

4WRLE

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

Size 10 ... 27

Component series 4X

Maximum operating pressure 350bar

Nominal flow 60...600 L/min ($\Delta p = 10$ bar)



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Features

- 1 - High-response 2-stage proportional directional valve, pilot valve and main valve with electrical position feedback, integrated digital controller
- 2 - Pilot valve: using spool/sleeve structure with servo valve performance, closed-loop position control
- 3 - Control spool of the main stage in the spring centered central position and/or in the offset position
- 4 - Flexible – suitable for position, speed and pressure control
- 5 - Precise – high response sensitivity and little hysteresis
- 6 - For subplate mounting: porting pattern to ISO4401(NS 10...27)
- 7 - Electrical connection: 6P+PE

Ordering details

4WRL	E	16	E	200	L	J	-	4X	/	M	XY	/	24	A1	*
01	02	03	04	05	06	07		08	09	10		11	12	13	

01	4WRL	Four way pilot operated directional control valve
02	E	With integrated digital electronics
03	10	NS 10
	16	NS 16
	25	NS 25
	27	NS 27

Symbols

04	E	E, E1-, W6-, W8-, V, V1-,Q3-; Hydraulic symbol table for details see page 2
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Rated flow ($\Delta p = 5$ bar/control edge)

05	60	60 l/min (only symbol E, E1-, W6-, W8-, V, V1-)	NS 10
	100	100 l/min	
	200	200 l/min (only symbol W6-, W8-)	NS 16
	250	250 l/min (only symbol E, E1-, V, V1-, Q3-)	
	350	350 l/min (only symbol W6-, W8-)	NS 25
	400	400 l/min (only symbol E, E1-, V, V1-, Q3-)	
	430	430 l/min (only symbol W6-, W8-)	NS 27
	600	600 l/min (only symbol E, E1-, V, V1-, Q3-)	

06	L	Linear
	P	Linear with fine control range (available for NG10, other sizes on request)
	M	Progressive with linear fine control (only symbol Q3-)

4WRL	E	16	E	200	L	J	-	4X	/	M	XY	/	24	A1	*
01	02	03	04	05	06	07		08		09	10		11	12	13

07 **J** Overlap jump (opening point 5% with covered valve; only symbols E, E1-, W6-, W8-)

08 **4X** Component series 40 ... 49 (40 ... 49: unchanged installation and mounting dimensions)

Seal material

09 **M** NBR seals
V FKM seals

Pilot oil supply and drain

10 **XY** External pilot oil supply, external pilot oil return
PY Internal pilot oil supply, external pilot oil return
PT Internal pilot oil supply; internal pilot oil return
XT External pilot oil supply, internal pilot oil return

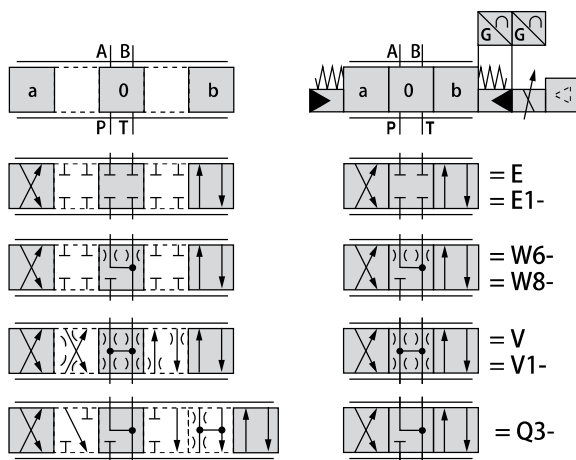
11 **24** Supply voltage 24 V

Interfaces of the control electronics

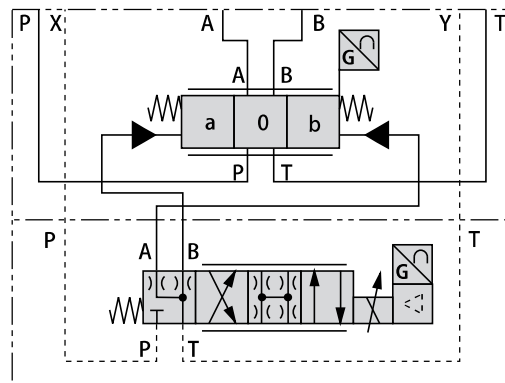
12 **A1** Command value input ± 10 V
F1 Command value input 4 ... (12) ... 20 mA

13 ***** Further details in the plain text

Symbols



Detailed (type "XY")

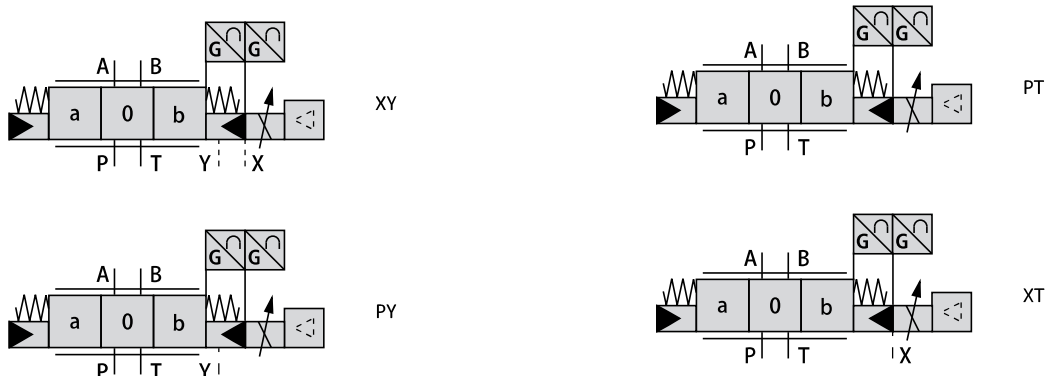


With symbols: E1-, V1-, W8-

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

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

Simple



Functions, section

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

Set-up

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

Function

When the integrated control electronics (OBE) is 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 control electronics (OBE) compares 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.

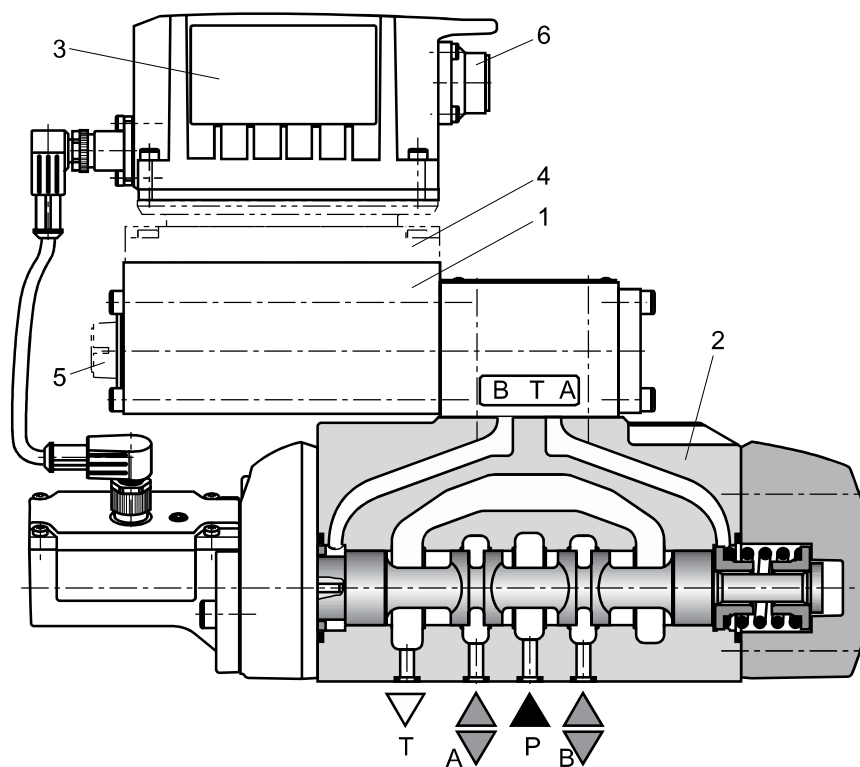
The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

In case of the following errors, the control solenoids are de-energized by the integrated electronics (OBE), the pilot control spool is set to "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

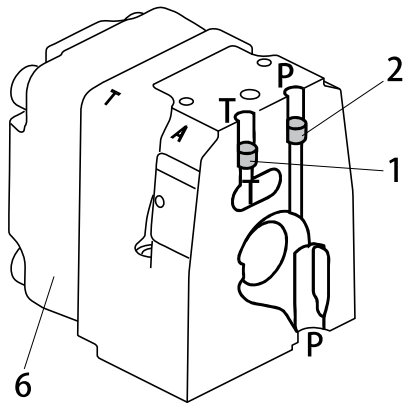
→ Only at interface "F1": falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop)).

4WRL...-4X/...

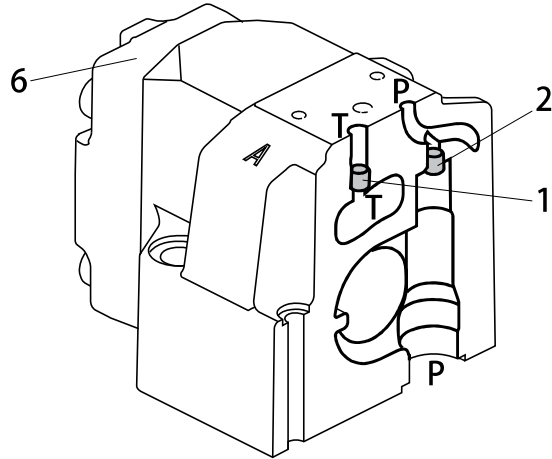


Pilot oil supply and drain

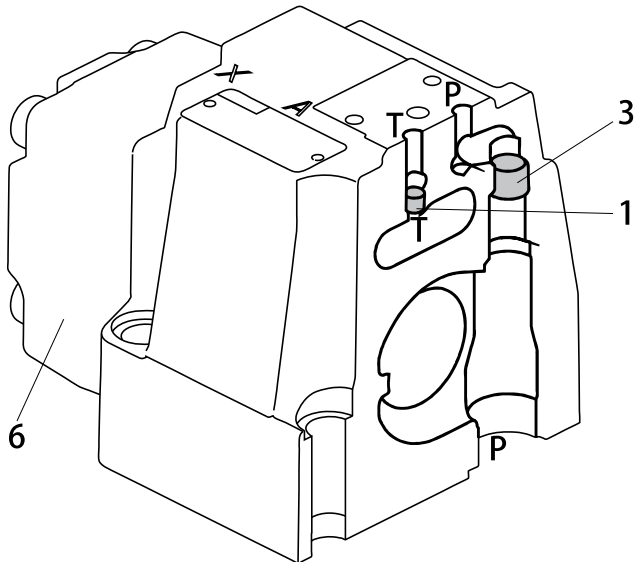
NS 10



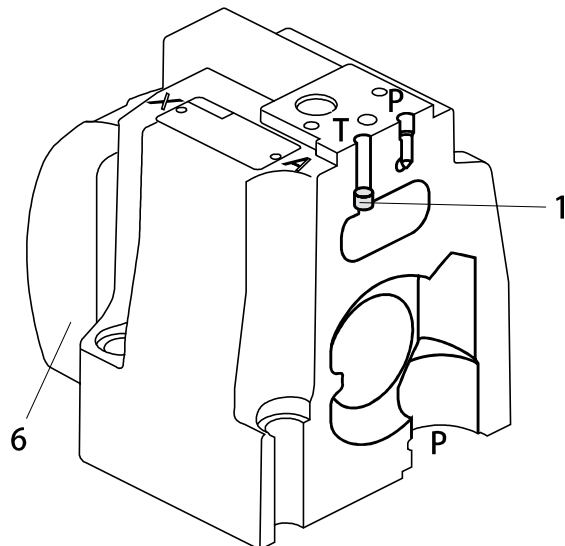
NS 16



NS 25



NS 27



Pilot oil supply
external: 2, 3 closed
internal: 2, 3 open

Pilot oil return
external: 1 closed
internal: 1 open

1. Plug screw M6 , wrench size 3 – pilot oil return
2. Plug screw M6 , wrench size 3 – pilot oil supply
3. Plug screw M12 x 1.5 , wrench size 6 – pilot oil supply
6. Housing cover main stage (position transducer side)

Pilot oil supply and drain

Version "XY"

External pilot oil supply; external pilot oil return
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
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
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
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.

