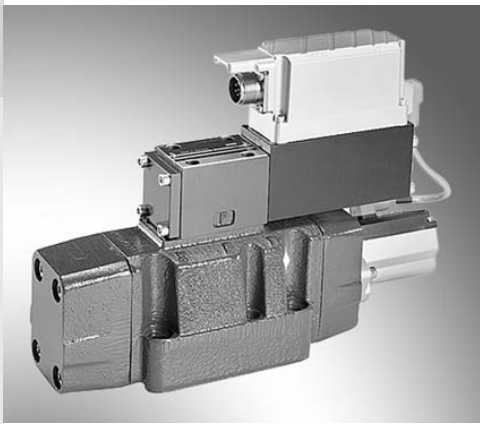
Rexroth
Bosch Group

4/3-way servo solenoid directional control valves, pilot operated, with electrical position feedback and on-board electronics (OBE)

RE 29088/01.16 1/18
Replaces: 10.10

Type 4WRLE 10...35, symbols V/V1

Sizes (NG) 10, 16, 25, 27, 35
Unit series 3X
Maximum working pressure P, A, B 350 bar (NG27: 280 bar)
Nominal flow 40…1000 l/min (Δp = 10 bar)



Type 4WRLE 10...35

List of contents

Features

- Pilot operated 4/3-way servo solenoid directional control valves NG10 to NG35
- Pilot valve NG6, with control piston and sleeve in servo quality, actuated on one side, 4/4 fail-safe position when switched off
- Control solenoid with electric position feedback and on-board electronics (OBE), calibrated at the factory
- Main stage in servo quality with position feedback
- Flow characteristic
  - M = Progressive with fine metering notch
  - P = Non-linear curve
  - L = Linear
- Electrical connection 6P+PE
  Signal input of differential amplifier with interface A1 ±10 V, or interface F1 4...20 mA (R_{sh} = 200 Ω)

For information regarding the available spare parts see:
www.boschrexroth.com/spc

Ordering data

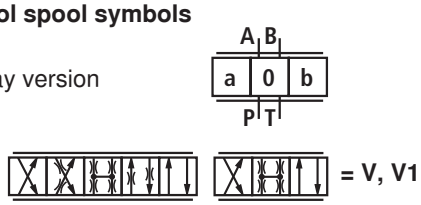
4WRL	E				–3X/	G24	K0/	M	*

With **on-board** electronics **= E**

Sizes
= 10
= 16
= 25
= 27 [1]
= 35 [2]

Control spool symbols

4/3-way version



= V, V1

With V1:
P → A: q_V B → T: $q_V/2$
P → B: $q_V/2$ A → T: q_V

Nominal flow rate
at 10 bar valve pressure difference
(5 bar per metering notch)

NG10
40 l/min [3] **= 40**
55 l/min [4] **= 55**
70 l/min [3] **= 70**
85 l/min [4] **= 85**

NG16
90 l/min [3] **= 90**
120 l/min [4] **= 120**
150 l/min [3] **= 150**
200 l/min [4] **= 200**

NG25
300 l/min [3] **= 300**
370 l/min [4] **= 370**

NG27
430 l/min [1] [4] **= 430**

NG35
1000 l/min [2] [4] **= 1000**

Further information in plain text

Seal material
M = NBR seals, suitable for mineral oils (HL, HLP) to DIN 51524

Interface for trigger electronics
A1 = Setpoint input ±10 V
F1 = Setpoint input 4…20 mA

Electrical connection
K0 = **without** plug-in connector, with plug to DIN 43563-AM6
Order plug-in connector separately

Control oil inlet "x" control oil return "y"
No desig. = "x" = external "y" = external
E = "x" = internal "y" = external
ET = "x" = internal "y" = internal
T = "x" = external "y" = internal

Power supply of trigger electronics
G24 = +24 V DC

3X = Unit series 30 to 39
(installation and connection dimensions unchanged)

Flow characteristic
M = Progressive with linear fine metering
P = Non-linear curve, linear (kink at 40 %)
L = Linear

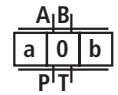
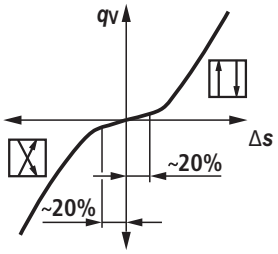
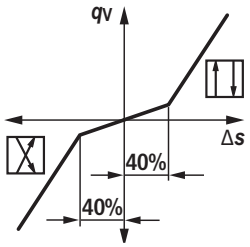
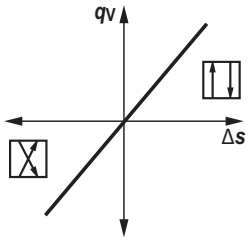
[1] NG27 is a high-flow version of NG25, ports P, A, B and T have ∅ 32 mm in the main stage. Contrary to standard ISO 4401-08-08-0-05, ports P, A, B and T may be drilled to max. ∅ 30 mm in the control block. These valves therefore offer higher flow rates $q_{VA} : q_{VB}$

[2] NG35 is a high-flow version of NG32, ports P, A, B and T have ∅ 50 mm in the main stage. Contrary to standard ISO 4401-10-09-0-05, ports P, A, B and T may be drilled to max. ∅ 48 mm in the control block. These valves therefore offer higher flow rates $q_{VA} : q_{VB}$

[3] q_{VN}: Flow characteristic "P"

[4] q_{VN}: Flow characteristic "M" or "L"

Symbols

	M: Progressive with fine metering	P: Non-linear, linear (40 %)	L: Linear
			

Testing and service equipment

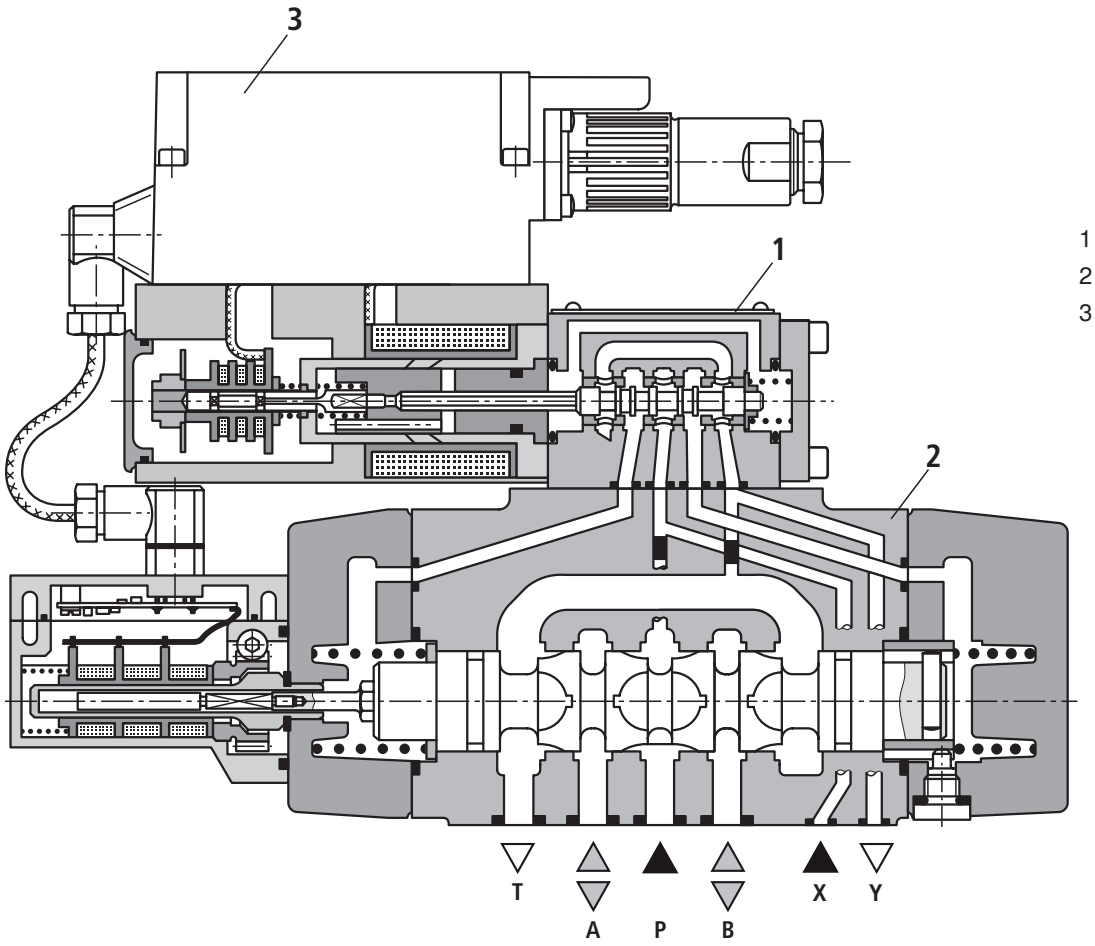
– Service case type VT-VETSY-1 with test device, see data sheet 29685
– Measuring adapter 6P+PE type VT-PA-2, see data sheet 30068

