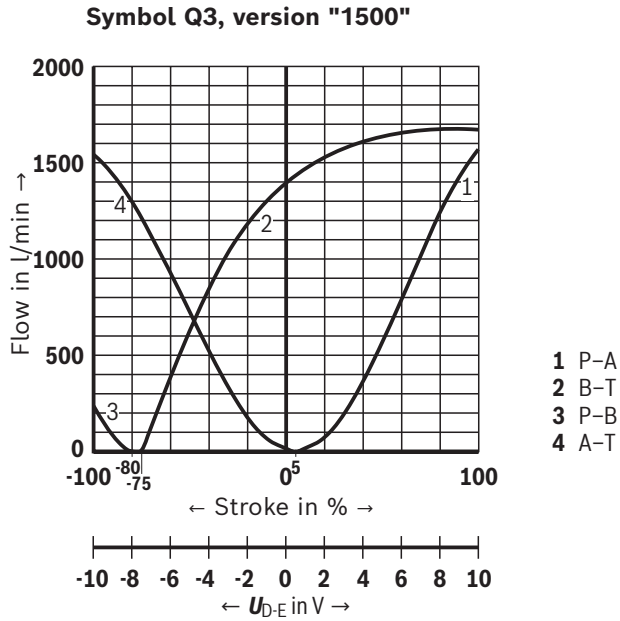


Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Flow characteristic "M"
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$; $\Delta p = 5 \text{ bar/control edge}$)

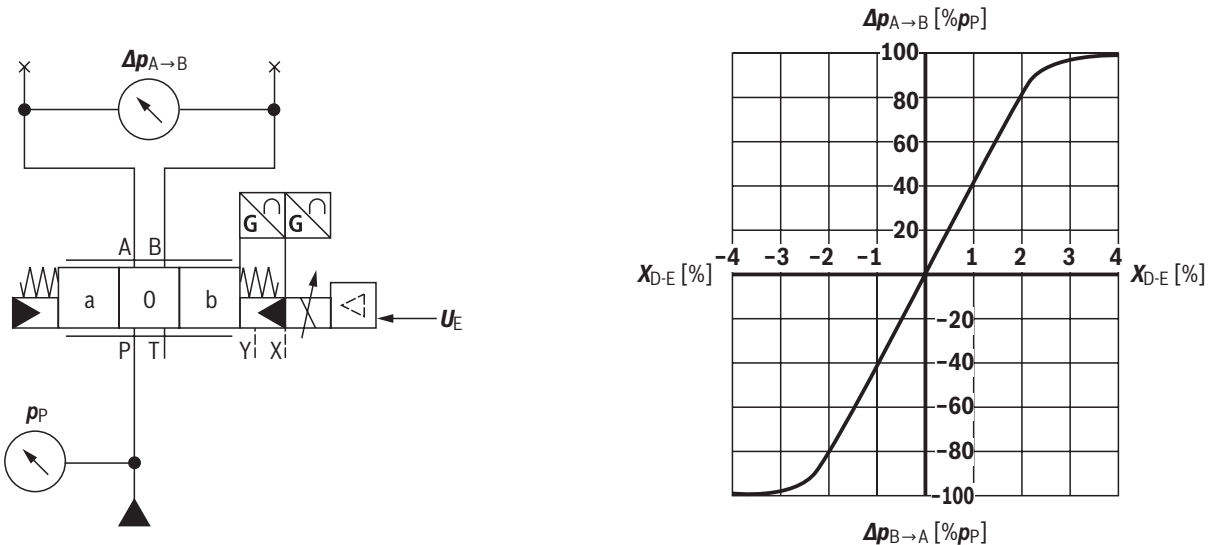
Flow/signal function



Notice:
 Typical characteristic curves which are subject to tolerance variations.

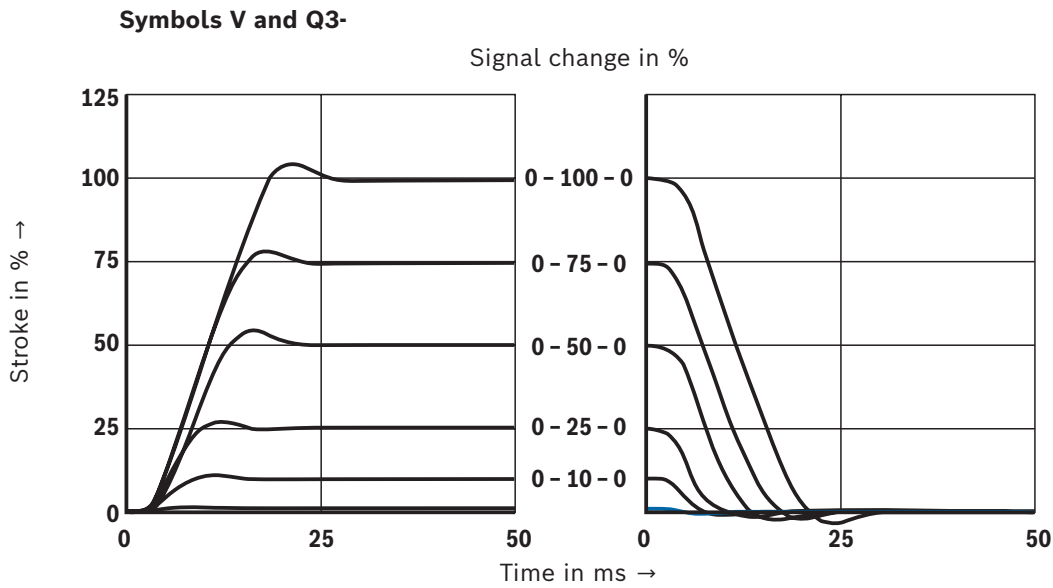
Characteristic curves
 (measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Pressure/signal characteristic curve

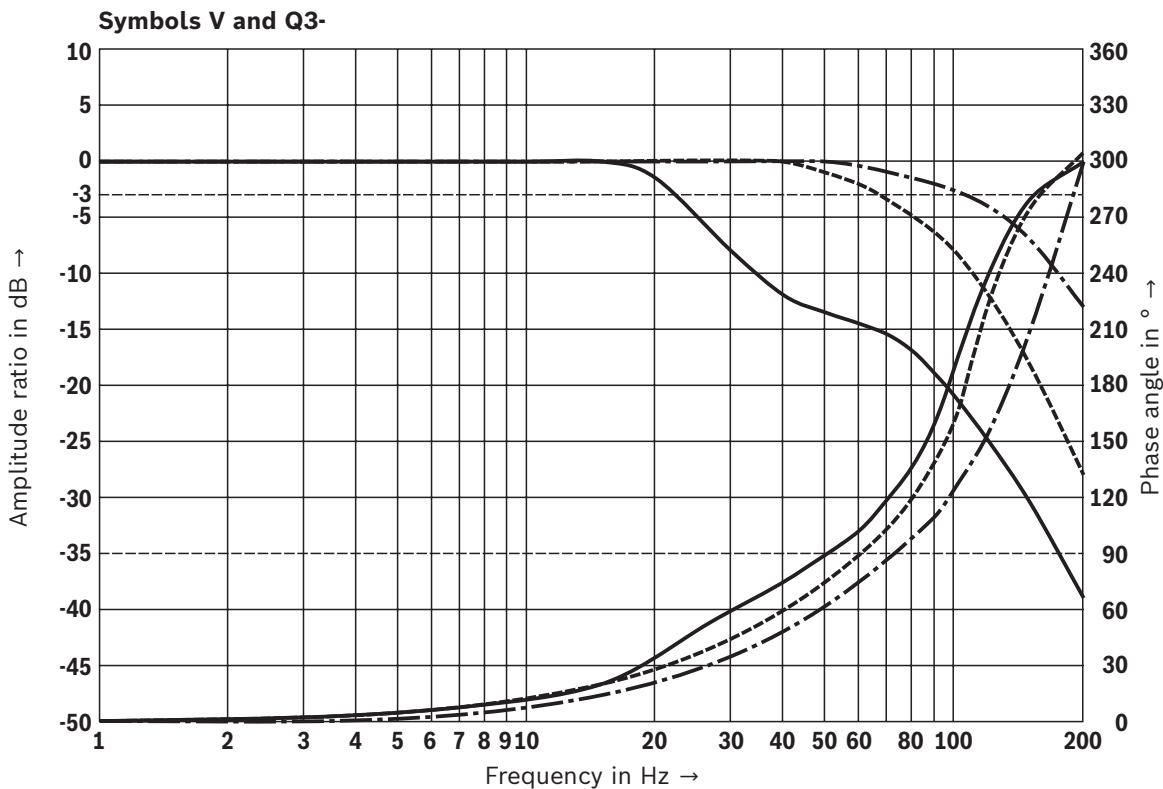


Characteristic curves: Size 10
 (measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Transition function with stepped electric input signals