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

General

Nominal size		10	16	25	25
Installation position		Any			
Ambient temperature range	°C	-20 ... +60			
Weight	Kg	9	12	19	19
Hydraulic (measured at p = 100 bar, with HLP46 at 40 °C ± 5 °C)					
Maximum operating pressure Ports A, B, P		350			270
-External pilot oil supply	bar				
-Pilot oil supply internal	bar	280			270
Port X	bar	280			270
Ports T, Y	bar	250			210
Minimum pilot pressure (pilot control valve)	bar	10			
Rated flow ($\Delta p = 5$ bar/control edge) ¹⁾	L/min	60	200	350	430
		100	250	400	600
Maximum flow	L/min	300	800	1250	4700
Pilot oil flow ²⁾					
Symbols E, W	L/min	2.4	3.5	7.5	
Symbols V, Q3	L/min	4.5	11.5	22	
Maximum leakage flow					
Symbols E, E1-main valve+pilot valve	L/min	0.14	0.28	0.42	
inlet pressure 100bar					
Symbols W6-, W8-main valve+pilot valve	L/min	0.2	0.41	0.6	
Maximum zero flow					
Symbols V, V1-main valve+pilot valve	L/min	1.85	2.6	3.2	3.7
inlet pressure 100bar					
Symbols Q3-main valve+pilot valve	L/min	0.55	1.9	2.2	2.6
Flow unloading central position $\Delta p = 5$ bar/control edge					
Symbol W6-		A→T	B→T	A→T	B→T
	L/min	2.8	2.8	4	4
Symbol W8-		A→T	B→T	A→T	B→T
	L/min	2.8	1.4	4	2
Pilot oil volume (0...100%)	ml	1.3	2.9	6.8	6.8
Hydraulic fluid		DIN51524...535 other fluids after prior consultation			
Hydraulic fluid temperature range (flown-through)	°C	-20 ... +70			
Viscosity range	mm ² /s	10 ... 800 (preferably 20 ... 100)			
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class ³⁾		ISO4406 18/16/13			
Hysteresis	%	< 0.1			
Range of inversion	%	< 0.08			
Response sensitivity	%	< 0.05			
Actuating time for 0 ... 100% at X = 210 bar	ms	25	37	36	36
Temperature drift (temperature range 20 °C ... 80 °C)	%/10°C	< 0.25			

1) Flow rate at a different Δp : $q_x = q_{V \text{ nom}} \cdot \sqrt{\frac{\Delta p_x}{5}}$

2) At X = 100 bar, step signal for 0 ... 100%

3) The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components.

Electrical connections

Electrical, integrated electronics (OBE)

Voltage type		VDC	DC
		VDC	24
Supply voltage	Terminal A	VDC	19...36
	Terminal B	VDC	0
Maximum admissible residual ripple		Vpp	2.5
Maximum power consumption		VA	40
Fuse protection, external		A _T	2.5
Command value	Version "A1" (U_{D-E})	V	±10
	Version "F1" (I_{D-E})	mA	4...20
			LVDT
Test signal, version "A1"	Terminal F	V	0...±10
	Terminal C		Reference 0V
			LVDT signal 4 ... 20 mA on external load 200 ... 500 Ω maximum
Test signal, version "F1"	Terminal F (I_{F-C})	mA	4...20
	Terminal C (I_{F-C})		Current loop I_{F-C} feedback
Relative duty cycle		%	100
Max. solenoid temperature		°C	120
Protection class according to EN 60529			IP65

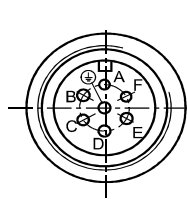
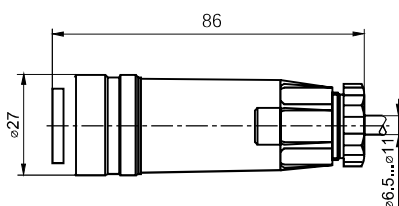
Electrical connection with a 7 - pin plug

Design	Slot	Allocation interface A1	Allocation interface F1	Allocation interface C2	Allocation interface A5	Allocation interface F5	Allocation interface C6
Supply power+	A	24VDC (21~40VDC)				GND, enable the reference potential	
Supply power -	B	GND					
	C	Feedback value reference point				(Enable input 24VDC enable ≥ 11VDC, disable ≤ 5VDC)	
Command input+	D	±10V com. value: $R_e > 50k\Omega$	4~20mA com. value: $R_e < 250\Omega$	4~20mA com. value: $R_e < 250\Omega$	±10V com. value: $R_e > 50k\Omega$	4~20mA com. value: $R_e < 250\Omega$	±10V com. value: $R_e < 250\Omega$
Command input-	E	Input command				Reference potential	
Position feedback	F	Actual value: ±10 V Maximum load: 5 mA	Actual value; 4~20mA Maximum load; 300Ω	Actual value; 4~20mA Maximum load; 300Ω	Actual value: ±10 V Maximum load: 5 mA	Actual value; 4~20mA Maximum load; 300Ω	Actual value; 4~ 20mA Maximum load; 300Ω
	PE	Connected with cooling body and valve housing					

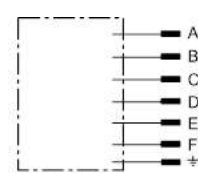
Control Value

Input signal (0~+100%)	0~+10V 12~20mA 0~+10mA	Working position P→A/B→T
Input signal (0~-100%)	0~-10V 12~4mA 0~-10mA	Working position P→B/A→T

For type 4WRAE((with integrated control electronics): connector conforming to DIN EN 175201-804 (Need to order separately)



Plug pin assignment



Metal nut structure (preferred model)

To be ordered separately. Order number: R00050406

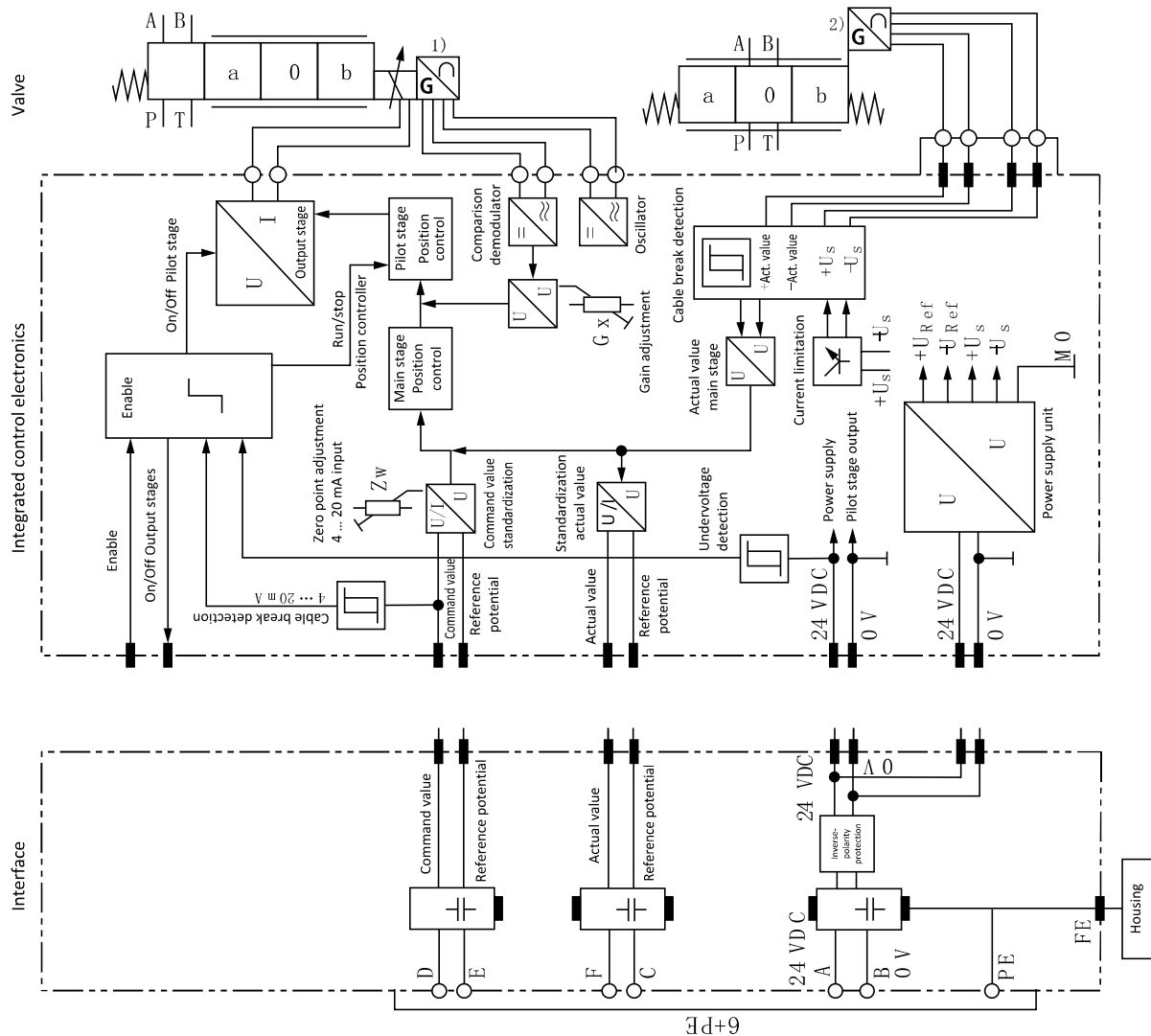
Plastic nut structure

To be ordered separately. Order number: R00050408

All - metal structure

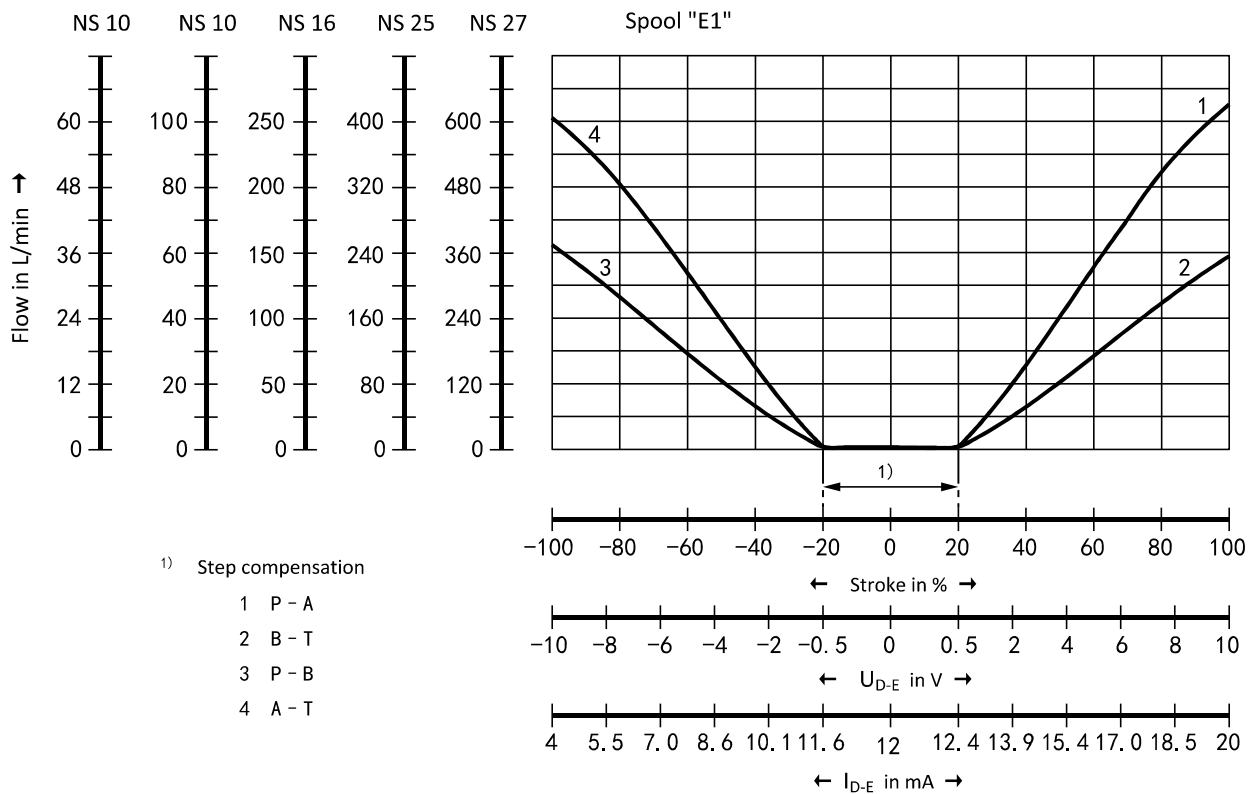
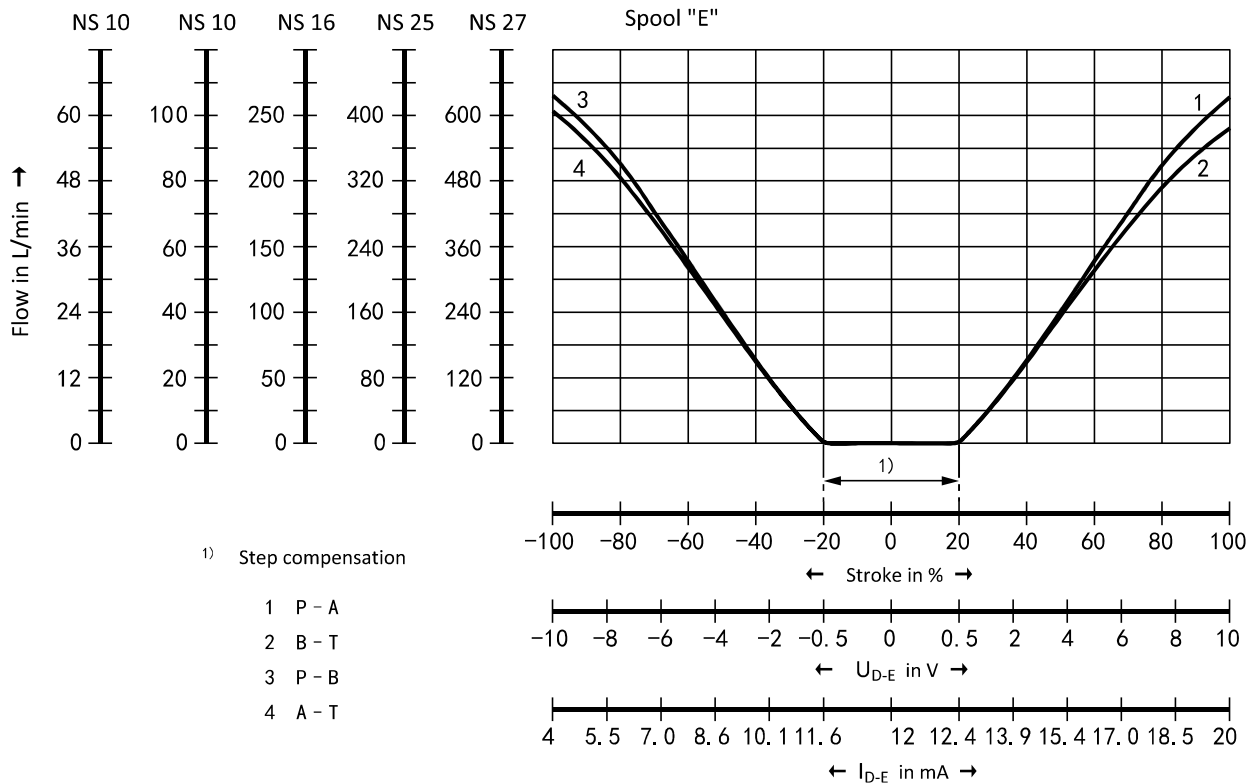
To be ordered separately. Order number: R00050407