Function, sectional diagram

Construction

The valve consists of three main assemblies:

– Pilot valve (1) with control spool and sleeve, return springs, control solenoid and inductive position transducer
– Main stage (2) with centering springs and position feedback
– On-board trigger electronics (3)



1 Pilot valve
2 Main stage
3 Trigger electronics

Functional description

When the control solenoid is not actuated, the control spool is held by springs in the fail-safe position, and the main stage spool remains in spring-centered offset position at 1…6% of the stroke in the direction P-B/A-T.
In the on-board electronics, the pre-defined setpoint is compared with the actual value for the position of the main stage control spool. In the event of an error signal, the control solenoid is actuated, and the pilot spool is moved as the magnetic force changes. The flow released through the control cross-sections causes the main control spool to move. The stroke/control cross-section of the main control spool is controlled proportionately to the setpoint. If the input setpoint is 0 V, the electronics move the main stage control spool to mid position.
The control oil is conveyed to the pilot valve either internally via port P or externally via port X. The oil returns to the tank internally via port T or externally via port Y.

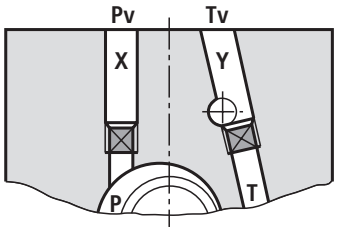
Power failure

In the event of a power failure or an open circuit, the on-board electronics cut off the electricity to the control solenoid and the pilot spool moves to the fail-safe position, relieving the control oil chambers of the main stage.
The main stage control spool is held by springs in the offset position.

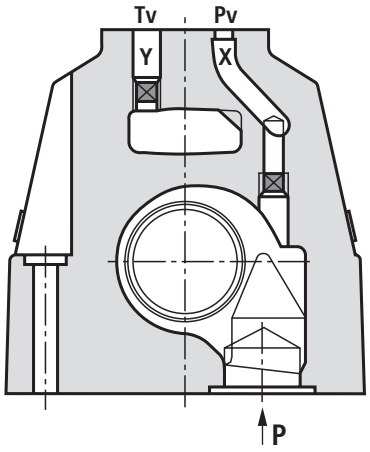
Control oil supply

The pilot valve can be supplied both via ports X and Y (externally) and via the main flow channels P and T.

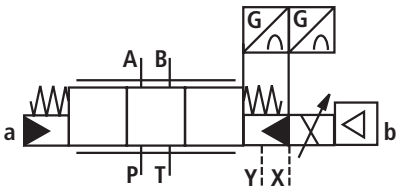
NG10, 25, 27, 35



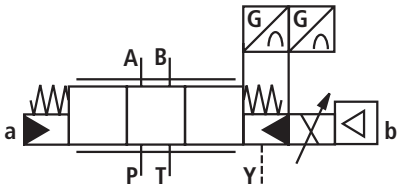
NG16



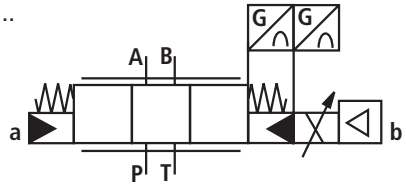
Type...–3X...



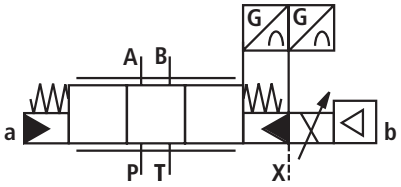
Type...–3X...E...



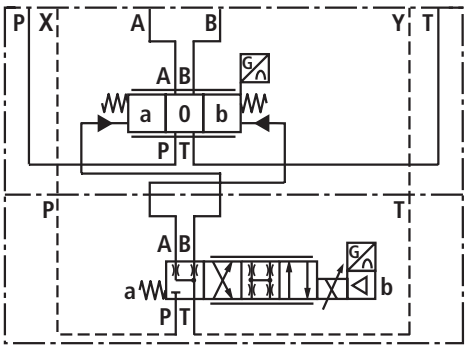
Type...–3X...ET...



Type...–3X...T...



Symbol in detail
(external control oil inlet and outlet)



No designation =	“x” = external	“y” = external
E =	“x” = internal	“y” = external
ET =	“x” = internal	“y” = internal
T =	“x” = external	“y” = internal

Important

Hydraulic symbols are largely derived from the symbols of the switching valves. 4/3-way servo solenoid directional control valves (pilot operated) do not have a closed mid position when switched off! They only perform their function in an active, closed control loop, even if the pilot valve features a fail-safe 4th position. See technical data for details on “switch-off behavior”.

Technical data

General

Construction		Spool type valve, pilot operated				
Actuation		Servo solenoid directional control valve NG6 OBE, with position controller for pilot valve and main stage				
Type of mounting		Subplate, mounting hole configuration NG10...35 to ISO 4401-...				
Installation position		Optional				
Ambient temperature range	°C	–20...+50				
Weight	kg	**NG10** 8.7	**NG16** 10.6	**NG25** 18.4	**NG27** 18.4	**NG35** 81
Vibration resistance, test condition		Max. 25 *g*, shaken in 3 dimensions (24 h)				

Hydraulic (measured with HLP 46, ϑ_{oil} = 40 °C ±5 °C)

Pressure fluid		Hydraulic oil to DIN 51524…535, other fluids after prior consultation				
Viscosity range	recommended mm²/s	20...100				
	max. permitted mm²/s	10...800				
Pressure fluid temperature range	°C	–20...+70				
Maximum permissible degree of contamination of pressure fluid Purity class to ISO 4406 (c)		Class 18/16/13 [1]				
Flow direction		See symbol				
Nominal flow at Δp = 5 bar per notch [2]	l/min	**NG10**: 40, 55, 70, 85	**NG16**: 90, 120, 150, 200	**NG25**: 300, 370	**NG27**: 430	**NG35**: 1000
Max. working pressure Ports P, A, B External control oil inlet	bar	350	350	350	280	350
Ports P, A, B Internal control oil inlet	bar	250				
Ports T, X, Y	bar	250				
Min. control oil pressure in “pilot stage”	bar	10				
q_{Vmax}	l/min	170	450	900	1000	3500
q_{VN} pilot valve	l/min	4	12	24	24	40
Zero flow of pilot valve at 100 bar	cm³/min	< 180	< 300	< 500	< 500	< 900
Zero flow of main stage at 100 bar	cm³/min	< 400 / < 600	< 1000	< 1000	< 1000	< 6000

Static/Dynamic

Hysteresis	%	< 0.1, scarcely measurable				
Manufacturing tolerance for Q_{max}	%	≦ 10				
Response time for signal change (at X = 100 bar)	0...100 %	25	26	32	32	90
	0...10 %	14	15	18	18	40
Response time for signal change (at X = 10 bar)	0...100 %	85	80	120	120	350
	0...10 %	50	30	50	50	150
Switch-off behavior		After electrical switch-off: Pilot valve in fail-safe Main stage moves to spring-centered “offset position”: 1…6% P-B/A-T				
Thermal drift		Zero point displacement < 1 % at ΔT = 40 °C				
Zero adjustment		Factory-set ±1 %				

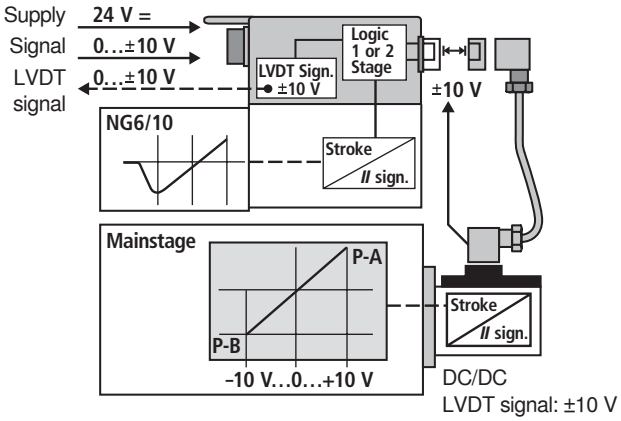
[1] The purity classes stated for the components must be complied with in hydraulic systems.
Effective filtration prevents problems and also extends the service life of components.
For a selection of filters, see www.boschrexroth.com/filter.