Frequency response



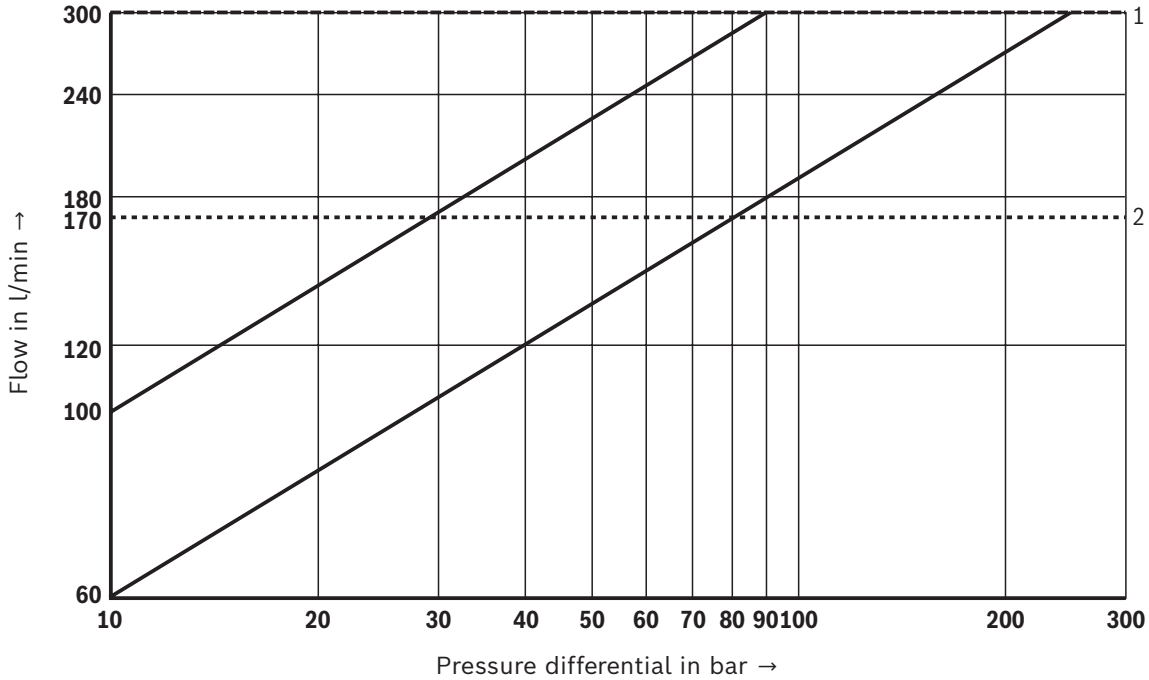
- Signal $\pm 5\%$
- Signal $\pm 25\%$
- Signal $\pm 100\%$

Notice:

- ▶ Typical characteristic curves which are subject to tolerance variations.
- ▶ Main valve, port P = 10 bar
- ▶ Pilot control valve, port X = 210 bar

Characteristic curves: Size 10
(valid for 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
(flow velocity 30 m/s)

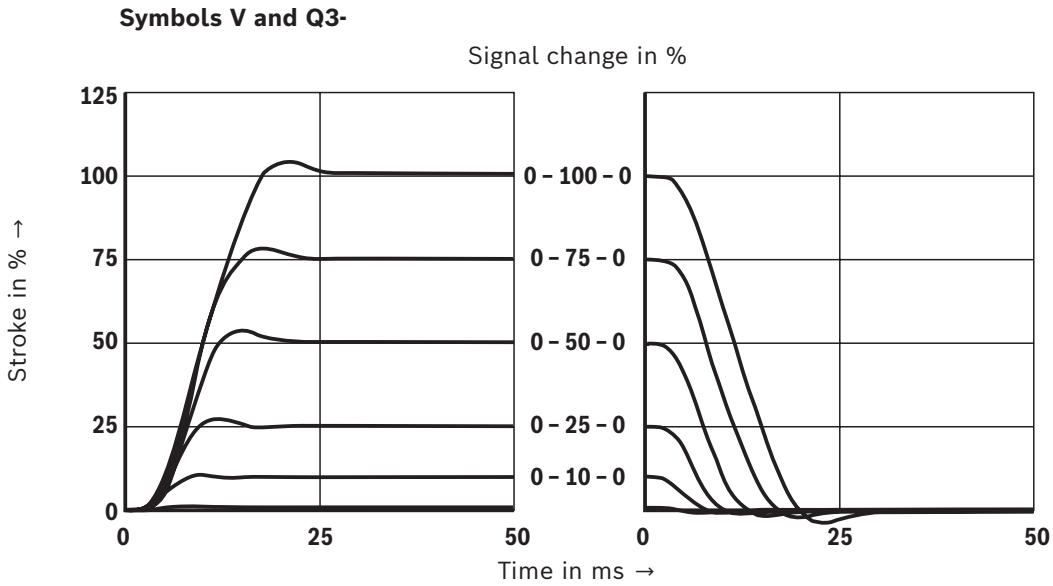


Notice:

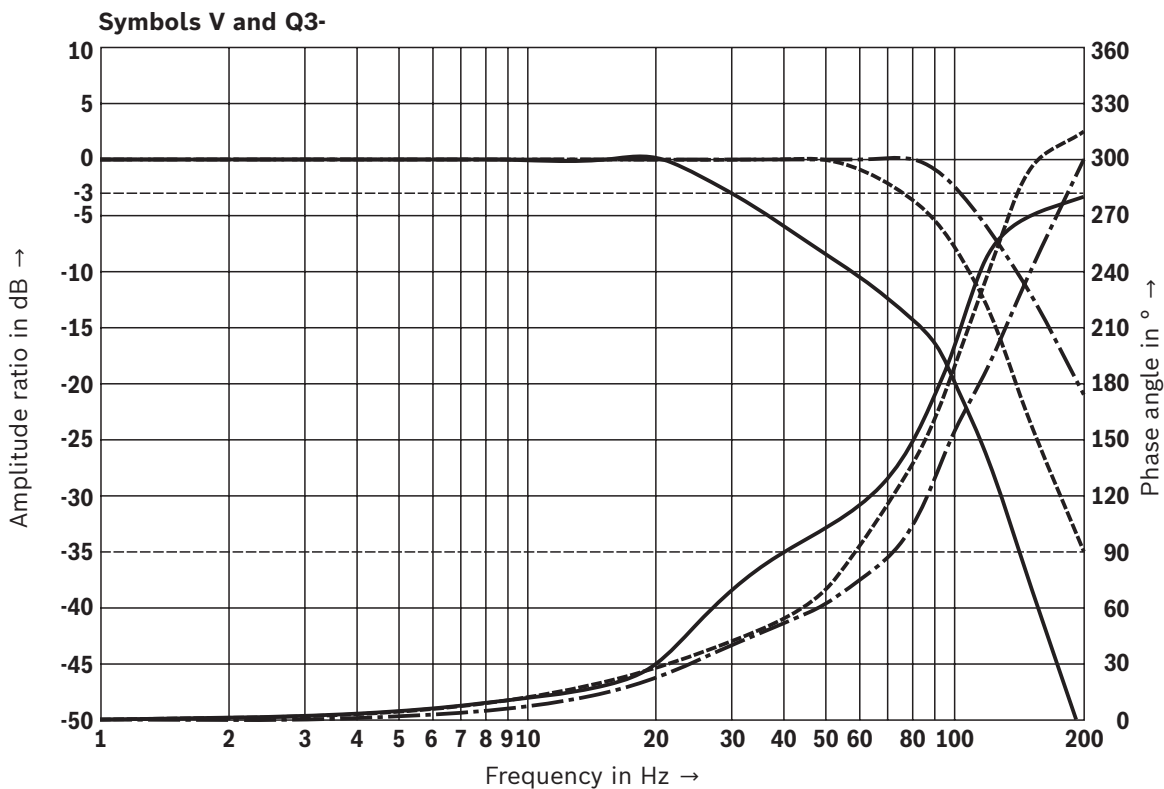
Typical characteristic curves which are subject to tolerance variations.