Block diagram/controller function block



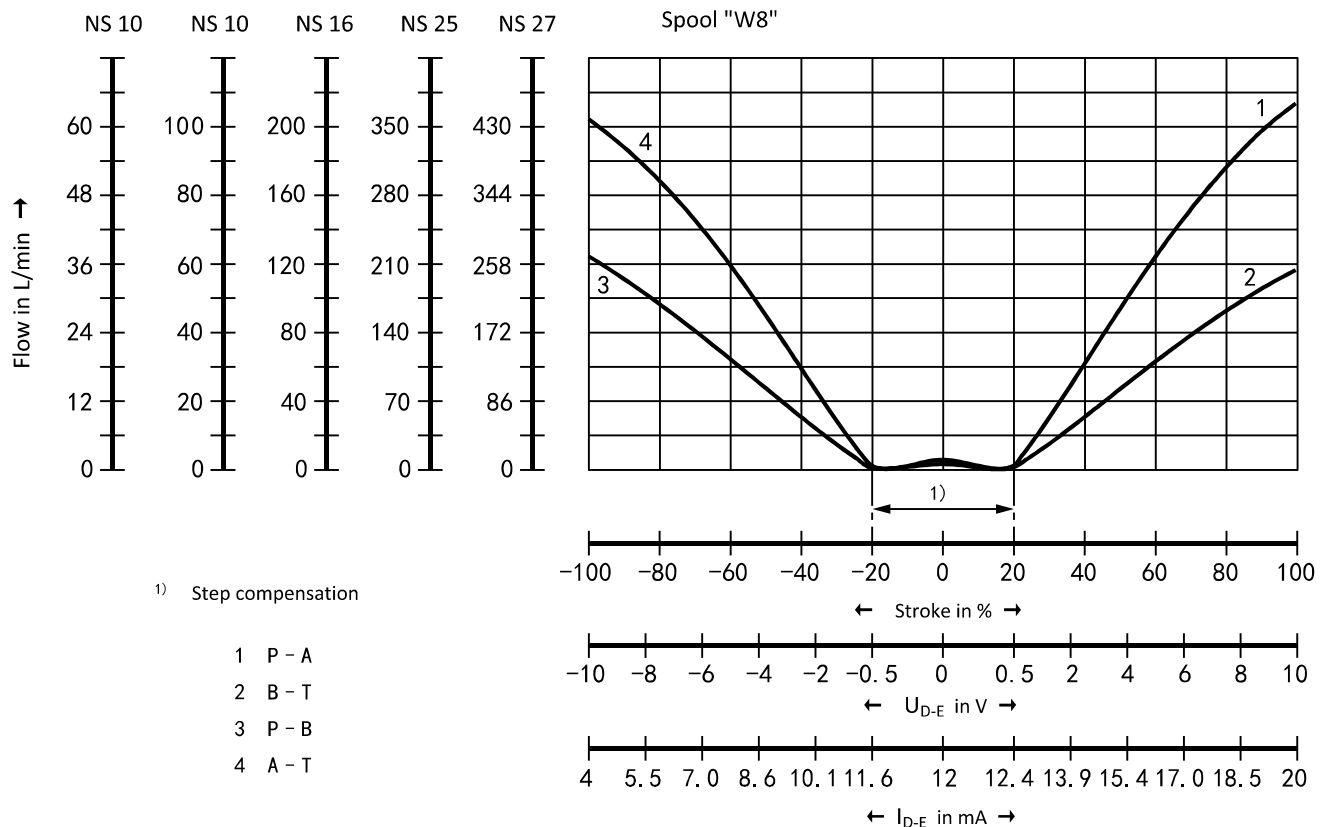
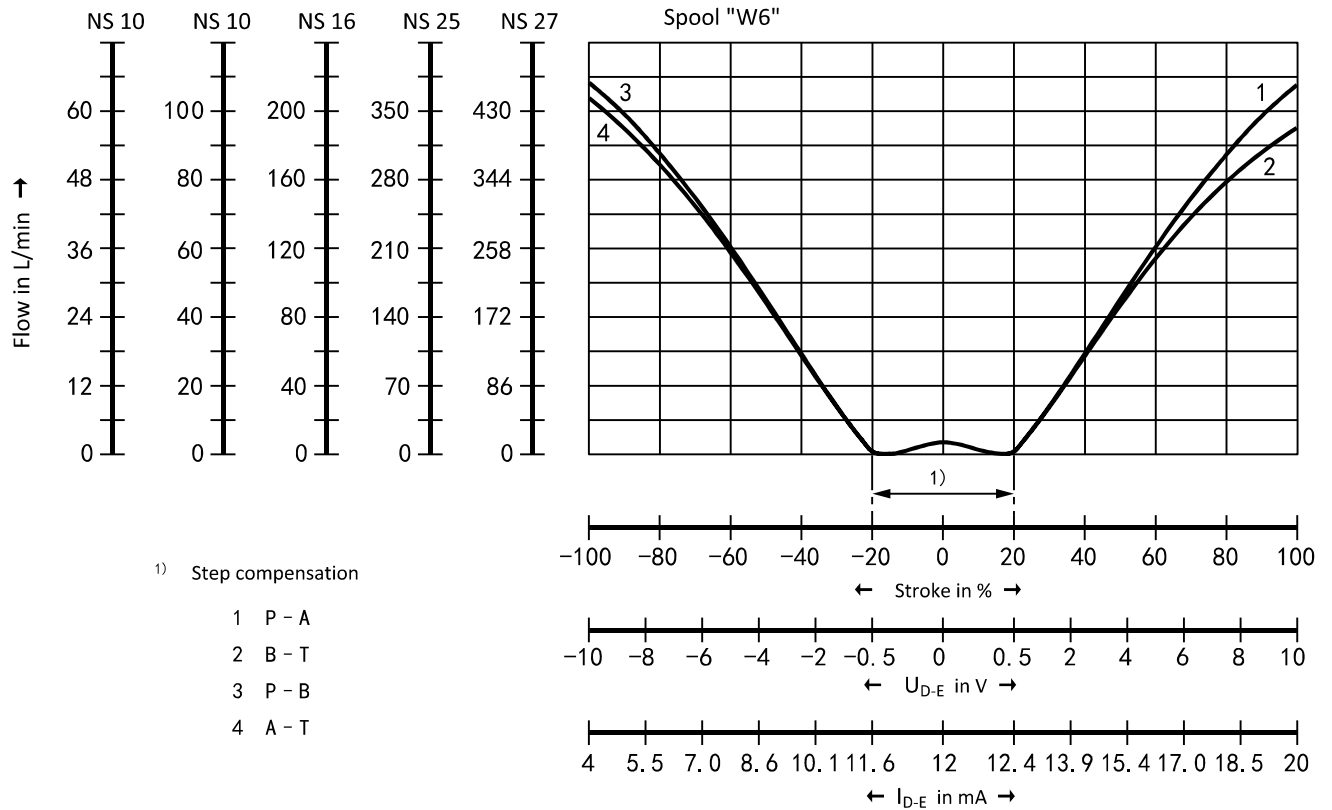
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "L" ($\Delta p = 5$ bar/control edge)



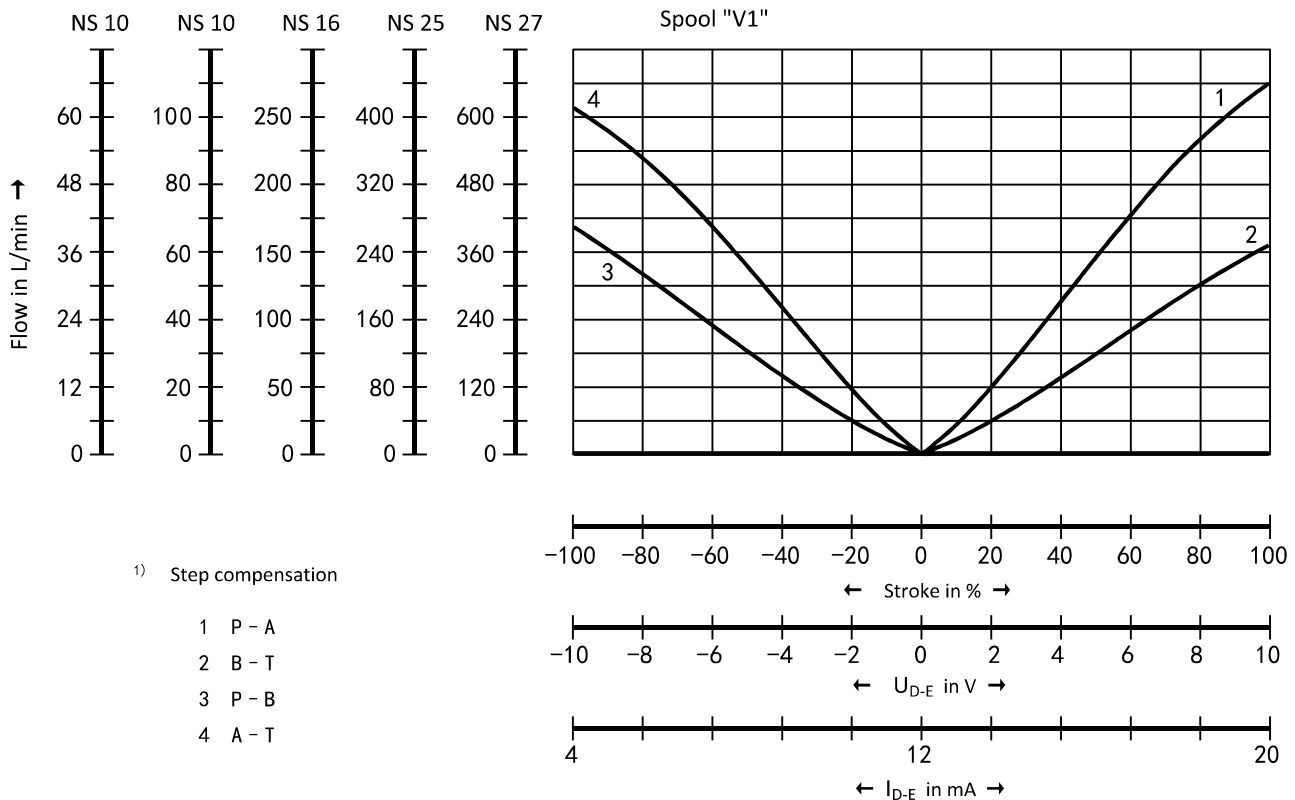
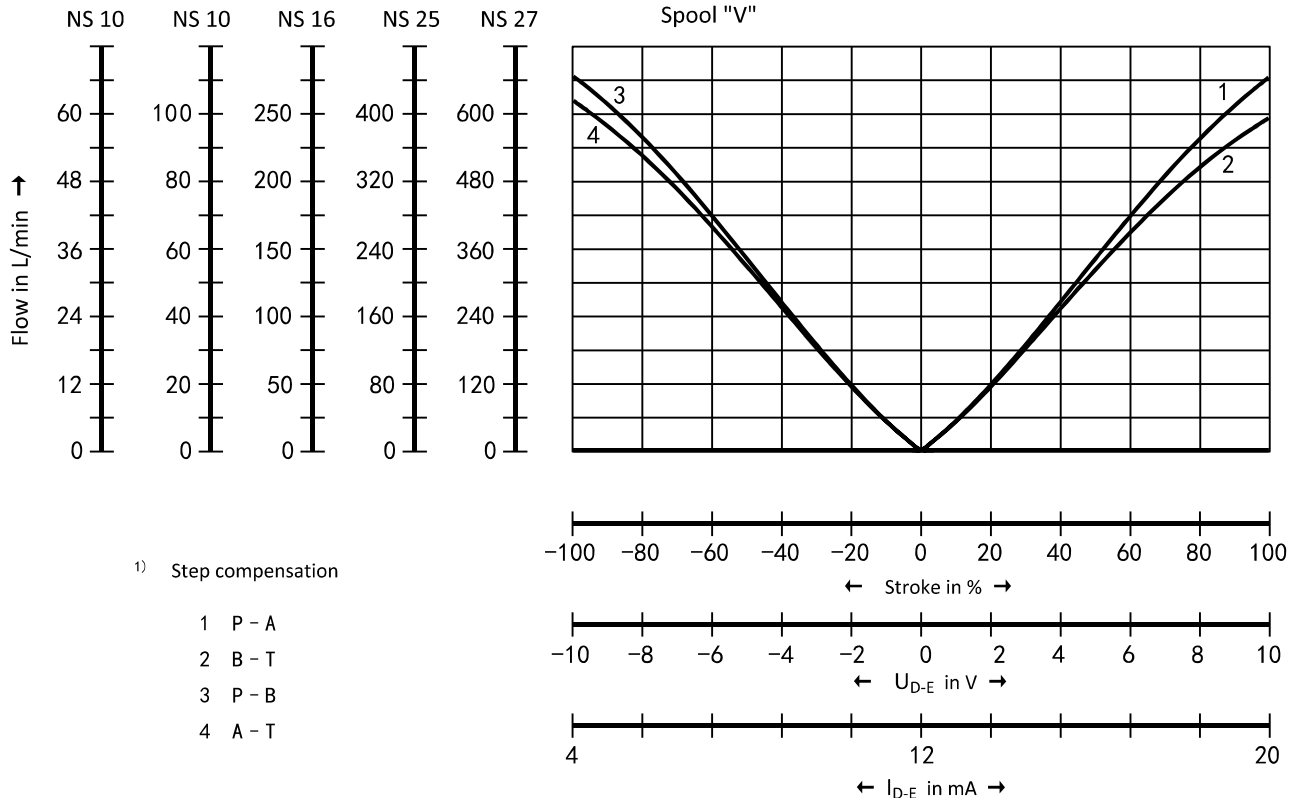
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "L" ($\Delta p = 5 \text{ bar/control edge}$)