[2] Flow rate at a different Δp $q_{Vx} = q_{Vnom} \cdot \sqrt{\frac{\Delta p_x}{5}}$

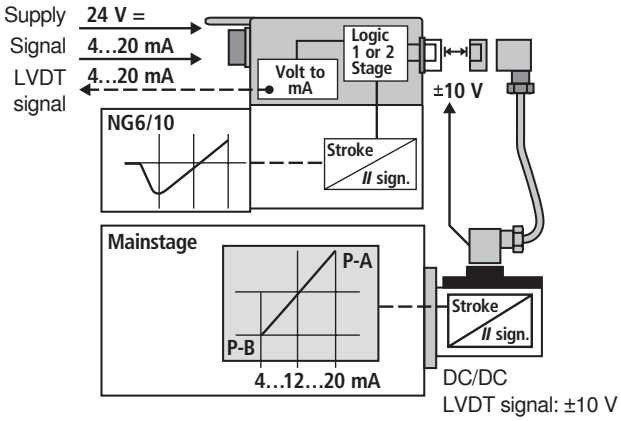
Technical data

Electric pilot valve NG6, trigger electronics integrated in the valve	
Cyclic duration factor %	100 ED
Degree of protection	IP 65 to DIN 40050 and IEC 14434/5
Connection	Plug-in connector 6P+PE, DIN 43563
Power supply Terminal A: Terminal B: 0 V	24 V DC_{nom} min. 21 V DC/max. 40 V DC Ripple max. 2 V DC
Max. power consumption	40 VA
External fuse	2,5 A_F
Input, “Standard” version Terminal D: U_E Terminal E:	Differential amplifier, R_i = 100 kΩ 0... ±10 V 0 V
Input, “mA signal” version Terminal D: $I_{D–E}$ Terminal E: $I_{D–E}$	Burden, Rsh = 200 Ω 4...(12)...20 mA Current loop $I_{D–E}$ feedback
Max. differential input voltage at 0 V	D → B E → B } max. 18 V DC
Test signal, “Standard” version Terminal F: U_{Test} Terminal C:	LVDT 0...±10 V Reference 0 V
Test signal, “mA signal” version Terminal F: $I_{F–C}$ Terminal C: $I_{F–C}$	LVDT signal 4...20 mA at external load 200...500 Ω max. 4...20 mA output Current loop $I_{F–C}$ feedback
Protective conductor and screen	See pin assignment (CE-compliant installation)
Calibration	Calibrated at the factory, see valve characteristic curve
Electromagnetic compatibility tested according to	EN 61000-6-2: 2005-08 EN 61000-6-3: 2007-01

Version A1: Standard



Version F1: mA signal

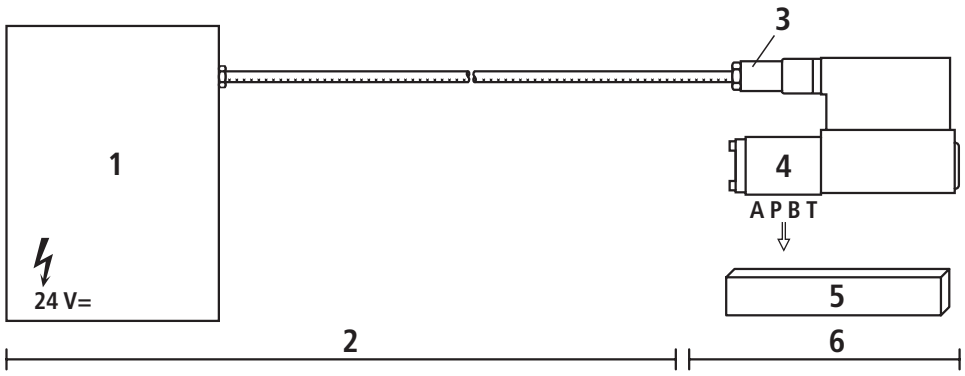


Important

Pilot operated 4/3-way servo solenoid directional control valves only perform their function in an active closed control loop and do not have a fail-safe position when switched off. For this reason, many applications require the use of “external check valves”, which must be taken into account during the On/Off switching sequence.

Electric connection

For electrical data, see page 7



1 Control
2 Provided by customer
3 Plug-in connector
4 Valve
5 Connecting surface
6 Provided by Rexroth

Technical notes on the cable

Version:
- Multi-wire cable
- Extra-finely stranded wire to VDE 0295, Class 6
- Protective conductor, green/yellow
- Cu braided screen

Types:
- e.g. Ölflex-FD 855 CP (from Lappkabel company)

No. of wires:
- Determined by type of valve, plug types and signal assignment

Cable Ø:
- 0.75 mm^2 to 20 m length
  1.0 mm^2 to 40 m length

Outside Ø:
- 9.4...11.8 mm – Pg11
  12.7...13.5 mm – Pg16

Note

Voltage supply 24 V $DC_{nom.}$,
if voltage drops below 18 V DC, rapid shutdown resembling "Enable OFF" takes place internally.
In addition, with the "mA signal" version:
$I_{D-E} \geqq 3$ mA – valve is active
$I_{D-E} \leqq 2$ mA – valve is deactivated.

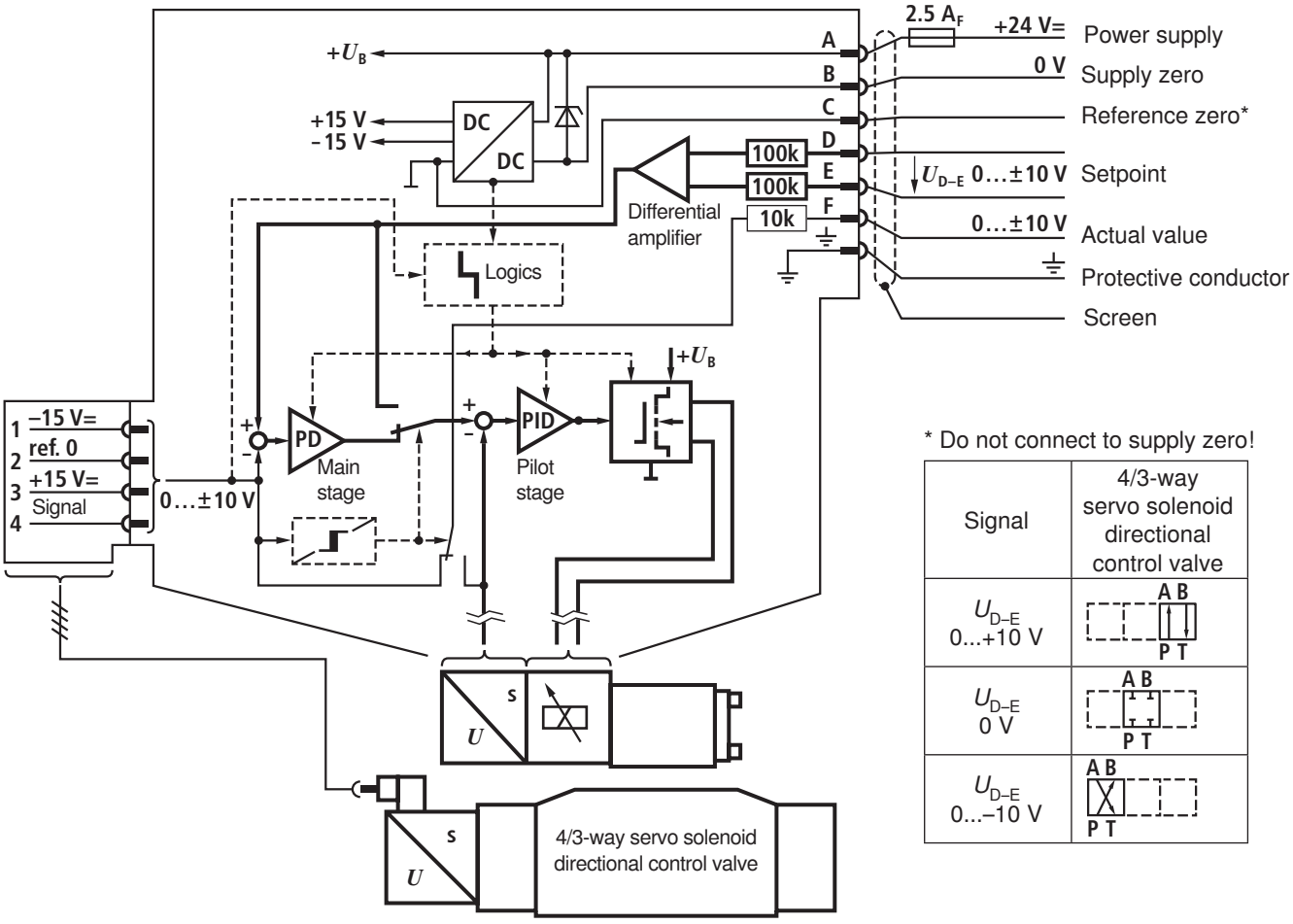
Electrical signals emitted via the trigger electronics (e.g. actual values) must not be used to shut down safety-relevant machine functions!