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



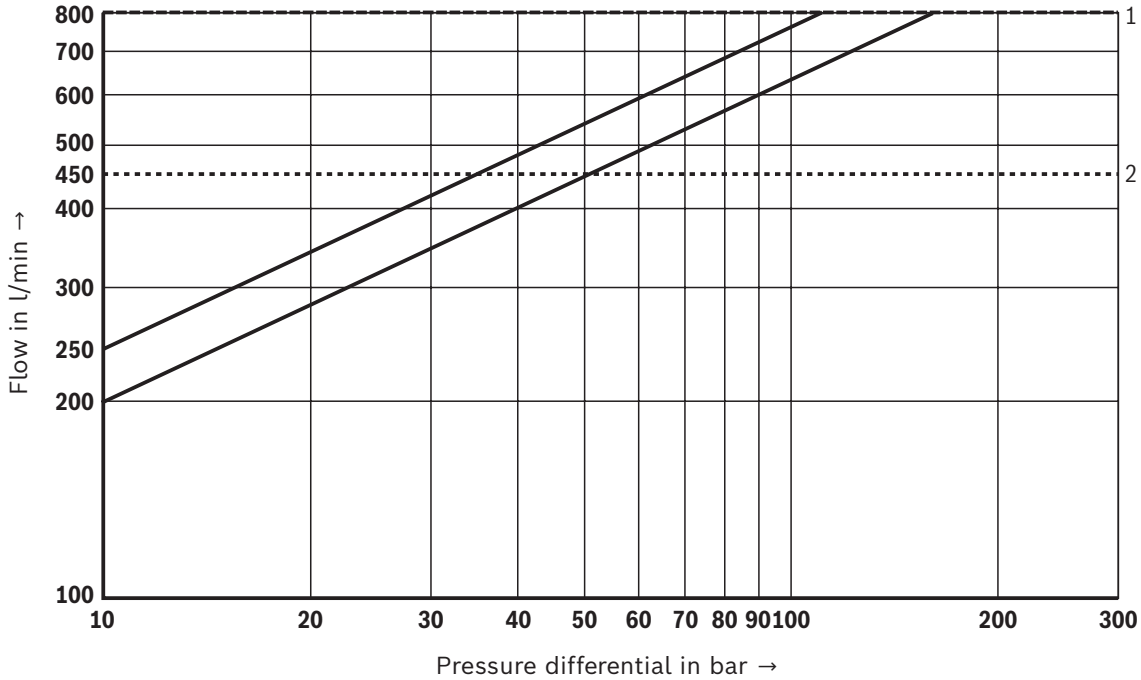
- Signal $\pm 5\%$
- - - Signal $\pm 25\%$
- Signal $\pm 100\%$

Notice:

- ▶ Typical characteristic curves which are subject to tolerance variations.
- ▶ Main valve, port P = 10 bar
- ▶ Pilot control valve, port X = 210 bar

Characteristic curves: Size 16
(valid for 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
(flow velocity 30 m/s)

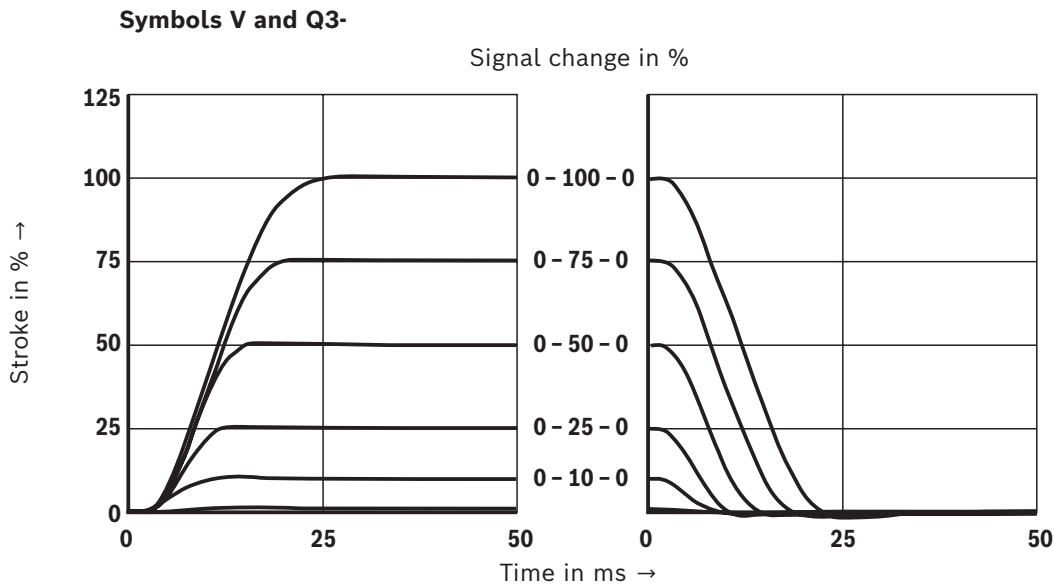


Notice:

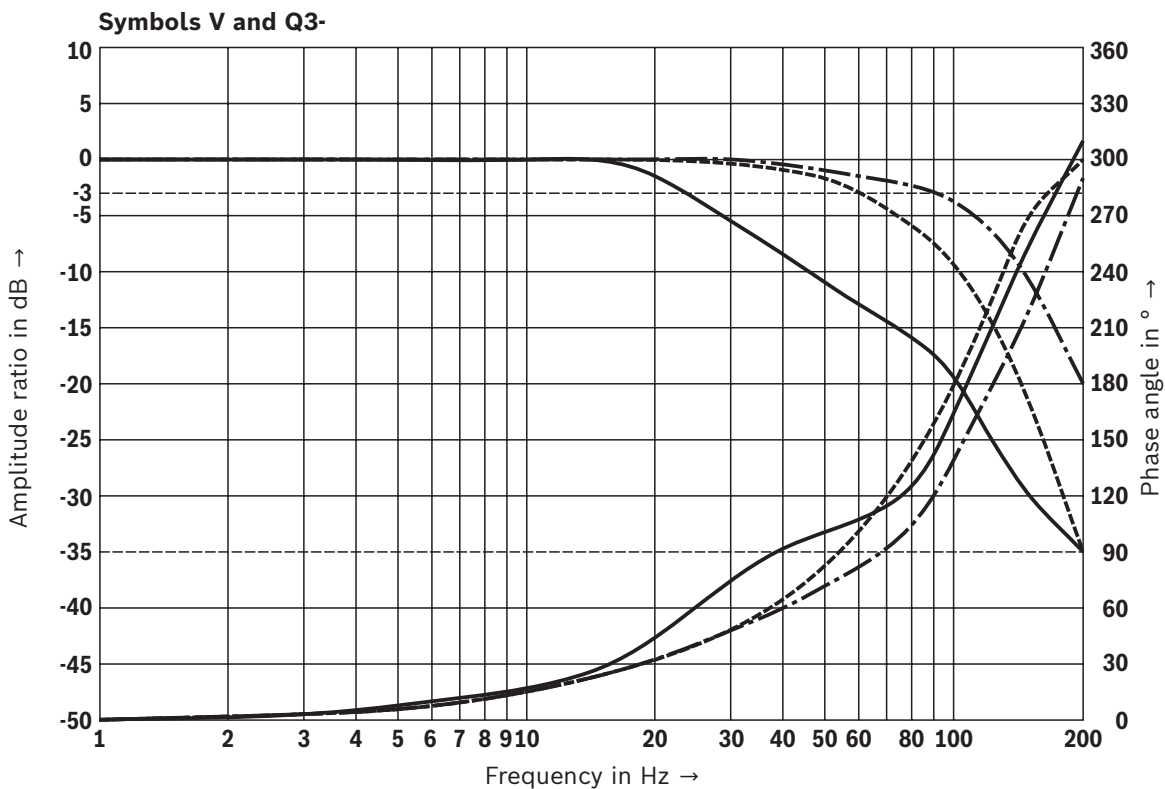
Typical characteristic curves which are subject to tolerance variations.