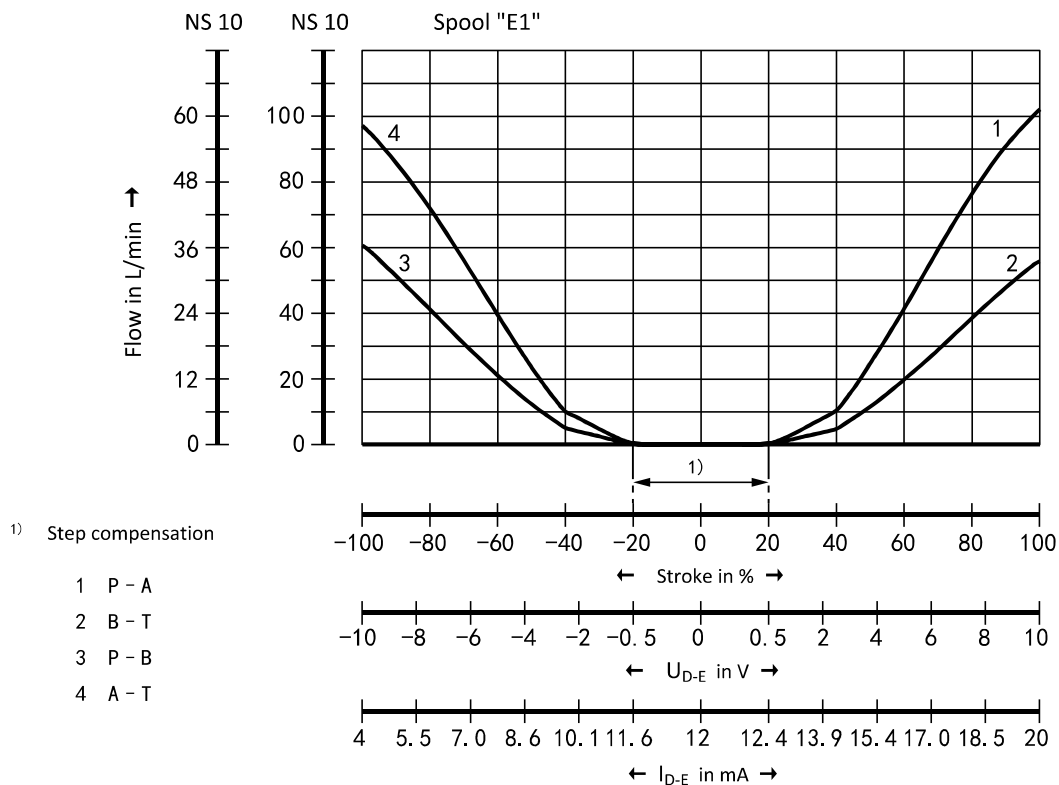
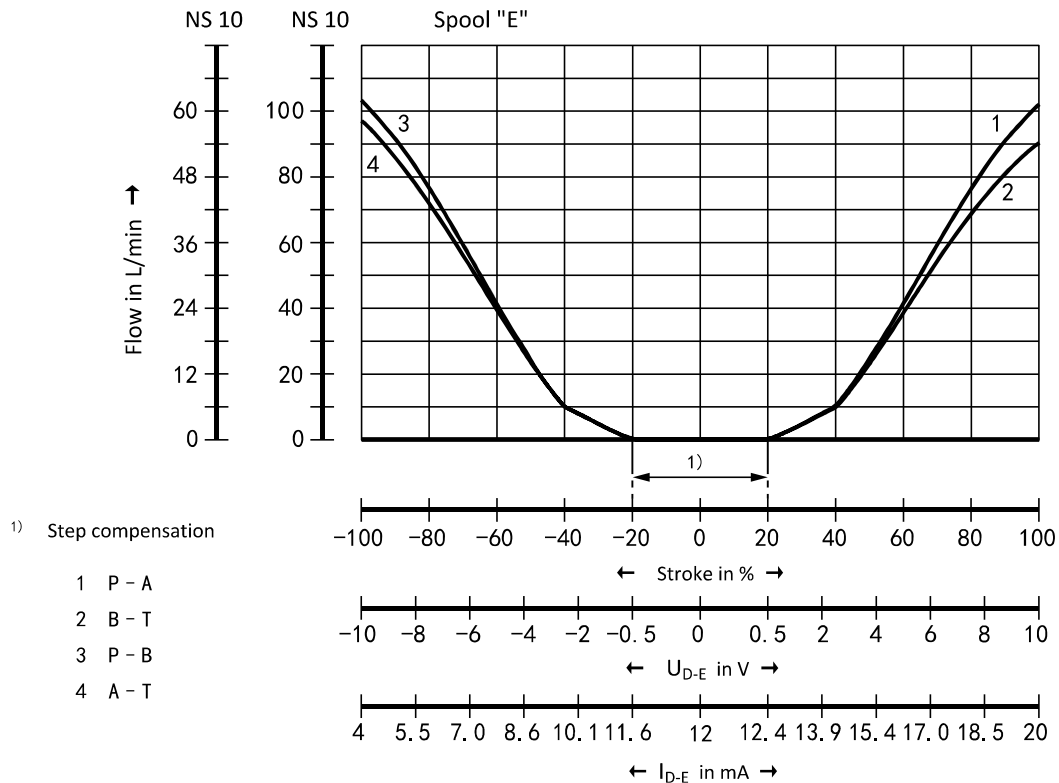
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "L" ($\Delta p = 5$ bar/control edge)



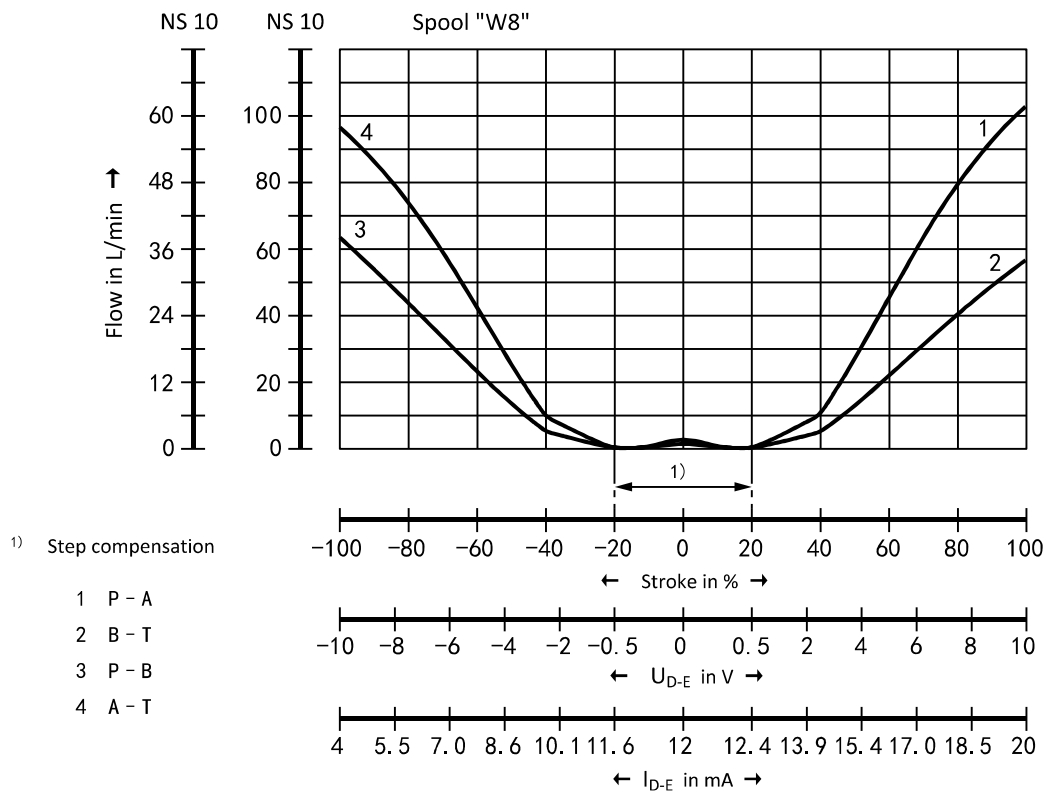
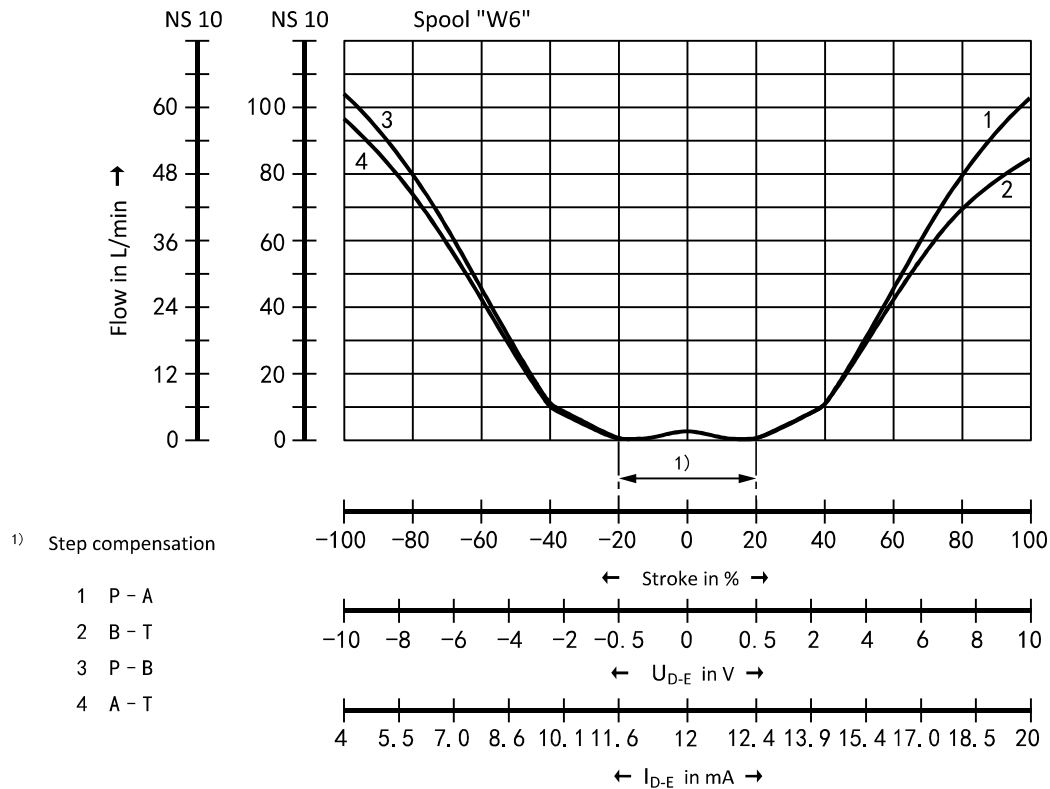
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "P" ($\Delta p = 5 \text{ bar/control edge}$)