(See European Standard, "Technical Safety Requirements for Fluid-Powered Systems and Components – Hydraulics", EN 982.)

On-board electronics

Block diagram/pin assignment

Version A1: U_{D-E} ±10 V

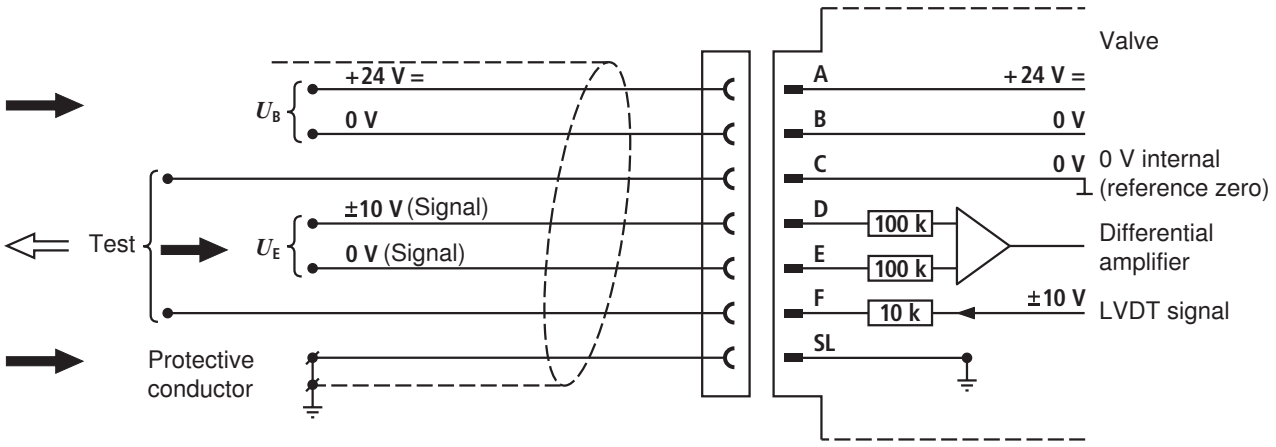


* Do not connect to supply zero!

Signal	4/3-way servo solenoid directional control valve
U_{D-E} 0...+10 V	
U_{D-E} 0 V	
U_{D-E} 0...–10 V	

Pin assignment 6P+PE

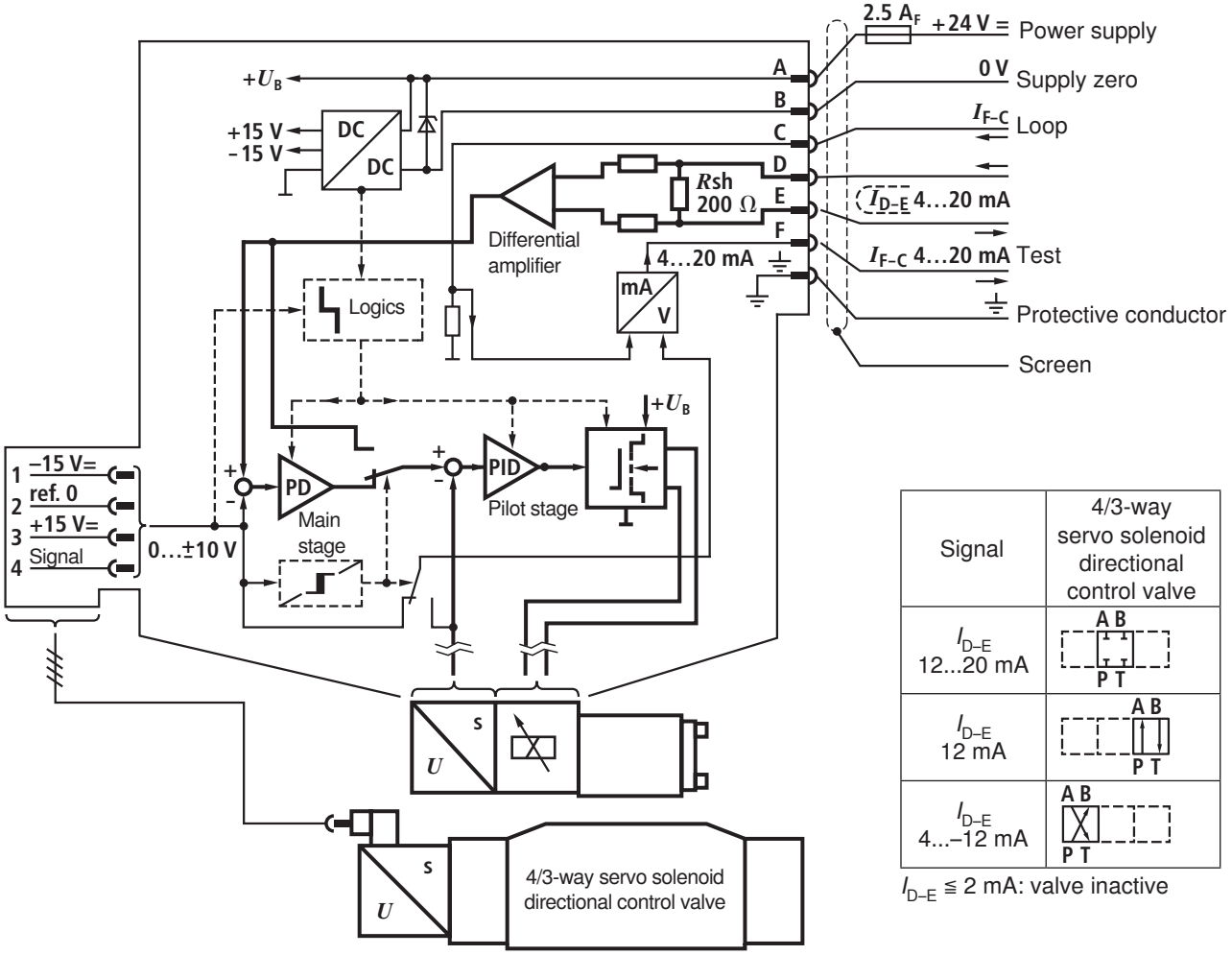
Version A1: U_{D-E} ±10 V
(R_i = 100 kΩ)



On-board electronics

Block diagram/pin assignment

Version F1: I_{D-E} 4...12...20 mA

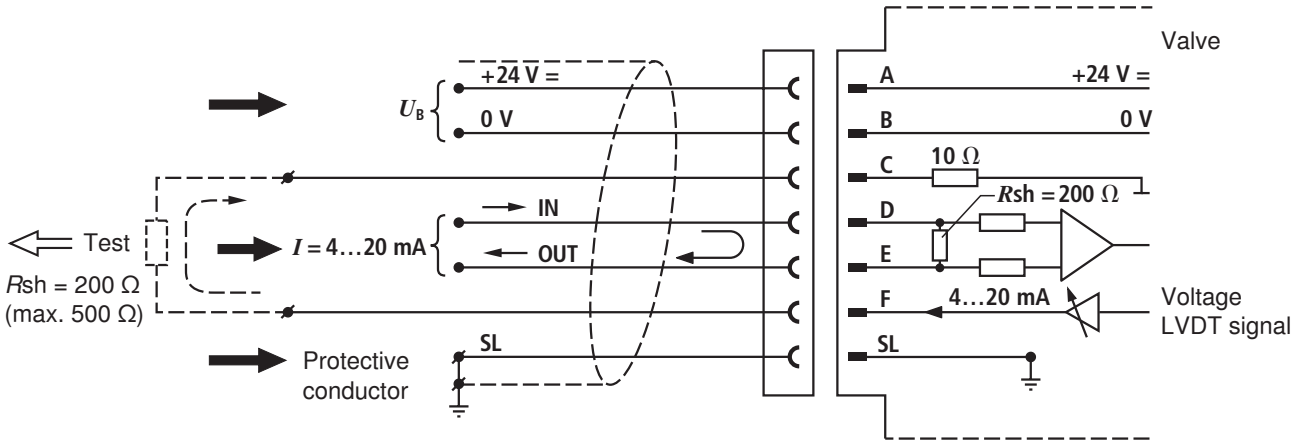


Signal	4/3-way servo solenoid directional control valve
I_{D-E} 12...20 mA	
I_{D-E} 12 mA	
I_{D-E} 4...–12 mA	