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



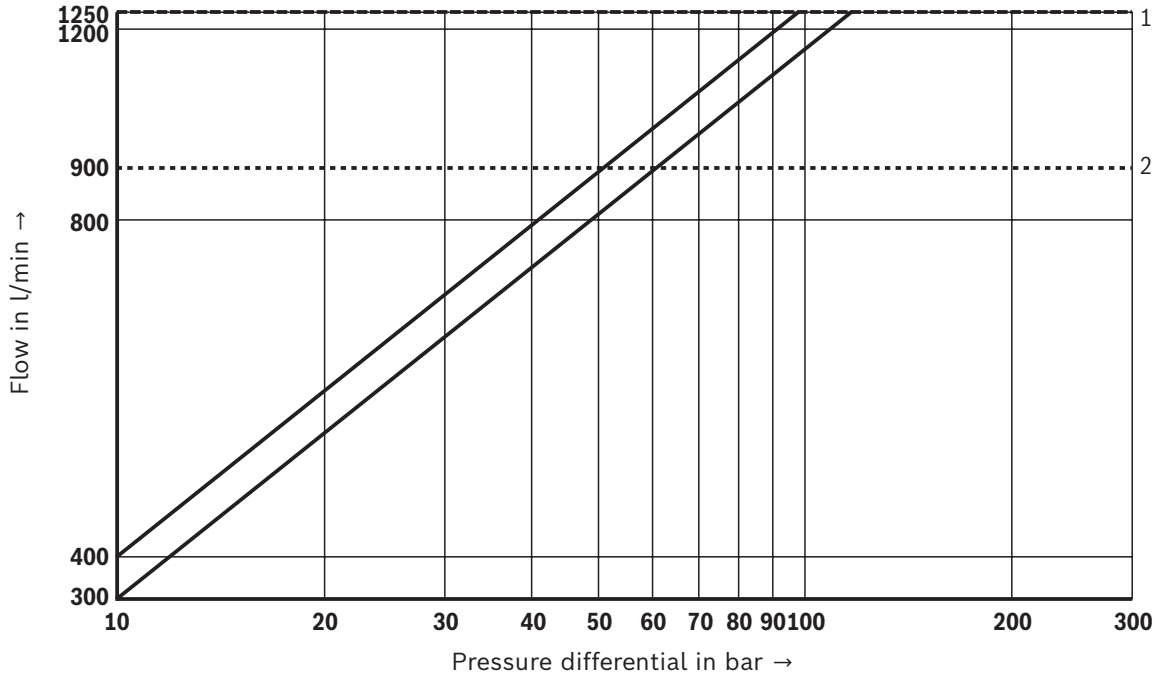
- · — · Signal ±5%
- - - - Signal ±25%
- Signal ±100%

Notice:

- ▶ Typical characteristic curves which are subject to tolerance variations.
- ▶ Main valve, port P = 10 bar
- ▶ Pilot control valve, port X = 210 bar

Characteristic curves: Size 25
(valid for 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
(flow velocity 30 m/s)

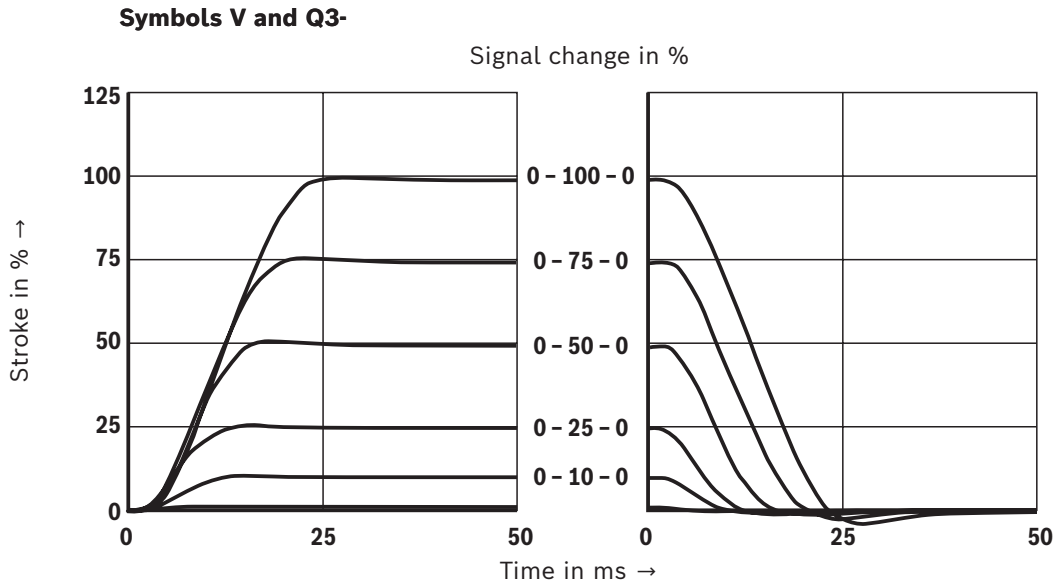


Notice:

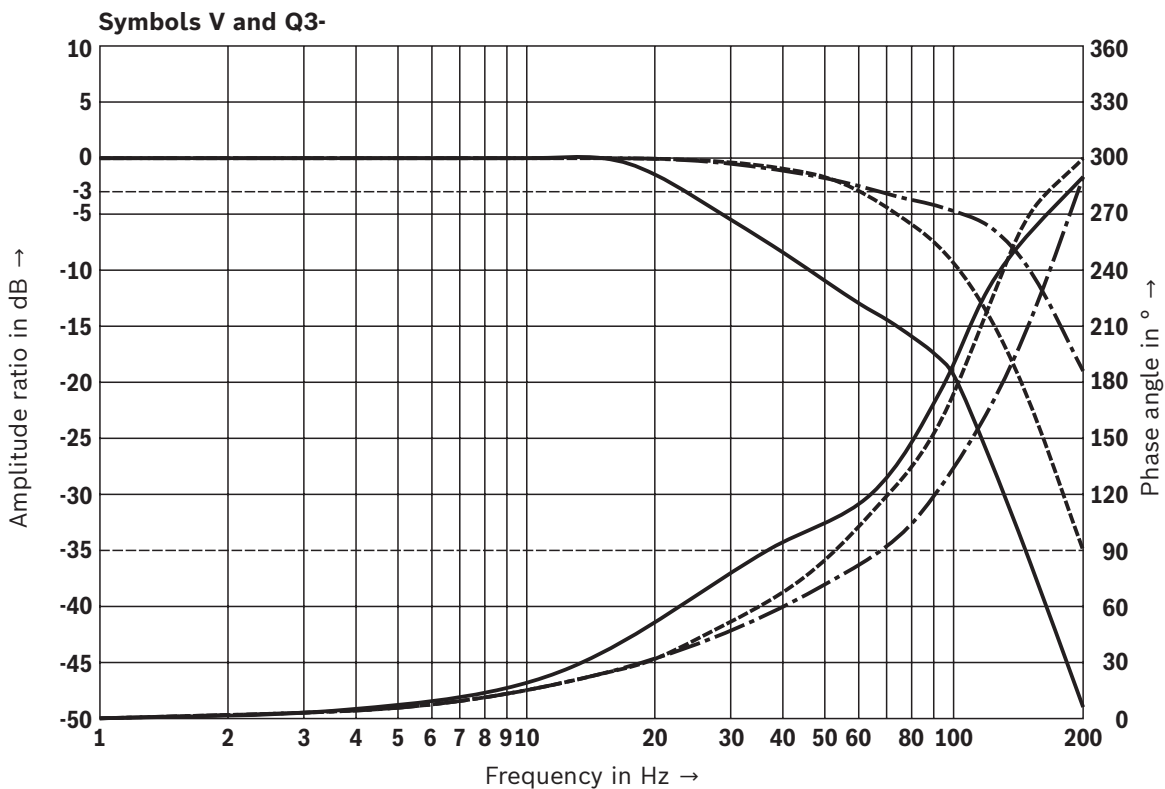
Typical characteristic curves which are subject to tolerance variations.

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



- Signal $\pm 5\%$
- - - Signal $\pm 25\%$
- Signal $\pm 100\%$

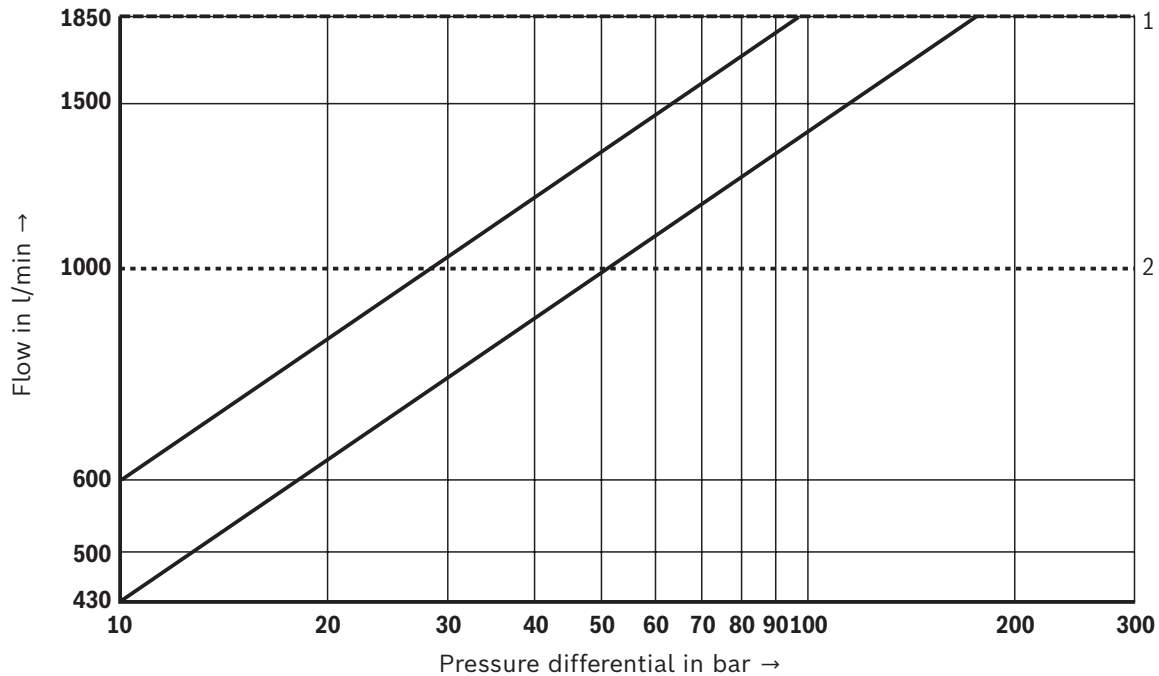


Notice:

- ▶ Typical characteristic curves which are subject to tolerance variations.
- ▶ Main valve, port P = 10 bar
- ▶ Pilot control valve, port X = 210 bar

Characteristic curves: Size 27
(valid for 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
(flow velocity 30 m/s)

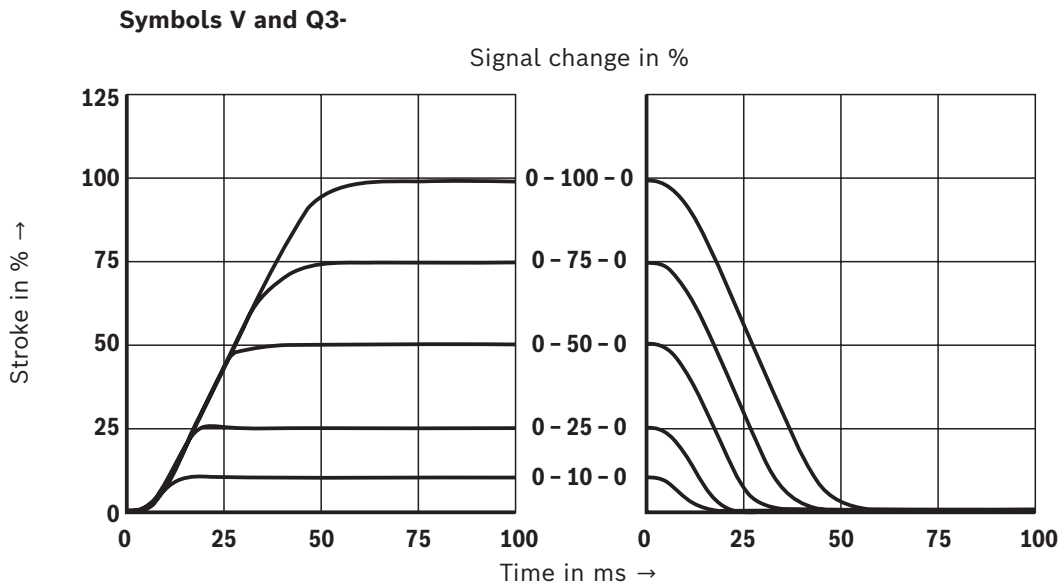


Notice:

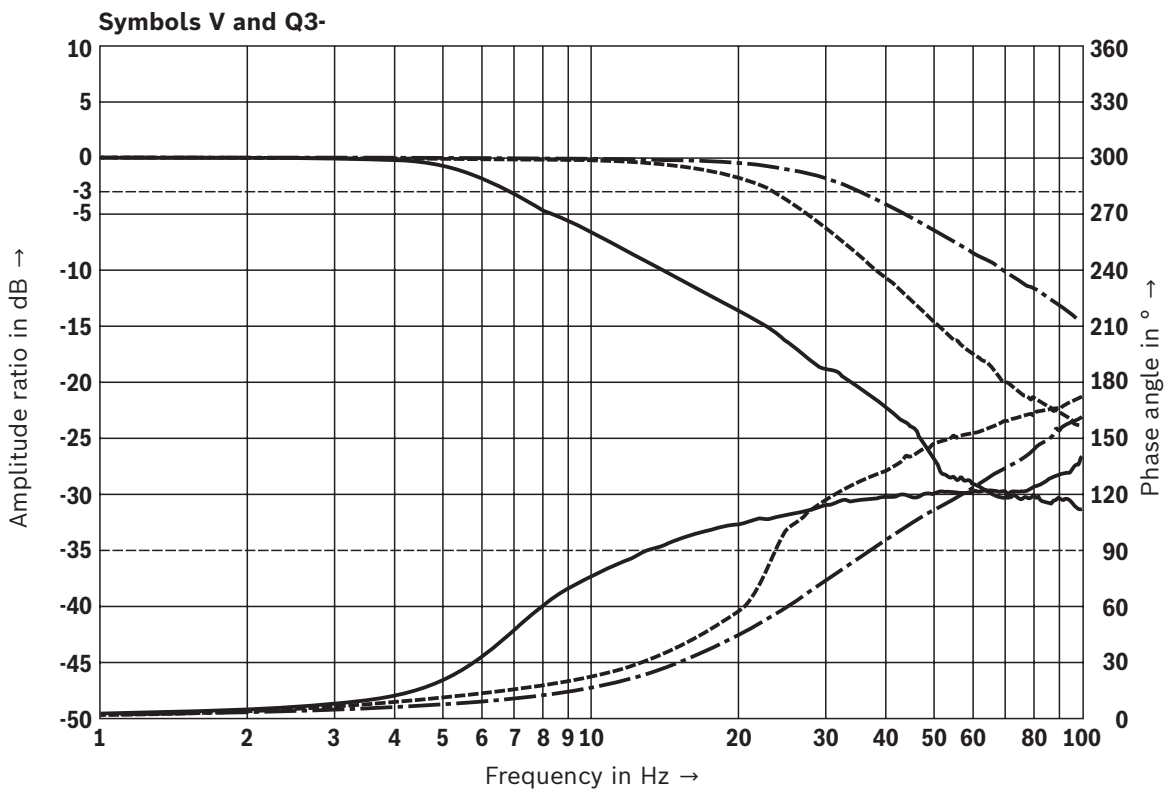
Typical characteristic curves which are subject to tolerance variations.

Characteristic curves: Size 35
 (measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Transition function with stepped electric input signals



Frequency response



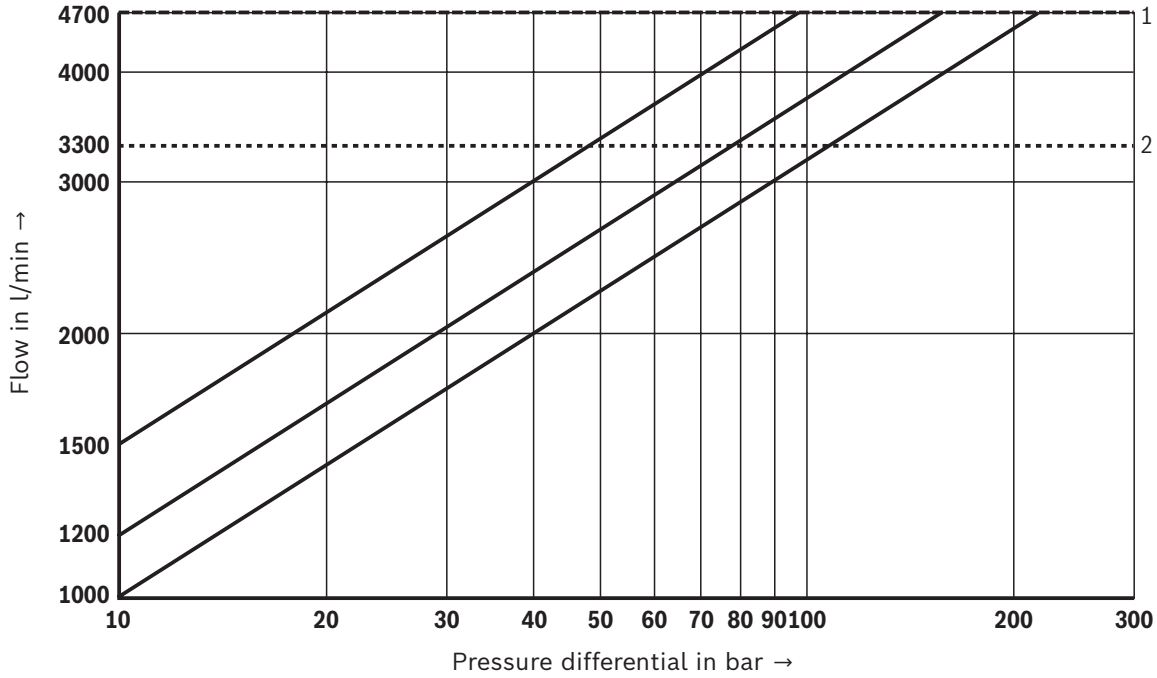
- Signal $\pm 5\%$
- - - Signal $\pm 25\%$
- Signal $\pm 100\%$