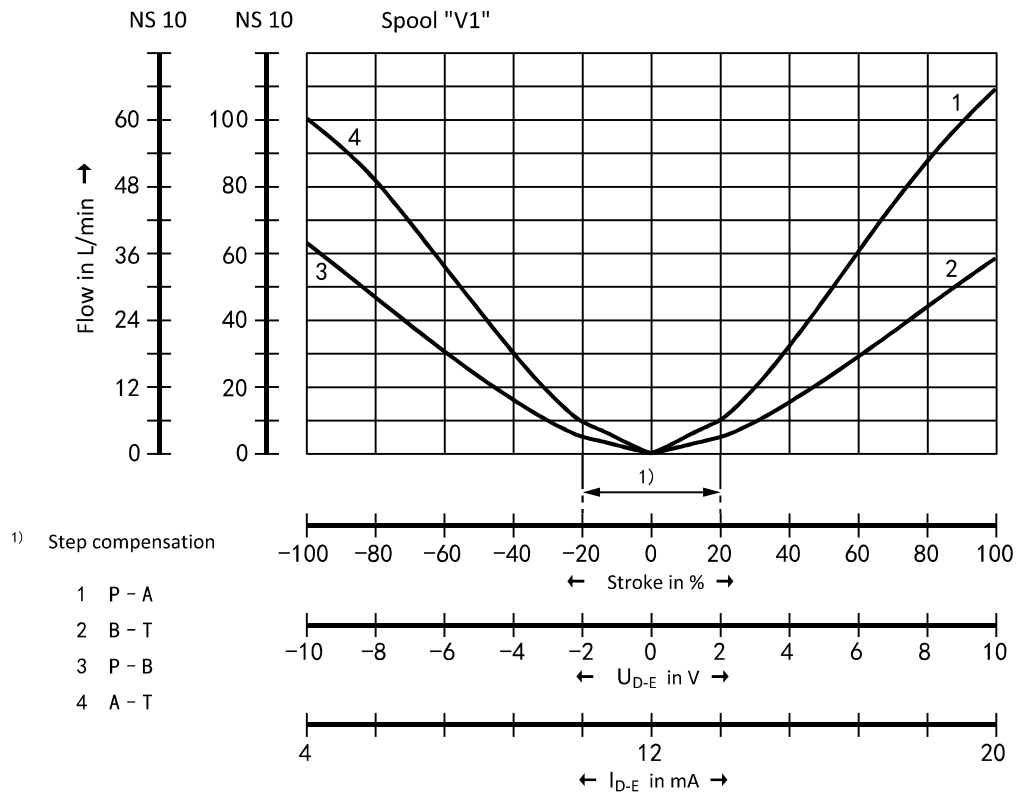
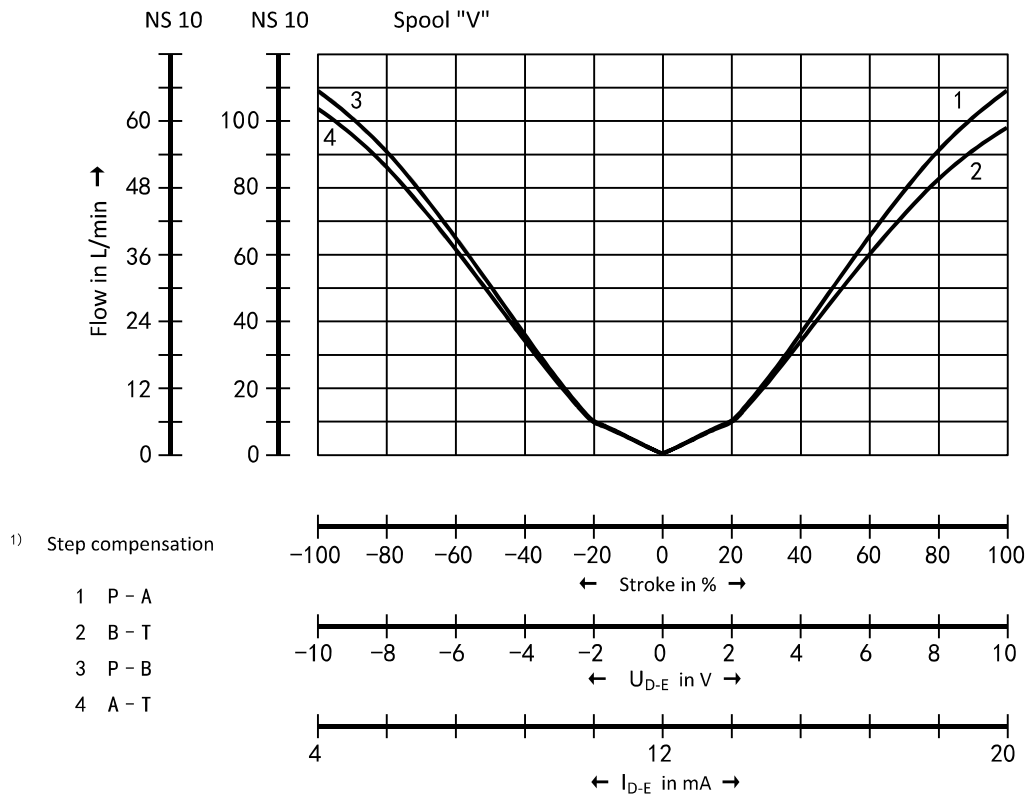
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "P" ($\Delta p = 5 \text{ bar/control edge}$)



Characteristic curves (HLP46 at 40 °C ± 5 °C)

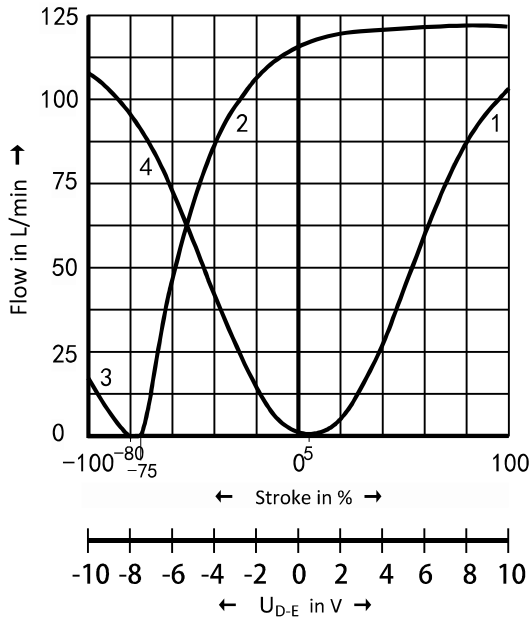
Characteristic curves: Flow characteristic "P" ($\Delta p = 5 \text{ bar/control edge}$)



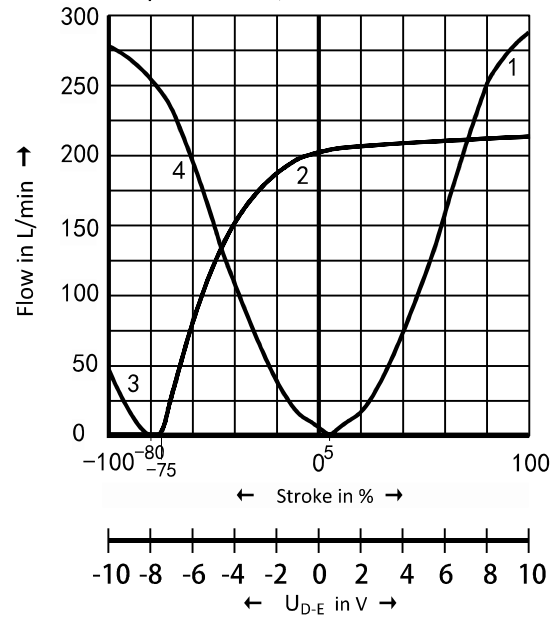
Characteristic curves (HLP46 at 40 °C ± 5 °C)

Characteristic curves: Flow characteristic "M" ($\Delta p = 5 \text{ bar/control edge}$)

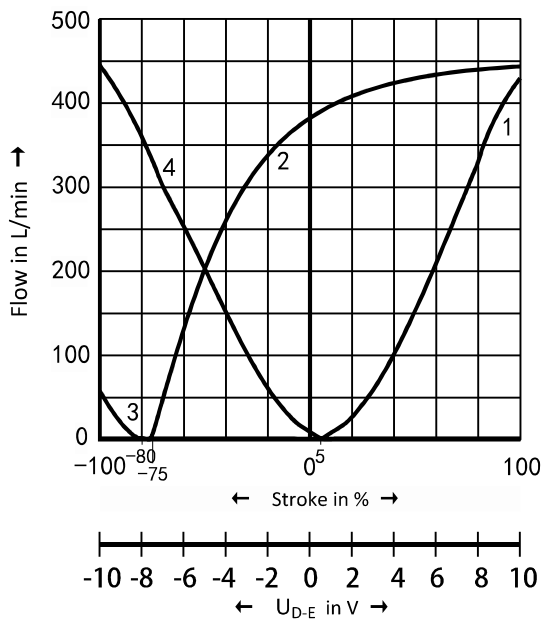
Symbol "Q3", version "100"



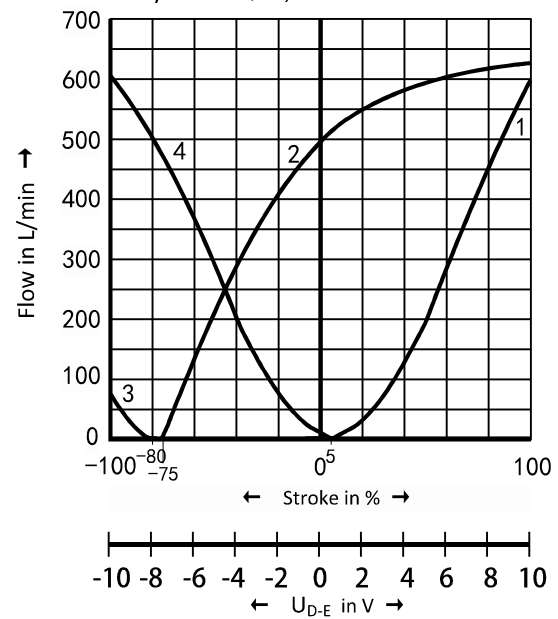
Symbol "Q3", version "250"



Symbol "Q3", version "400"



Symbol "Q3", version "600"

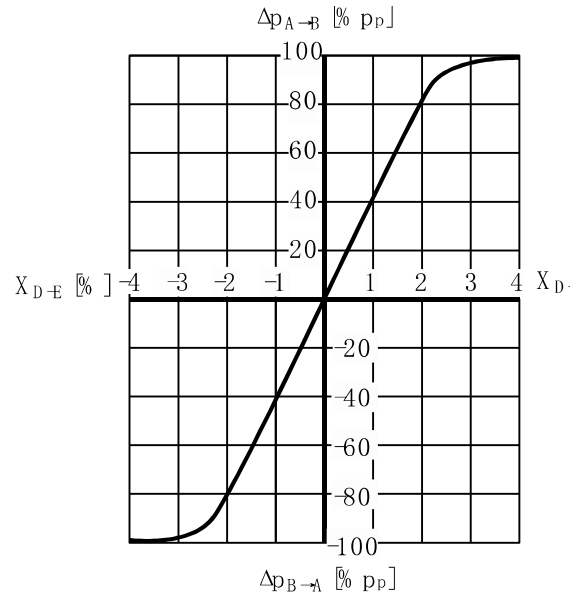
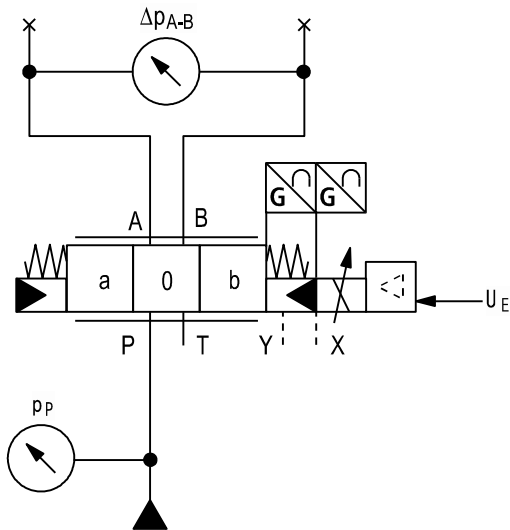


- 1 P→A
- 2 B→T
- 3 P→B
- 4 A→T

Characteristic curves (HLP46 at 40 °C ± 5 °C)

Test block diagram

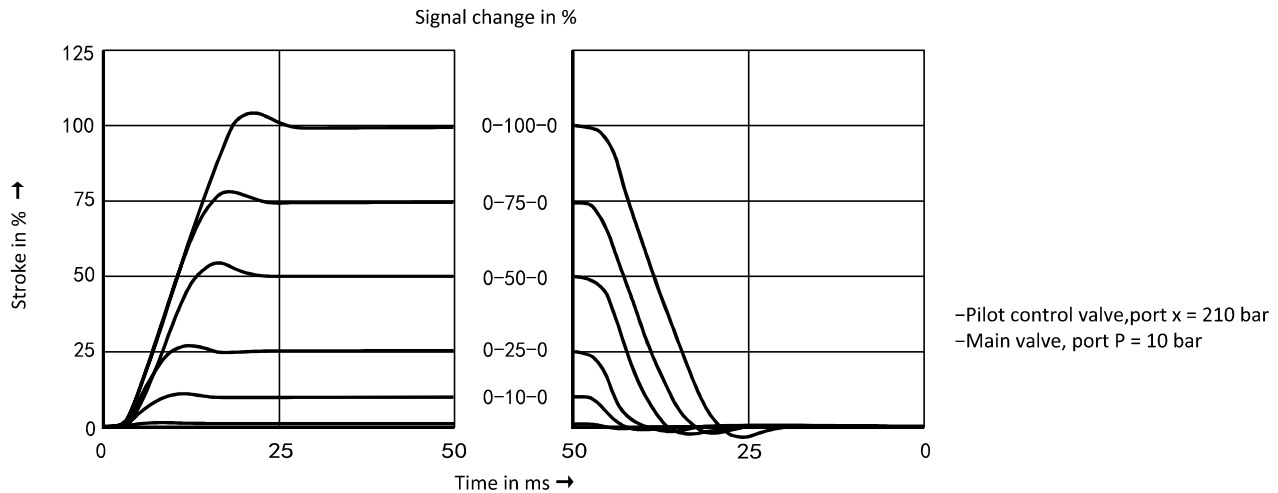
Pressure gain



Characteristic curves NS 10 (HLP46 at $40\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$)