I_{D-E} ≦ 2 mA: valve inactive

Pin assignment 6P+PE

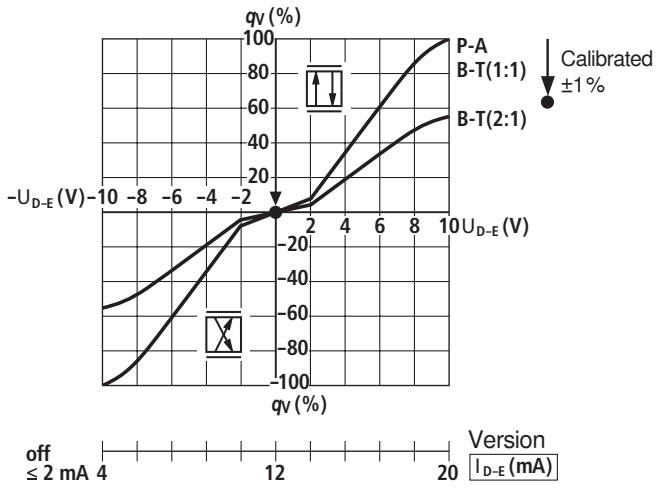
Version F1: I_{D-E} 4...12...20 mA
(*R*sh = 200 Ω)



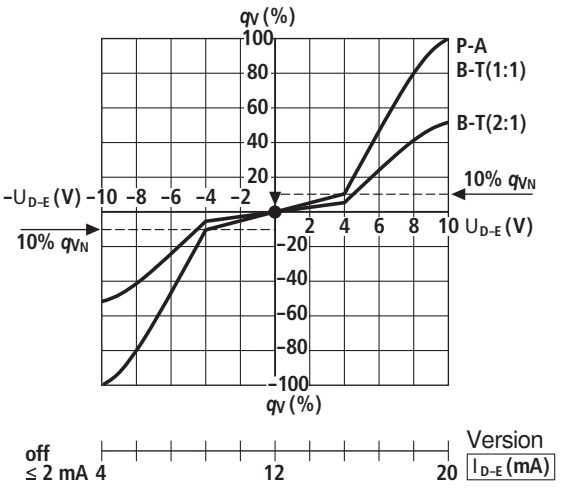
Characteristic curves (measured with HLP 46, ϑ_{oil} = 40 °C ±5 °C)

Flow rate – signal function $q_V = f(U_{D-E})$
$q_V = f(I_{D-E})$

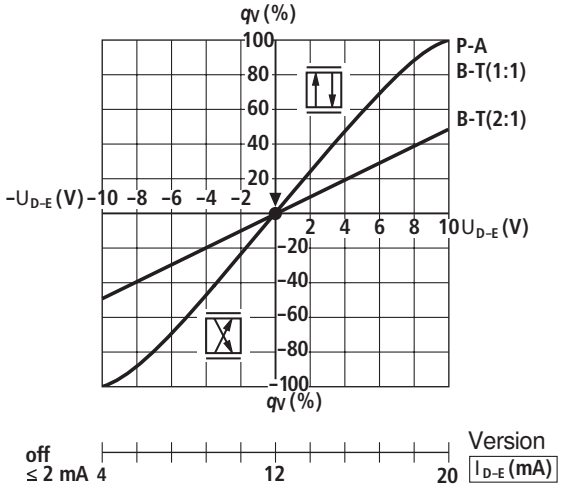
Flow characteristic M



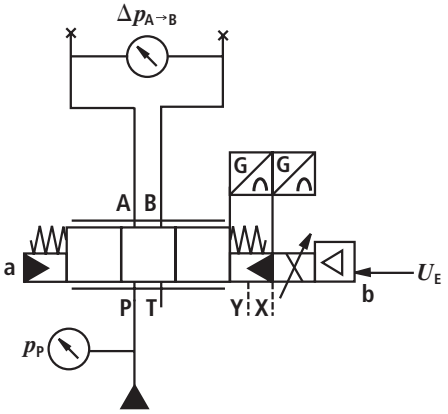
Flow characteristic P

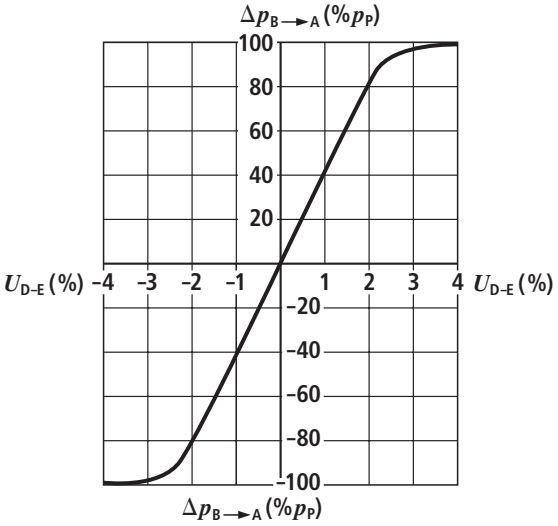


Flow characteristic L



Pressure gain

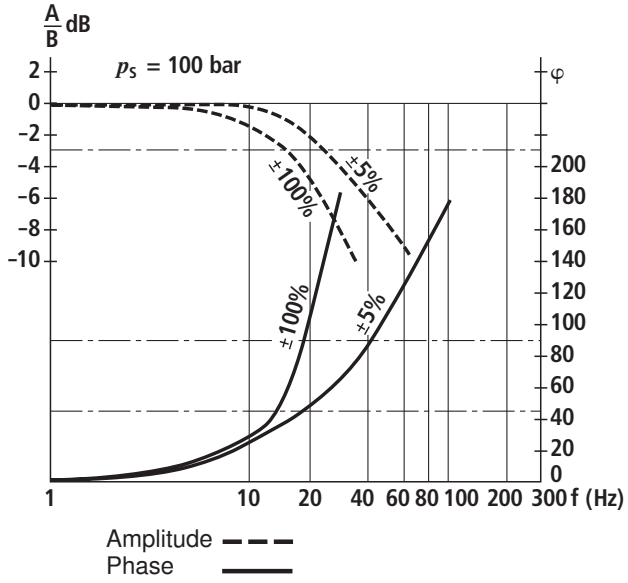




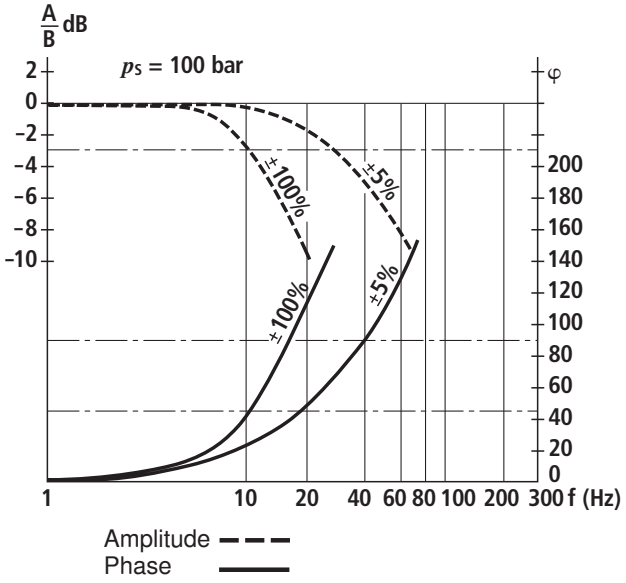
Characteristic curves (measured with HLP 46, ϑ_{oil} = 40 °C ±5 °C)