Notice:

- ▶ Typical characteristic curves which are subject to tolerance variations.
- ▶ Main valve, port P = 10 bar
- ▶ Pilot control valve, port X = 210 bar

Characteristic curves: Size 35
 (valid for HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ } ^\circ\text{C}$)

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



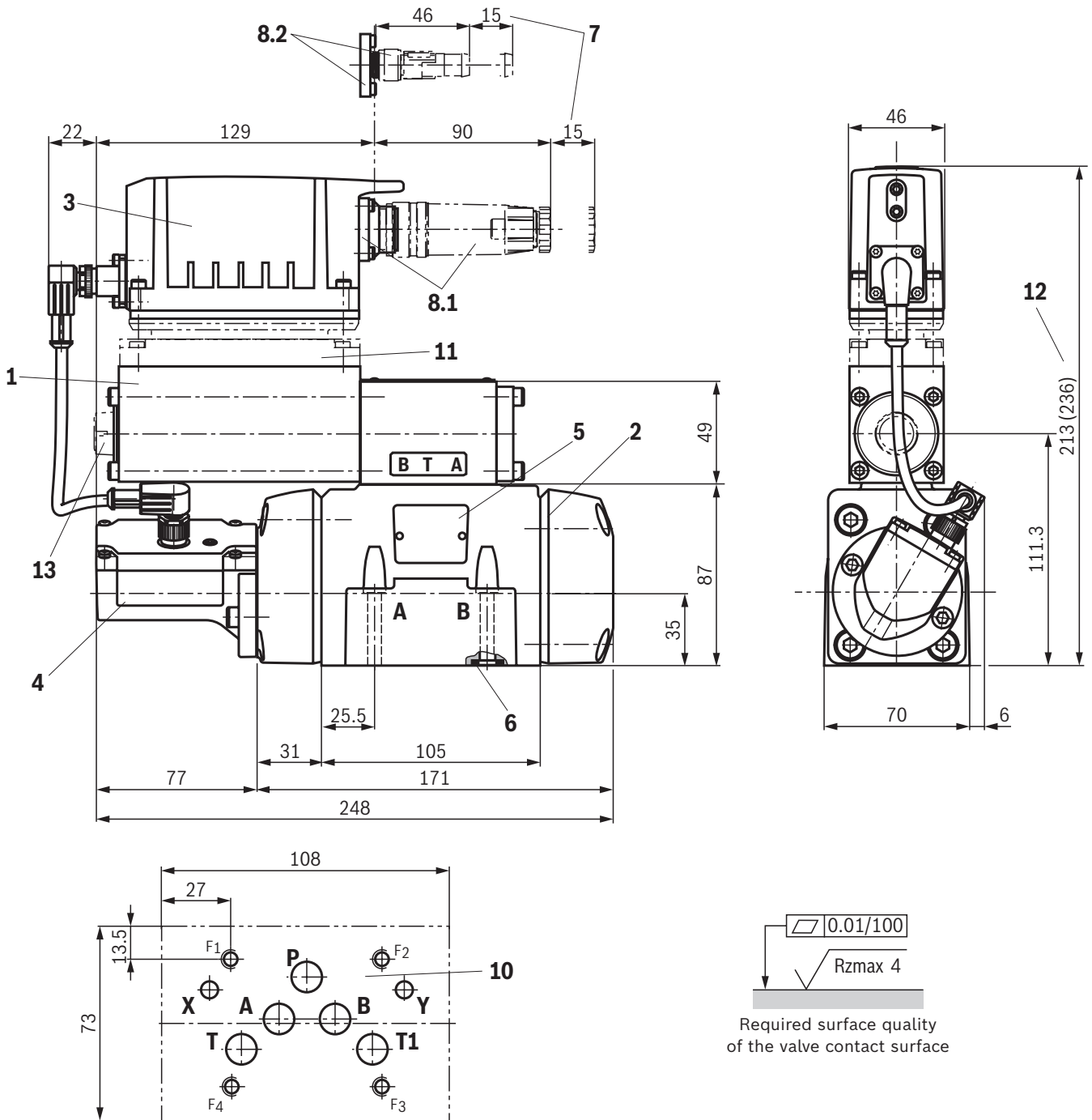
- 1 Maximum admissible flow
- 2 Recommended flow
(flow velocity 30 m/s)



Notice:

Typical characteristic curves which are subject to tolerance variations.

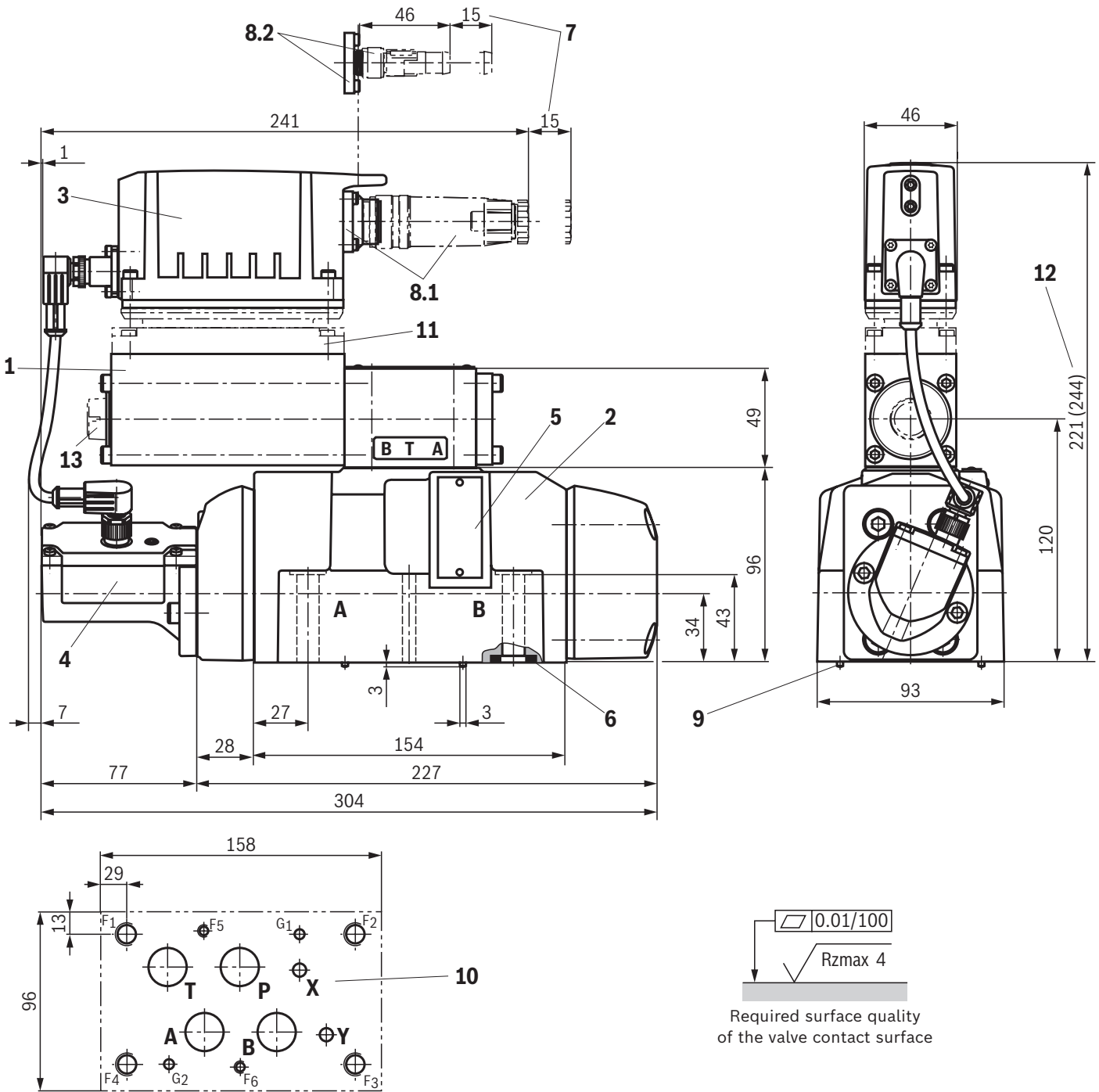
Dimensions: Size 10
(dimensions in mm)



Item explanations, see page 39. Valve mounting screws and subplates, see page 40.