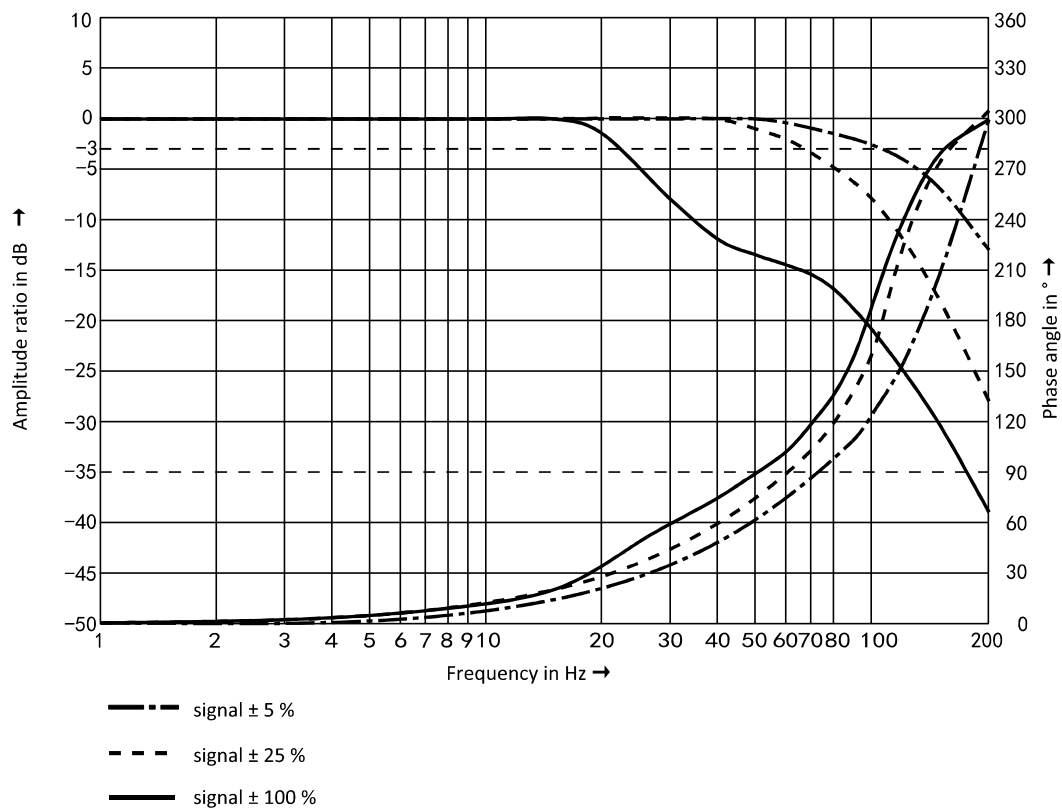
Transition function with stepped electric input signals

Symbols "V" and "Q3"



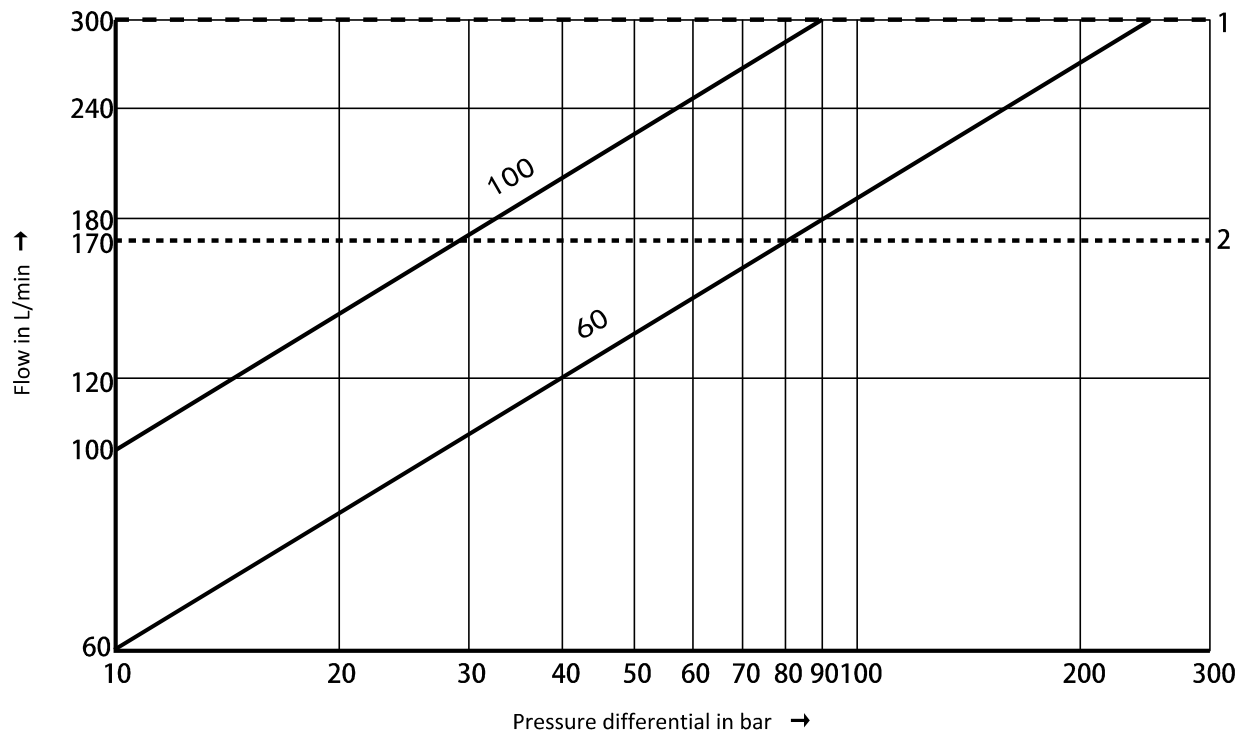
Frequency response characteristic curves

Symbols "V" and "Q3"



Characteristic curves NS 10 (HLP46 at 40 °C ± 5 °C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)

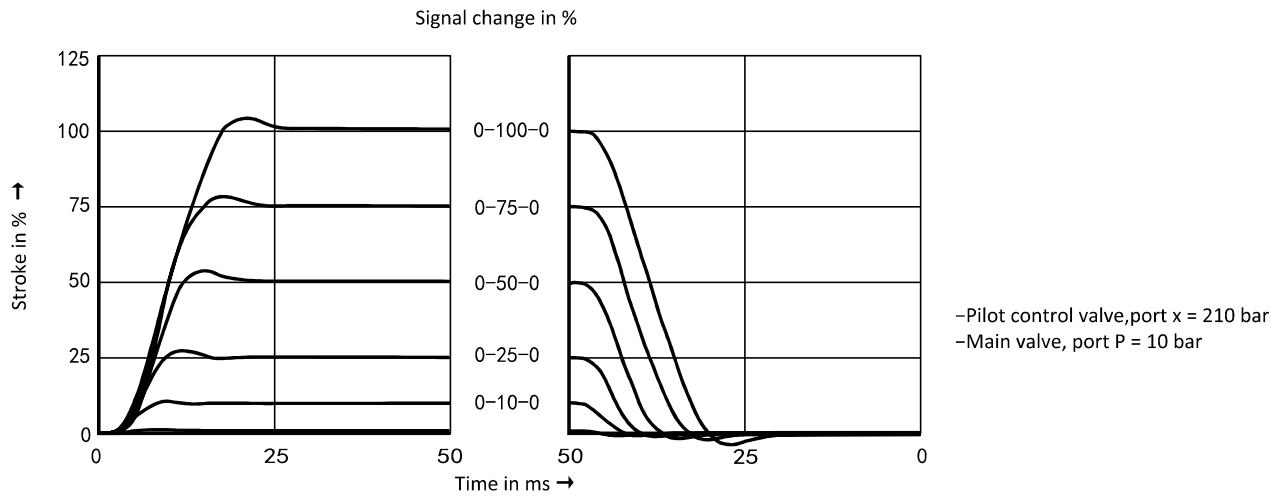


- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)

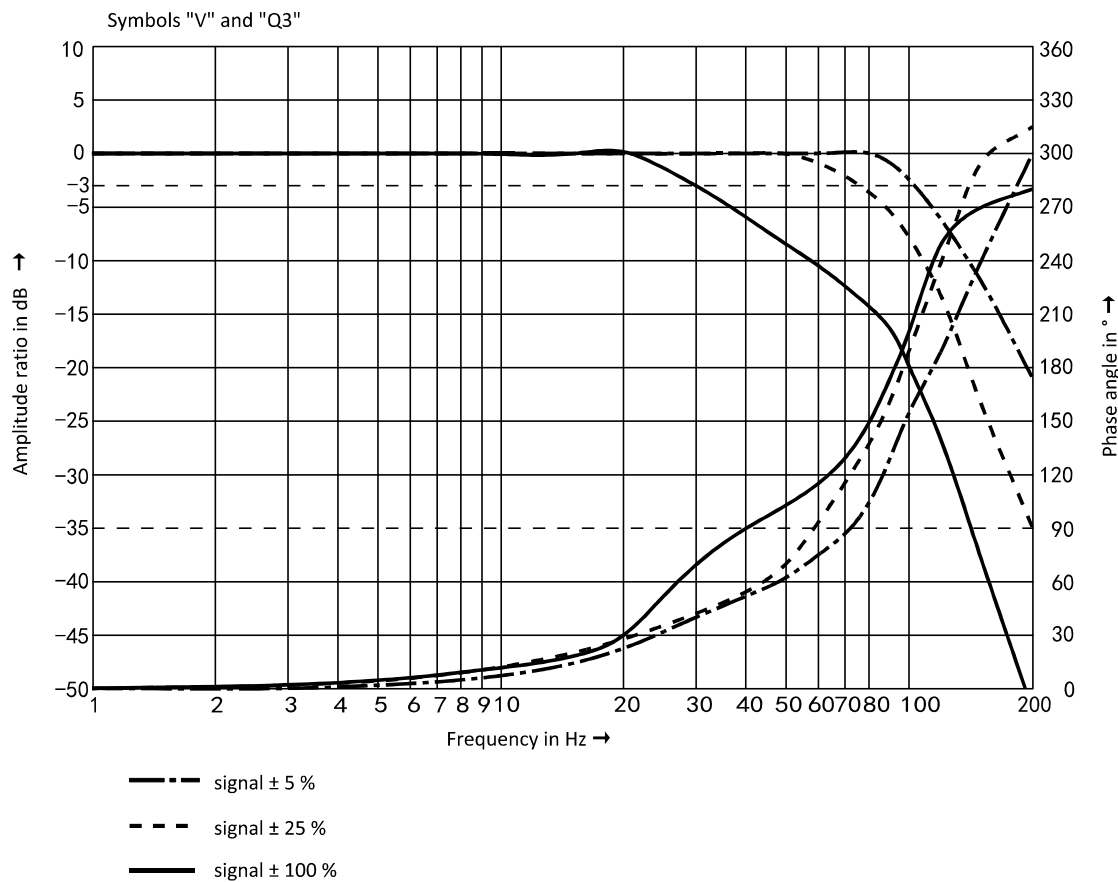
Characteristic curves NS 16 (HLP46 at 40 °C ± 5 °C)

Transition function with stepped electric input signals

Symbols "V" and "Q3"

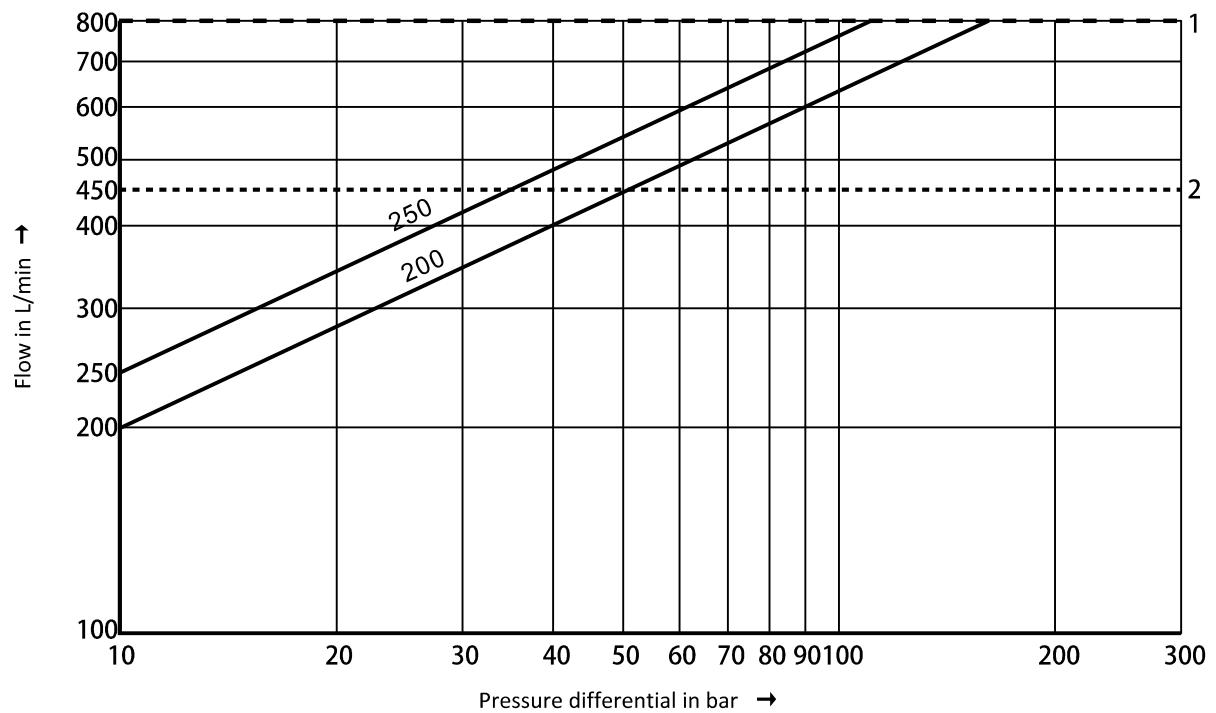


Frequency response characteristic curves



Characteristic curves NS 16 (HLP46 at 40 °C ± 5 °C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)