Bode diagram

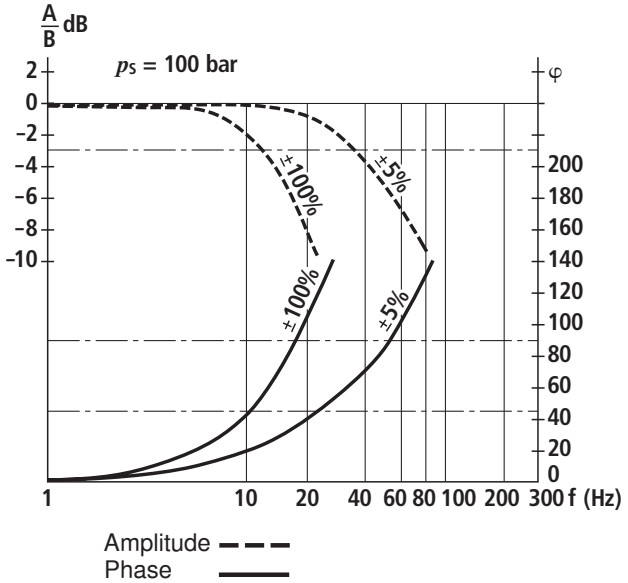
NG10



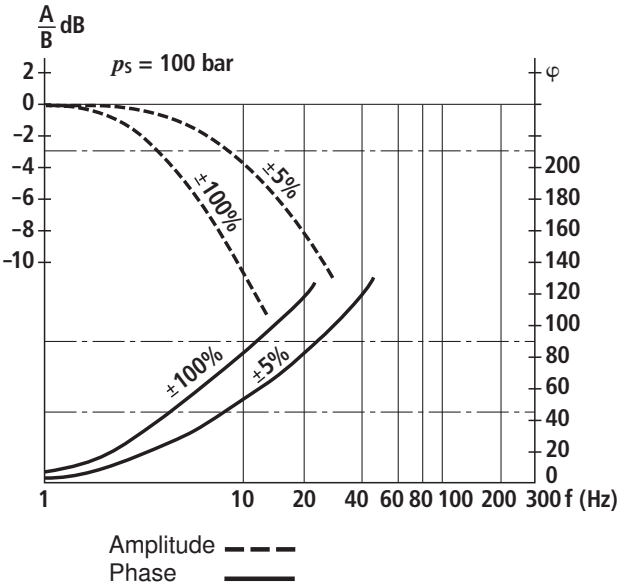
NG16



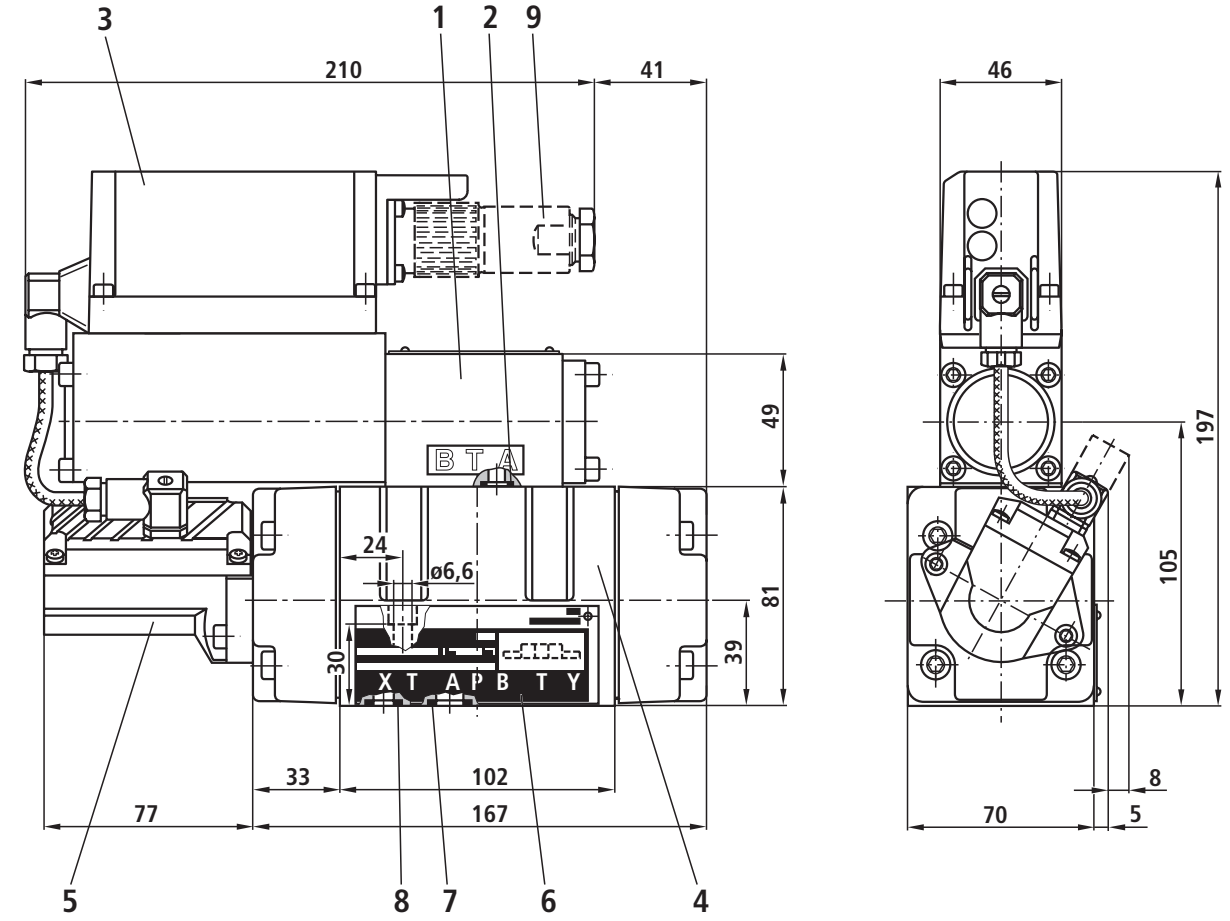
NG25/27

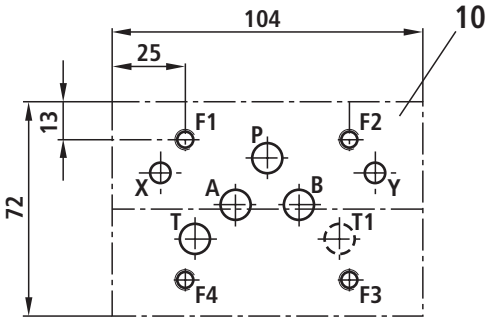


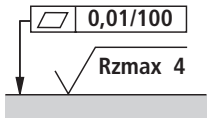
NG35



Unit dimensions NG10 (dimensions in mm)







Required surface quality of valve mounting face

1 Pilot valve
2 O-ring 9.25 x 1.78 (ports P, A, B, T)
3 On-board electronics
4 Main valve
5 Inductive position transducer (main valve)
6 Nameplate
7 O-ring 12 x 2 (ports P, A, B, T, T1)
8 O-ring 10 x 2 (ports X, Y)
9 Plug-in connector not included in delivery, see data sheet 08008 (order separately)

10 Machined valve contact surface, mounting hole configuration according to ISO 4401-05-05-0-05
Deviates from standard:
Ports P, A, B, T, T1 ∅ 10.5 mm
Minimum thread depth: Ferrous metal 1.5 x ∅
Non-ferrous 2 x ∅

Subplates, see data sheet 45054 (order separately)