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

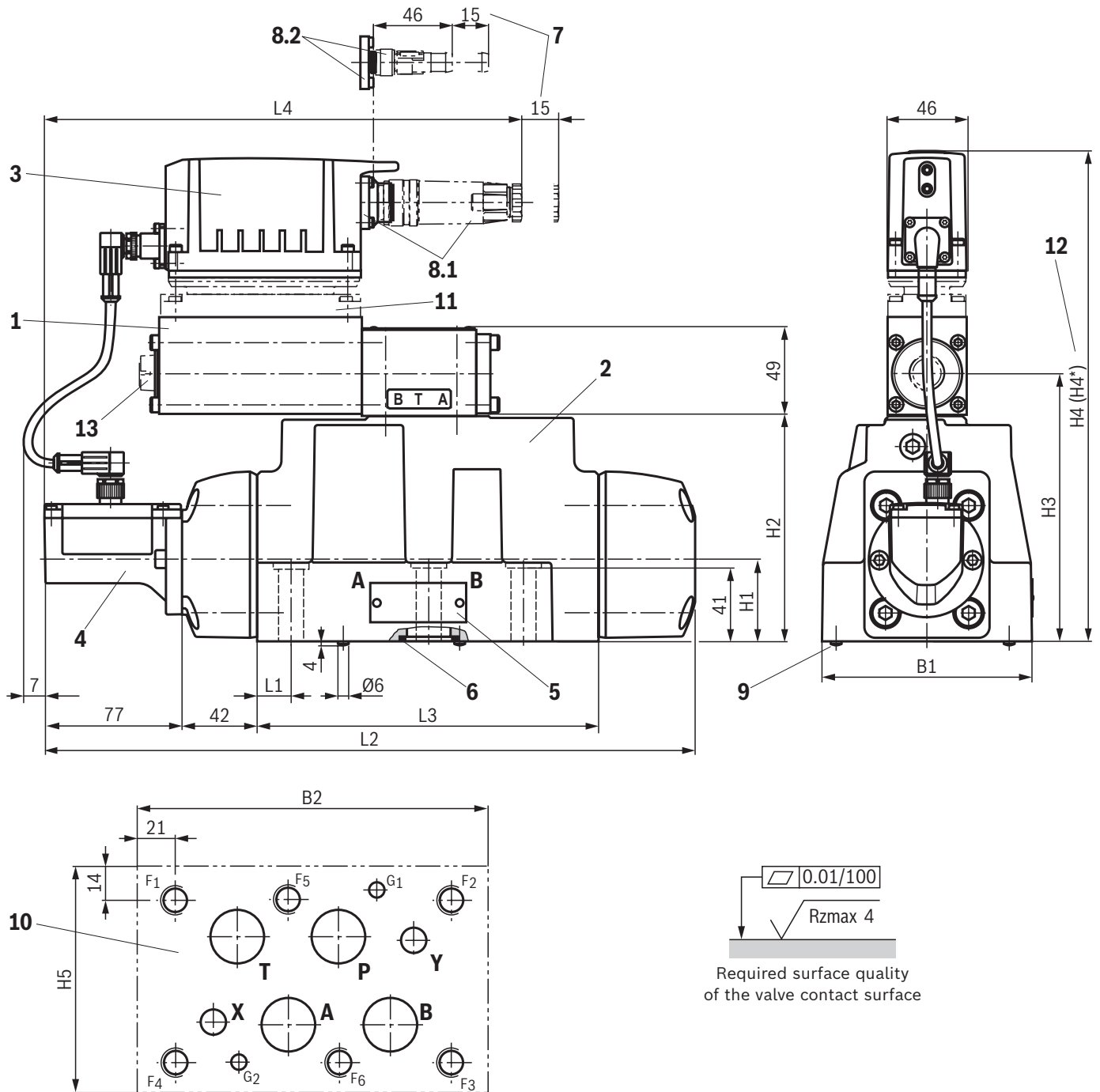
Dimensions: Size 16
(dimensions in mm)



Item explanations, see page 39. **Valve mounting screws** and **subplates**, see page 40.

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

Dimensions: Sizes 25 and 27
(dimensions in mm)



NG	L1	L2	L3	L4	H1	H2	H3	H4	H4*	H5	B1	B2
25	19	364	191	274	46	126	150	251	274	120	118	195
27	20.5	371	198	277	50	140	164	265	288	124	120	200

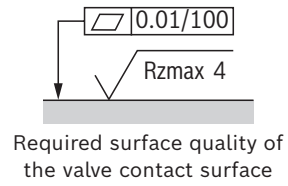
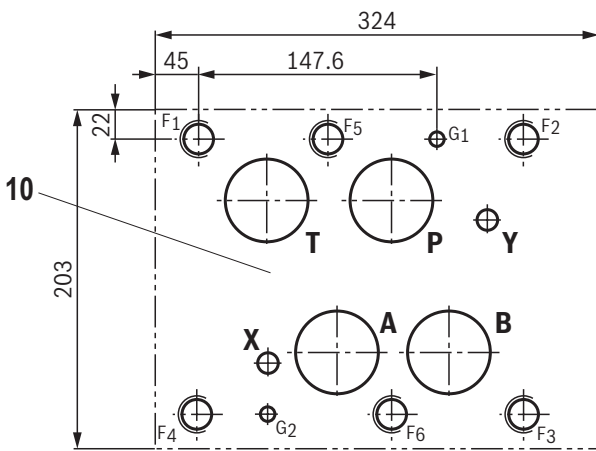
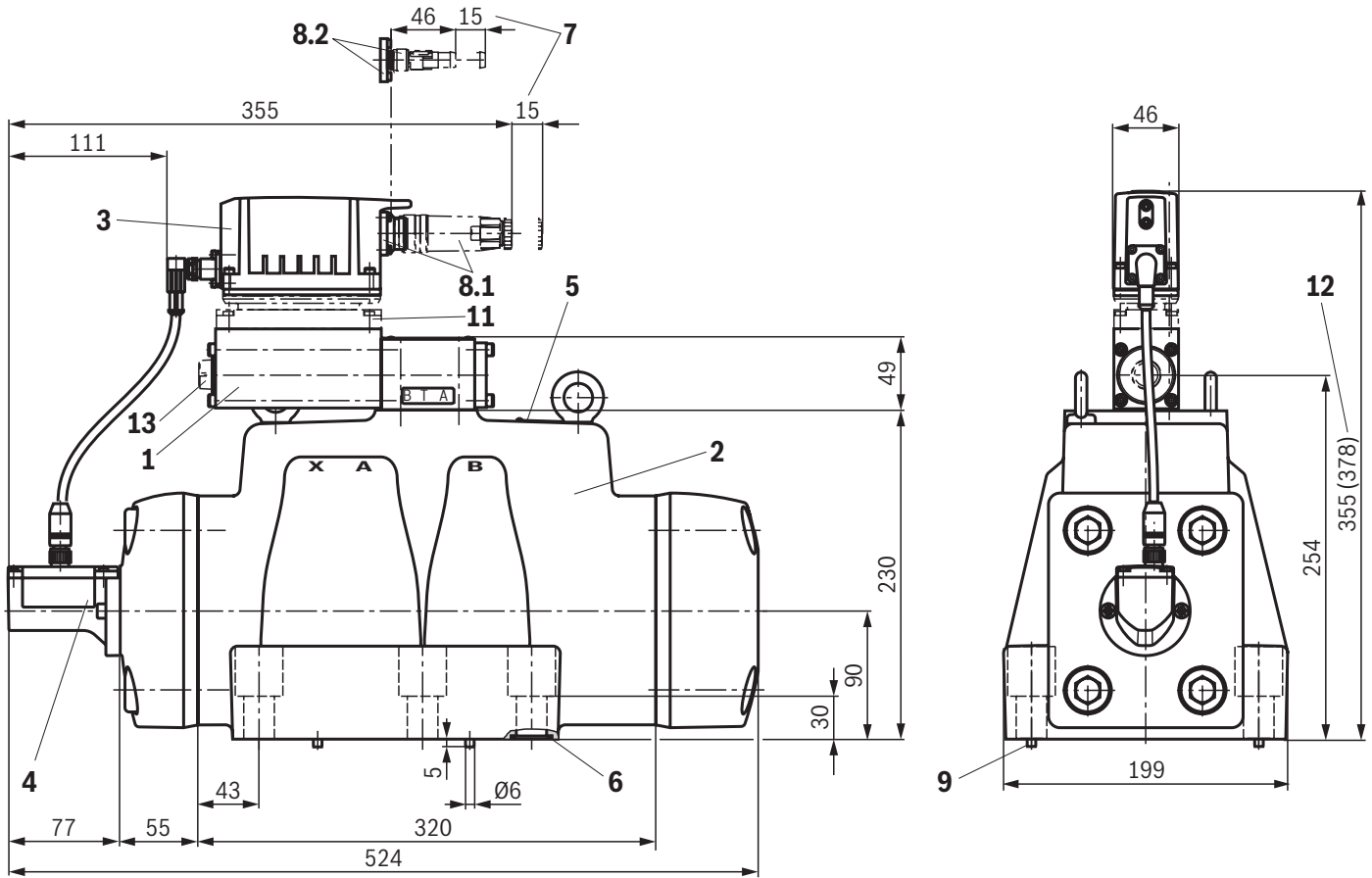
Item explanations, see page 39. **Valve mounting screws** and **subplates**, see page 40.