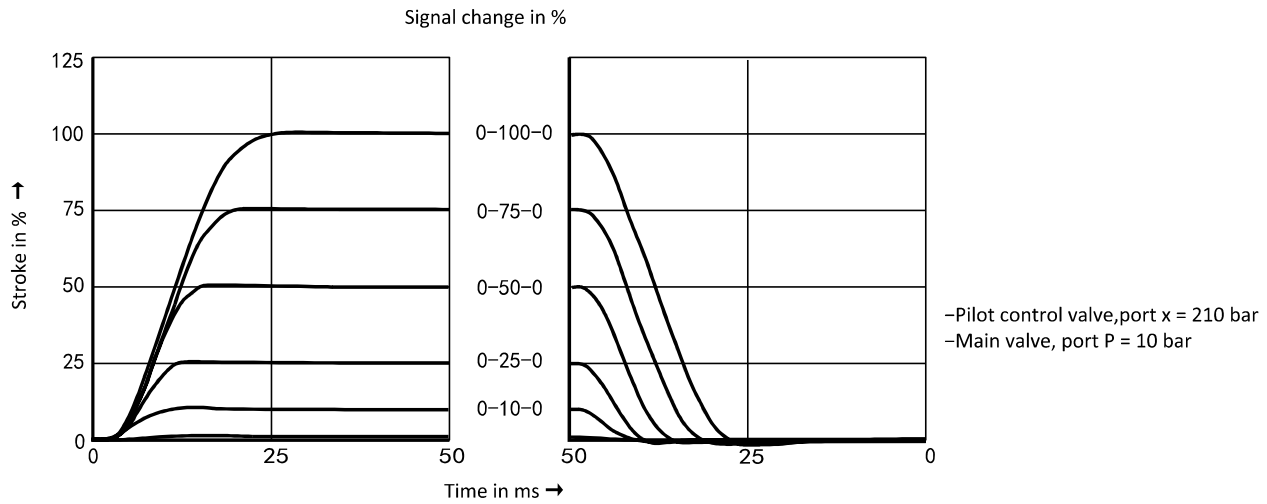


- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)

Characteristic curves NS 25 (HLP46 at 40 °C ± 5 °C)

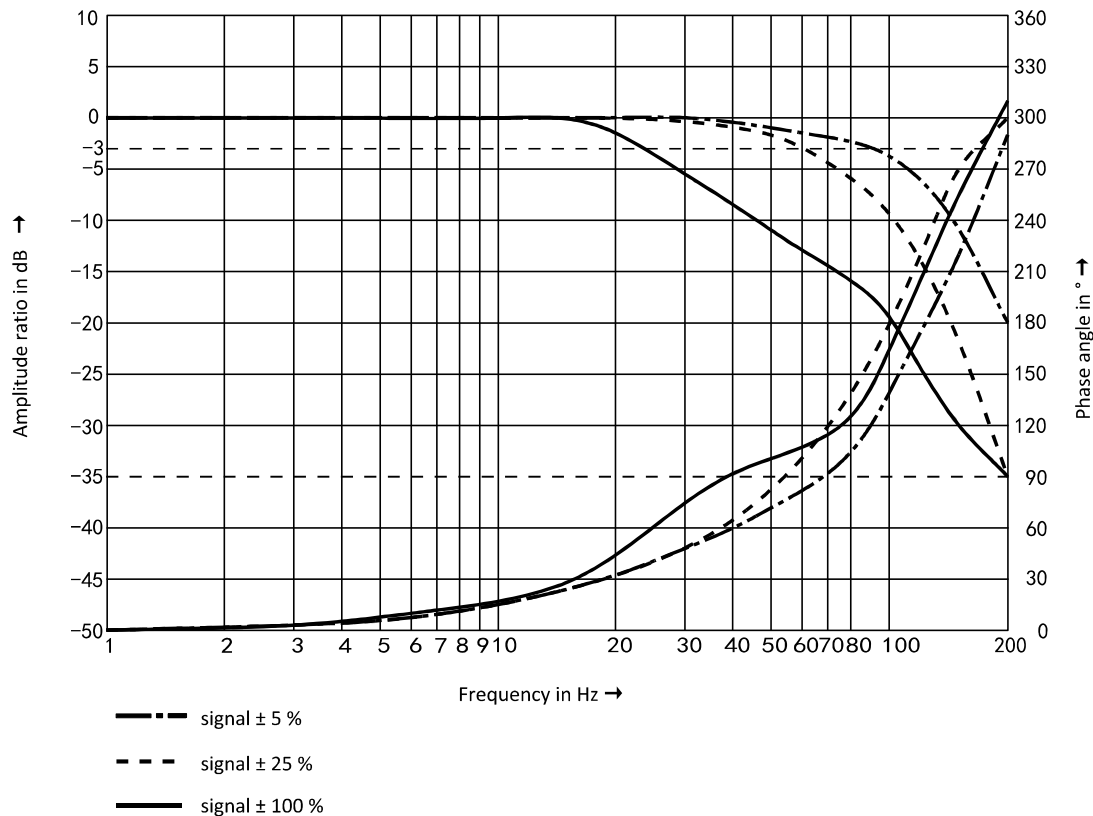
Transition function with stepped electric input signals

Symbols "V" and "Q3"



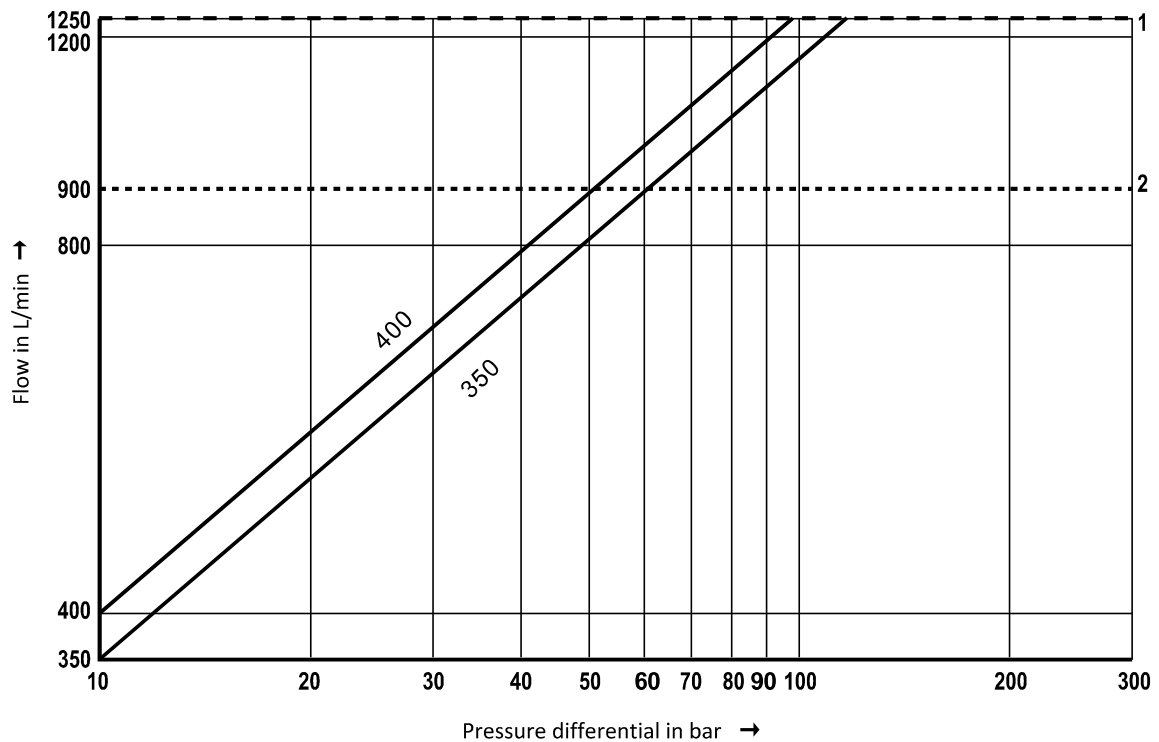
Frequency response characteristic curves

Symbols "V" and "Q3"



Characteristic curves NS 25 (HLP46 at 40 °C ± 5 °C)

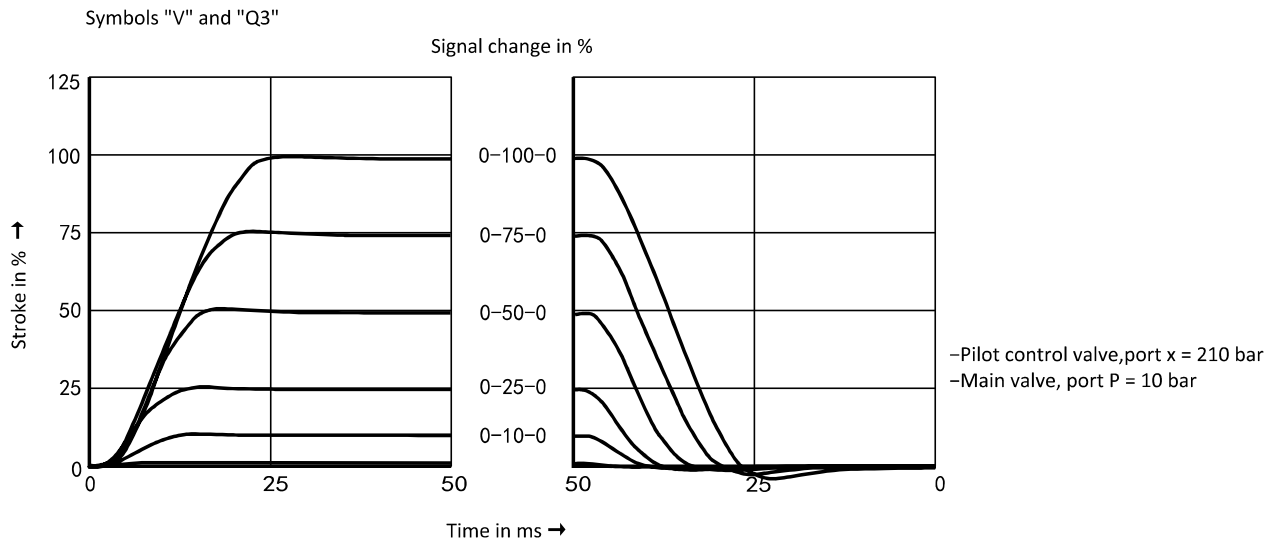
Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)



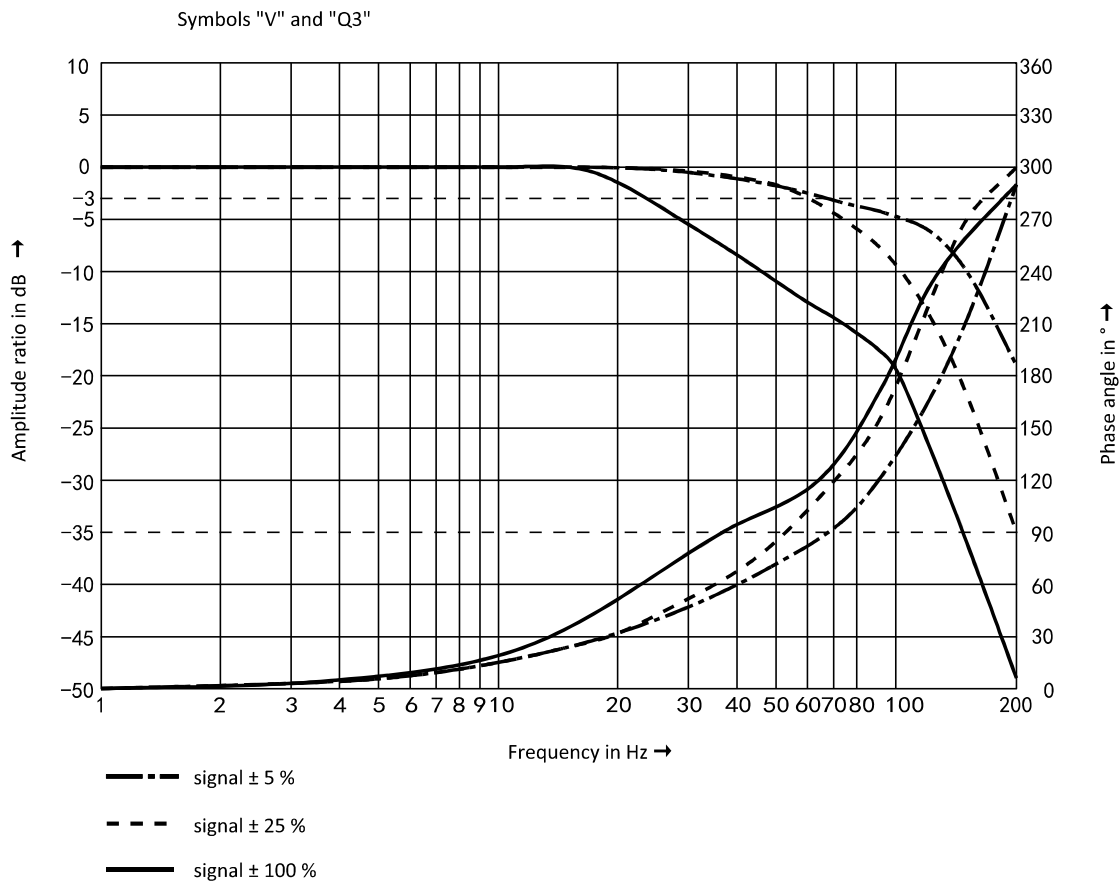
- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)