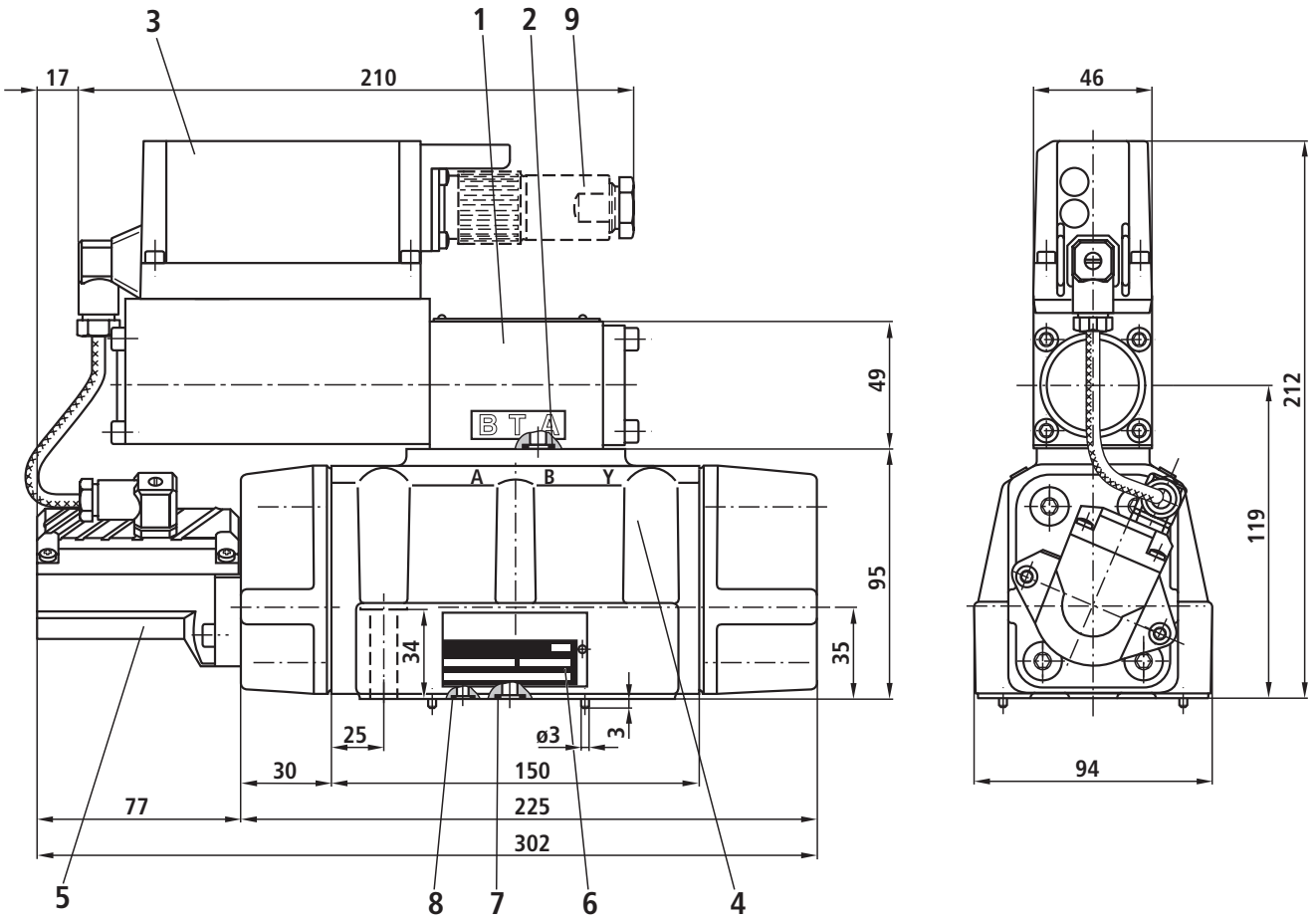
Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

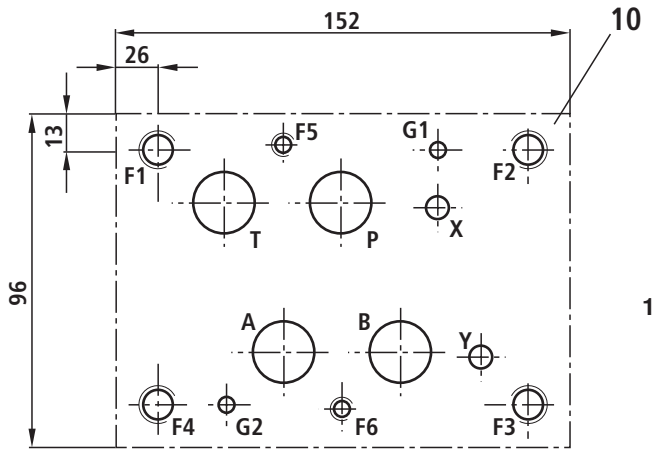
4 cheese-head bolts ISO 4762-M6x40-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)

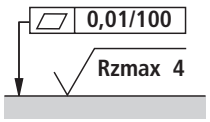
Tightening torque M_A = 11+3 Nm

Material no. **2910151209**

Unit dimensions NG16 (dimensions in mm)







Required surface quality of valve mounting face

1 Pilot valve

2 O-ring 9.25 x 1.78 (ports P, A, B, T)

3 On-board electronics

4 Main valve

5 Inductive position transducer (main valve)

6 Nameplate

7 O-ring 23 x 2.5 (ports P, A, B, T)

8 O-ring 9 x 2 (ports X, Y)

9 Plug-in connector not included in delivery, see data sheet 08008 (order separately)

10 Machined valve contact surface, mounting hole configuration according to ISO 4401-07-07-0-05

Deviates from standard:
Ports P, A, B, T ∅ 20 mm
Minimum thread depth: Ferrous metal 1.5 x ∅
Non-ferrous 2 x ∅

Subplates, see data sheet 45057 (order separately)

Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

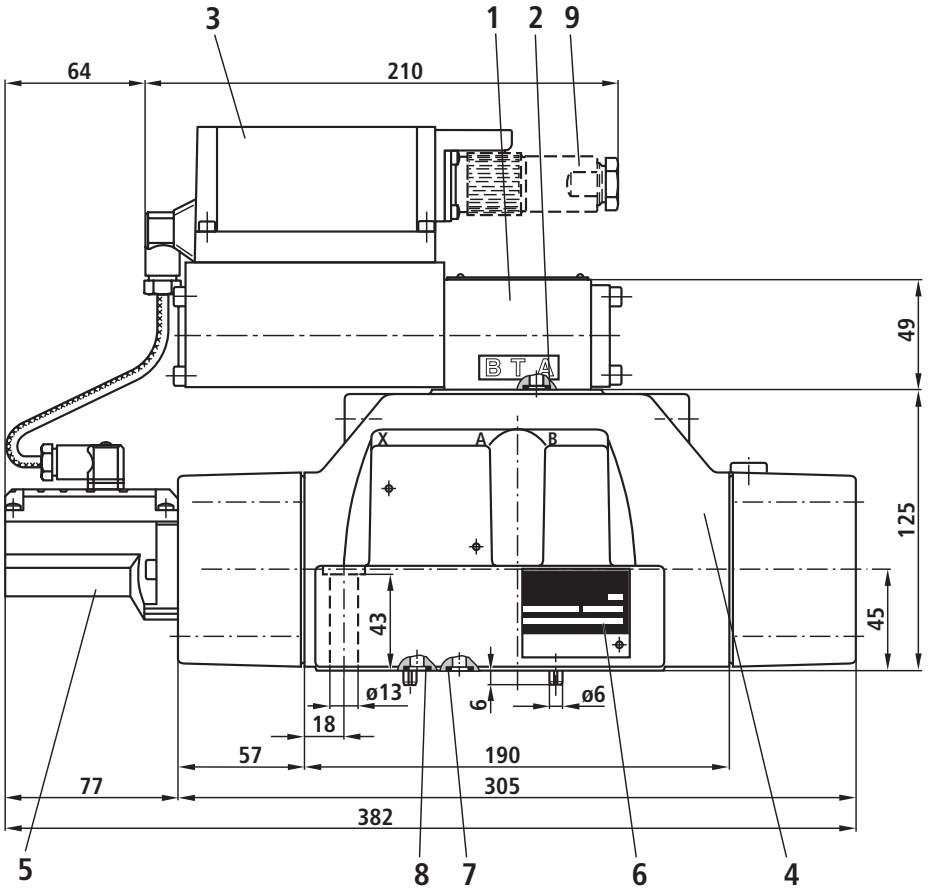
2 cheese-head bolts ISO 4762-M6x45-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 11+3 Nm