Notice:

The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Size 35
(dimensions in mm)



Item explanations, see page 39. **Valve mounting screws** and **subplates**, see page 40.



Notice:

The dimensions are nominal dimensions which are subject to tolerances.

Dimensions

- 1 Pilot control valve
- 2 Main valve
- 3 Integrated electronics (OBE)
- 4 Inductive position transducer (main valve)
- 5 Name plate
- 6 Identical seal rings for ports P, A, B, T
Identical seal rings for ports X, Y
- 7 Space required for removing the mating connector
- 8.1 Mating connectors for version "A1", "F1" and "C6",
separate order, see page 41 and data sheet 08006.
- 8.2 Mating connectors for version "L1", separate order,
see page 41 and data sheet 08006.
- 9 Positioning pin
- 10 Machined valve contact surface
 - ▶ Size 10:
Porting pattern according to ISO 4401-05-05-0-05
 - ▶ Size 16:
Porting pattern according to ISO 4401-07-07-0-05
Deviating from the standard:
Ports P, A, B, T – Ø20 mm
 - ▶ Size 25 and 27:
Porting pattern according to ISO 4401-08-08-0-05
Deviating from the standard:
NG27: Ports P, A, B, T – Ø32 mm
 - ▶ Size 35:
Porting pattern according to ISO 4401-10-09-0-05
Deviating from the standard:
Ports P, A, B, T – Ø50 mm
1)Position G1 according to DIN 24340 Form A
- 11 Damping plate "D"
- 12 Dimension in () for version with damping plate "D"
- 13 Electronics protection membrane "-967"

Dimensions

Valve mounting screws (separate order)

Size	Quantity	Hexagon socket head cap screws	Material number
10	4	ISO 4762 - M6 x 45 - 10.9-CM-Fe-ZnNi-5-Cn-T0-H-B Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 13.5 \text{ Nm} \pm 10\%$	R913043777
	or		
	4	ISO 4762 - M6 x 45 - 10.9 Friction coefficient $\mu_{\text{total}} = 0.12 \dots 0.17$; tightening torque $M_A = 15.5 \text{ Nm} \pm 10\%$	Not included in the Rexroth delivery range
	or		
	4	ASME B18.3 - 1/4-20 UNC x 1 3/4" - ASTM-A574 Tightening torque $M_A = 15 \text{ Nm} [11 \text{ ft-lbs}] \pm 10\%$	Not included in the Rexroth delivery range
16	2	ISO 4762 - M6 x 60 - 10.9-CM-Fe-ZnNi-5-Cn-T0-H-B Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 12.2 \text{ Nm} \pm 10\%$	R913043410
	4	ISO 4762 - M10 x 60 - 10.9-fZn/nc/480h/C Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 58 \text{ Nm} \pm 20\%$	R913014770
	or		
	2	ISO 4762 - M6 x 60 - 10.9 Friction coefficient $\mu_{\text{total}} = 0.12 \dots 0.17$; tightening torque $M_A = 15.5 \text{ Nm} \pm 10\%$	Not included in the Rexroth delivery range
	4	ISO 4762 - M10 x 60 - 10.9 Friction coefficient $\mu_{\text{total}} = 0.12 \dots 0.17$; tightening torque $M_A = 75 \text{ Nm} \pm 10\%$	
	or		
	2	ASME B18.3 - 1/4-20 UNC x 2 1/4" - ASTM-A574 Tightening torque $M_A = 15 \text{ Nm} [11 \text{ ft-lbs}] \pm 10\%$	Not included in the Rexroth delivery range
	4	ASME B18.3 - 3/8-16 UNC x 2 1/4" - ASTM-A574 Tightening torque $M_A = 60 \text{ Nm} [44 \text{ ft-lbs}] \pm 10\%$	
25, 27	6	ISO 4762 - M12 x 60 - 10.9-fZn/nc/480h/C Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 100 \text{ Nm} \pm 20\%$	R913015613
	or		
	6	ISO 4762 - M12 x 60 Friction coefficient $\mu_{\text{total}} = 0.12 \dots 0.17$; tightening torque $M_A = 100 \text{ Nm} \pm 10\%$	Not included in the Rexroth delivery range
	or		
	6	ASME B18.3 - 1/2-13 UNC x 2 1/4" - ASTM-A574 Tightening torque $M_A = 110 \text{ Nm} [81 \text{ ft-lbs}] \pm 10\%$	Not included in the Rexroth delivery range
35	6	ISO 4762 - M20 x 60 - 10.9-fZn/nc/480h/C Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 465 \text{ Nm} \pm 20\%$	R913014726
	or		
	6	ISO 4762 - M20 x 60 - 10.9 Friction coefficient $\mu_{\text{total}} = 0.12 \dots 0.17$; tightening torque $M_A = 610 \text{ Nm} \pm 10\%$	Not included in the Rexroth delivery range
	or		
	6	ASME B18.3 - 3/4-10 UNC x 2 1/4" - ASTM-A574 Tightening torque $M_A = 395 \text{ Nm} [291 \text{ ft-lbs}] \pm 10\%$	Not included in the Rexroth delivery range



Notice:

- ▶ The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.
- ▶ Only the valve mounting screws listed here may be used (for size 16, a minimum screw length of 55 mm is admissible, as well).
- ▶ Prior to assembly, check the existing mounting bore on the block for sufficient screw-in depth.

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

Accessories (separate order)**Valves with integrated electronics**

Interface	Mating connectors 6-pole + PE	Design	Version	Material number	Data sheet
"A1", "F1", "C6"	For the connection of valves with integrated electronics, round connector 6+PE, line cross-section 0.5 ... 1.5 mm ²	Straight	Metal	R900223890	08006
		Straight	Plastic	R900021267	08006
		Angled	Plastic	R900217845	–

Interface	Cable sets 6-pole + PE	Length in m	Material number	Data sheet
"A1", "F1", "C6"	For the connection of valves with integrated electronics, round connector 6+PE, straight connector, shielded, potted-in mating connector, line cross-section 0.75 mm ²	3.0	R901420483	08006
		5.0	R901420491	08006
		10.0	R901420496	08006
		20.0	R901448068	–

Test and service devices

	Material number	Data sheet
Service case with test device for continuous control valves with integrated electronics (OBE)	R901049737	29685

Valves with integrated electronics and IO-Link interface

Cable sets for IO-Link	Length in m	Material number	Data sheet
For the connection of valves with IO-Link interface, M12-5, A-coded, unshielded, line cross-section 5 x 0.34 mm ²	1.5	R901508849	–
	3.0	R901554223	–
	5.0	R901415747	–

Project planning information

- ▶ The use of the valves with IO-Link as a shut-off element up to category 3, PL d according to EN 13849-1 is possible from component series 43 (4WRLE . E...-43/...L1). For additional application notes regarding safe shut-off, see operating instructions 29118-B.
For component series ≤ 42 , the valve must not be used for safe shut-off.
- ▶ The maximum operating pressure of 350 bar at port T is possible with size 35 from component series 43.
For component series ≤ 42 , the valve may be operated up to a maximum of 250 bar.
- ▶ Maximum operating pressure of 350 bar at port T only with double flow (supply via ports P and T, discharge via ports A and B; the supply pressure must be kept constant, load pressure in the discharge can be pulsating) without changing the direction of flow.
- ▶ Can be used without restriction up to a maximum operating pressure of 250 bar at port T.

Further information

- | | |
|--|--|
| ▶ Hydraulic valves for industrial applications | Data sheet 07600-B |
| ▶ Subplates | Data sheet 45100 |
| ▶ Hydraulic fluids on mineral oil basis | Data sheet 90220 |
| ▶ Environmentally compatible hydraulic fluids | Data sheet 90221 |
| ▶ Flame-resistant, water-free hydraulic fluids | Data sheet 90222 |
| ▶ 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 |
| ▶ Directional control valves, direct operated, with electrical position feedback and IO-Link interface | Data sheet 29400-PA |
| ▶ Information on available spares | www.boschrexroth.com/spc |
| ▶ Connecting hydraulic systems via IO-Link | www.boschrexroth.com/io-link |

Notes

Notes

Bosch Rexroth AG
Industrial Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52/ 40 30 20
my.support@boschrexroth.de
www.boschrexroth.de

© All rights reserved to Bosch Rexroth AG, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
The data specified above only serve to describe the product.
No statements concerning a particular condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.