Characteristic curves NS 27 (HLP46 at 40 °C ± 5 °C)

Transition function with stepped electric input signals

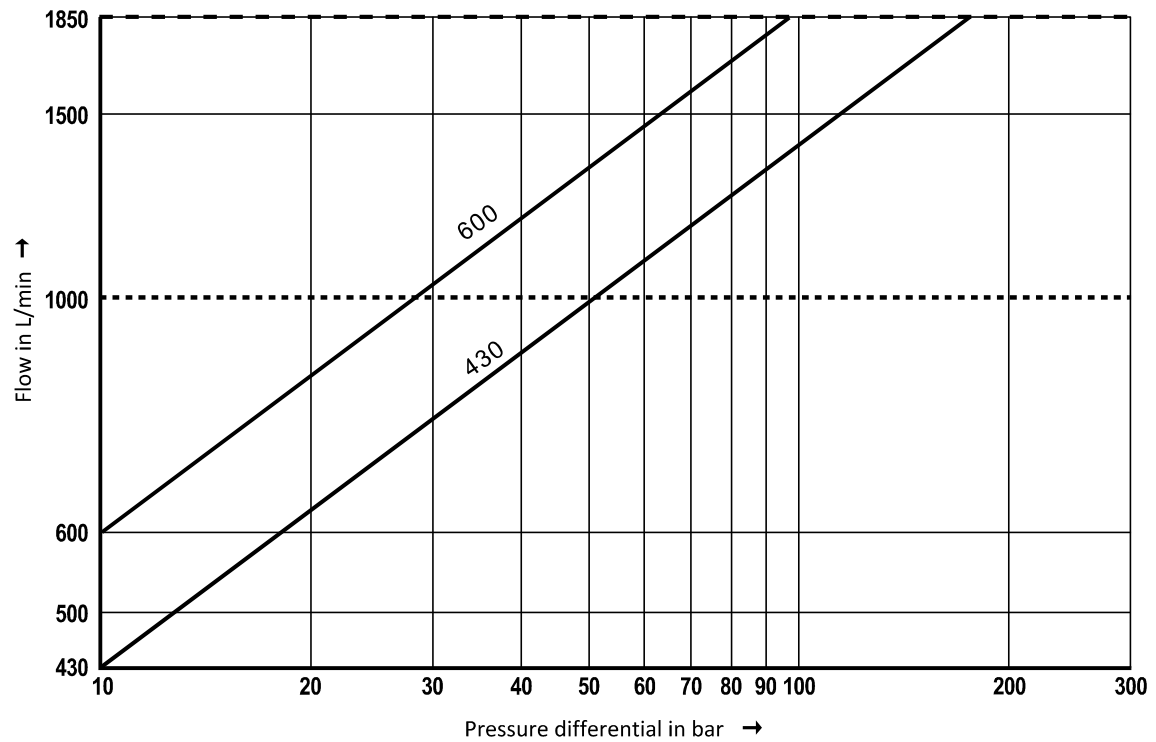


Frequency response characteristic curves



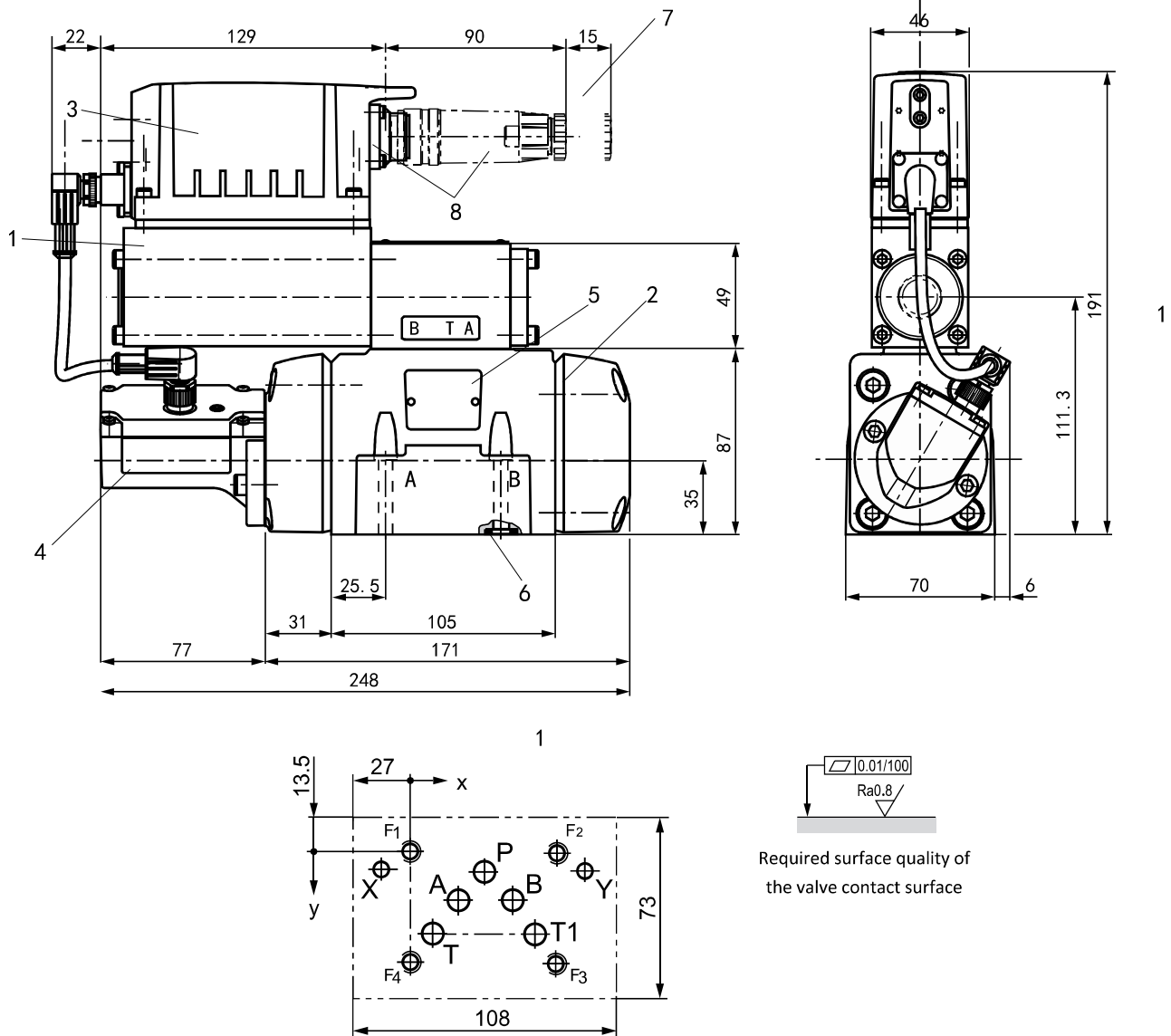
Characteristic curves NS 27 (HLP46 at 40 °C ± 5 °C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)



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

Unit dimensions: NS 10 (Dimensions in mm)



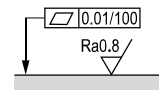
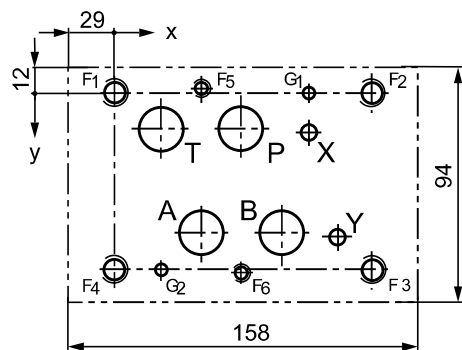
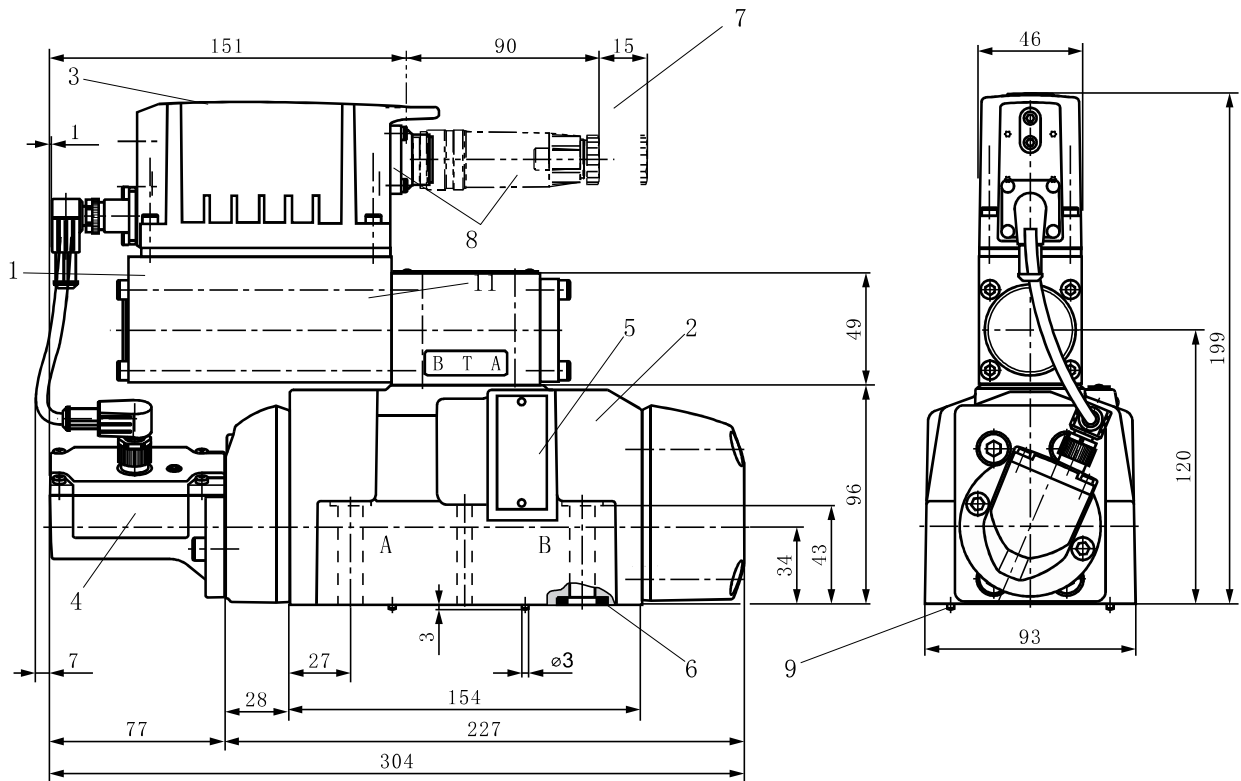
Dimensions in mm	P	A	T	T1	B	F1	F2	F3	F4	X	Y
Diameter/thread	Max. ø11.2	Max. ø11.2	Max. ø11.2	Max. ø11.2	Max. ø11.2	M6	M6	M6	M6	Max. ø6.3	Max. ø6.3
x	27	16.7	3.2	50.8	37.3	0	54	54	0	-8	62
y	6.3	21.4	32.5	32.5	21.4	0	0	46	46	11	11

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 A, B, P, T, X, Y
7. Space required for connection cable and to remove the mating connector

8. Mating connector 6-pole + PE (separate order)
9. Locking pin
10. Machined valve contact surface, porting pattern according to ISO 4401-05-05-0-05

Fixing screws: 4 GB/T 70.1 - M6 x 45 10.9
 Torque: 15.5 Nm $\pm$ 10 %

Unit dimensions: NS 16 (Dimensions in mm)



Required surface quality of the valve contact surface

Dimensions in mm	P	A	T	B	X	Y	G1	G2	F1	F2	F3	F4	F5	F6
Diameter/thread	Max. ø17.5	Max. ø17.5	Max. ø17.5	Max. ø17.5	Max. ø6.3	Max. ø6.3	ø4	ø4	M10	M10	M10	M10	M6	M6
x	50	34.1	18.3	65.9	76.6	88.1	76.6	18.3	0	101.6	101.6	0	34.1	50
y	14.3	55.6	14.3	55.6	15.9	57.2	0	69.9	0	0	69.9	69.9	-1.6	71.5

- Pilot control valve
- Main valve
- Integrated electronics (OBE)
- Inductive position transducer (main valve)
- Name plate
- Identical seal rings for ports A, B, P, T, X, Y
- Space required for connection cable and to remove the mating connector
- Mating connector 6-pole + PE (separate order)
- Locking pin
- Machined valve contact surface, porting pattern according to ISO 4401-07-07-0-05
Deviating from the standard: ports A, B, P, T – ø20 mm

Fixing screws: 4 GB/T 70.1 - M10 x 60 10.9

2 GB/T 70.1-M6x60-10.9

Torque: 75 Nm ± 20 %