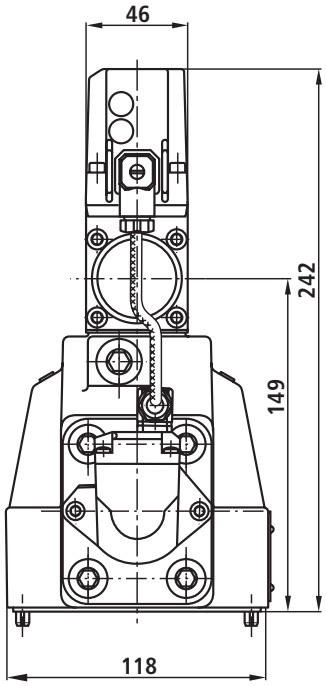
Material no. **2910151211**

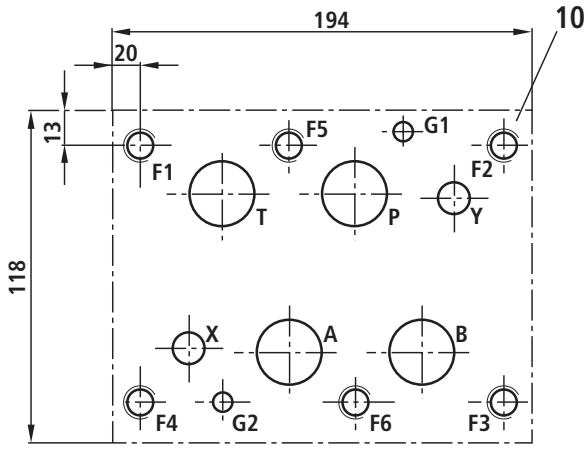
4 cheese-head bolts ISO 4762-M10x50-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 50+10 Nm

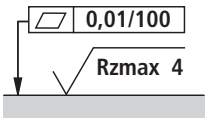
Material no. **2910151301**

Unit dimensions NG25/27 (dimensions in mm)









Required surface quality of valve mounting face

1 Pilot valve

2 O-ring 9.25 x 1.78 (ports P, A, B, T)

3 On-board electronics

4 Main valve

5 Inductive position transducer (main valve)

6 Nameplate

7 O-ring (ports P, A, B, T)
NG25: 28 x 3
NG27: 34.6 x 2.62

8 O-ring 15 x 2.5 (ports X, Y)

9 Plug-in connector not included in delivery, see data sheet 08008 (order separately)

10 Machined valve contact surface, mounting hole configuration according to ISO 4401-08-08-0-05
Deviates from standard:
NG25: Ports P, A, B, T ∅ 25 mm
NG27: Ports P, A, B, T ∅ 32 mm
Minimum thread depth: Ferrous metal 1.5 x ∅
Non-ferrous 2 x ∅

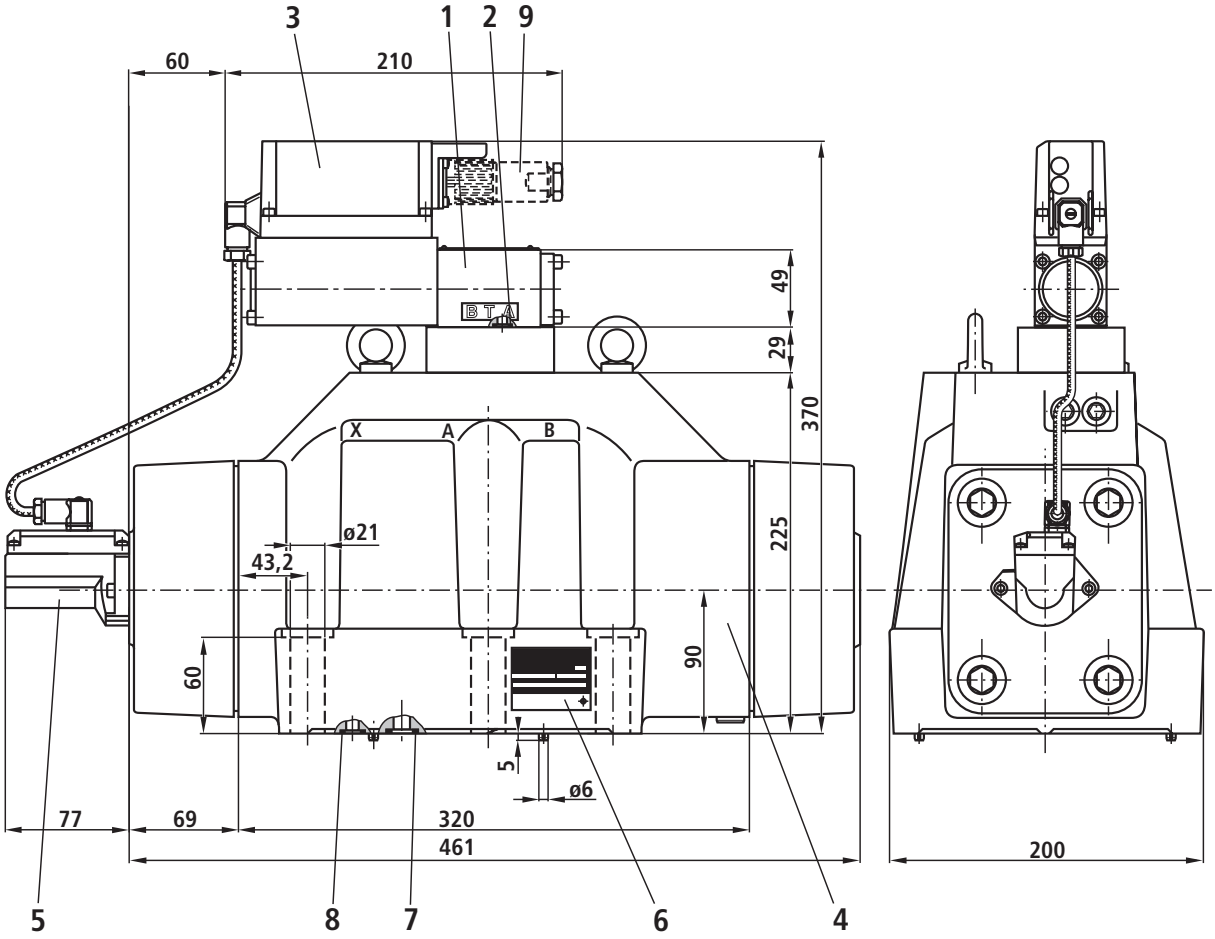
Subplates, see data sheet 45059 (order separately)

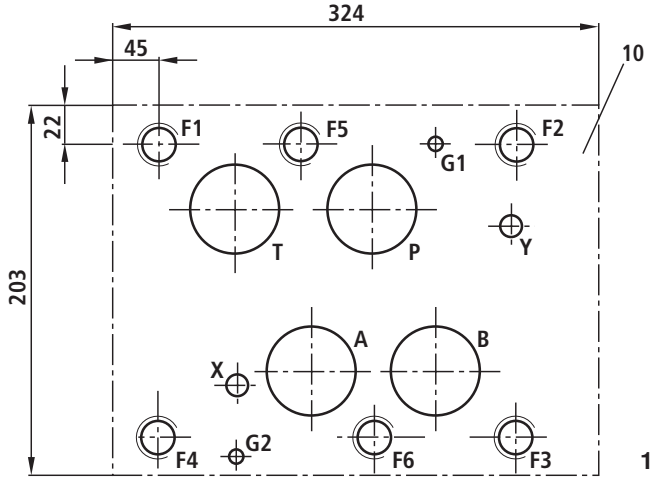
Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

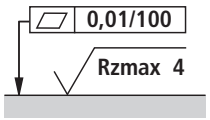
6 cheese-head bolts ISO 4762-M12x60-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque NG25 M_A = 90+30 Nm,
NG27 M_A = 90±15 Nm

Material no. **2910151354**

Unit dimensions NG35 (dimensions in mm)







Required surface quality of valve mounting face

1 Pilot valve

2 O-ring 9.25 x 1.78 (ports P, A, B, T)

3 On-board electronics

4 Main valve

5 Inductive position transducer (main valve)

6 Nameplate

7 O-ring 53.57 x 3.53 (ports P, A, B, T)

8 O-ring 15 x 2.5 (ports X, Y)

9 Plug-in connector not included in delivery, see data sheet 08008 (order separately)

10 Machined valve contact surface, mounting hole configuration according to ISO 4401-10-09-0-05

Deviates from standard:
Ports P, A, B, T ∅ 48 mm
Minimum thread depth: Ferrous metal 1.5 x ∅
Non-ferrous 2 x ∅

Subplates, see data sheet 45060 (order separately)

Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

6 cheese-head bolts ISO 4762-M20x90-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 450+110 Nm

Material no. **2910151532**

Notes

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Telefon +49 (0) 93 52 / 18-0
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Telefon +49 (0) 93 52 / 18-0
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Telefon +49 (0) 93 52 / 18-0
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de