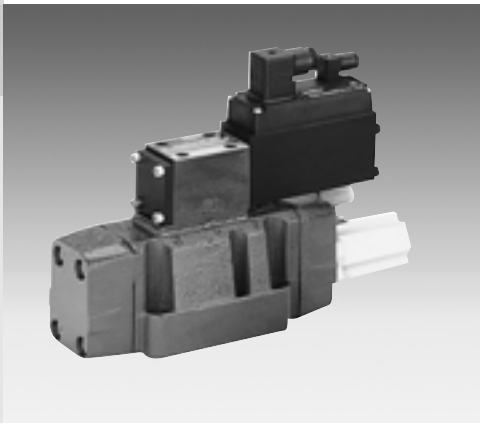
4/3-way servo solenoid directional control valves, pilot operated, with electrical position feedback (Lvdt DC/DC ±10V)

RE 29086/01.09
Replaces: 01.05

Type 4WRL 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 rate 55...1000 l/min (Δp = 10 bar)

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

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 electrical position feedback and electronics for position transducer (Lvdt DC/DC)
- Main stage in servo quality with position feedback
- Flow characteristic
  - M = Progressive with fine metering notch
  - P = Non-linear curve
  - L = Linear
- For subplate attachment, mounting hole configuration NG10 to ISO 4401-05-05-0-05, NG16 to ISO 4401-07-07-0-05, NG25/27 to ISO 4401-08-08-0-05 and NG35 to ISO 4401-10-09-0-05
- Subplates as per Technical Data Sheet, NG10 RE 45055, NG16 RE 45057, NG25/27 RE 45059 and NG35 RE 45060 (order separately)
- Plug-in connectors to DIN 43560-AM2
  Solenoid 2P+PE/M16 x 1.5, position transducer 4P/Pg7 included in delivery, see Technical Data Sheet RE 08008
- External trigger electronics (order separately)
  - Electric amplifier for standard curve “M” and “L”
  - Electric amplifier for non-linear curve “P”

Ordering data

4WRL | | | | | **–3X/G24** | | **Z4/M** | *

Further information in plain text

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

Electrical connection

Z4 = **with** plug-in connector, with plug to DIN 43560-AM2 Plug-in connector included in delivery

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

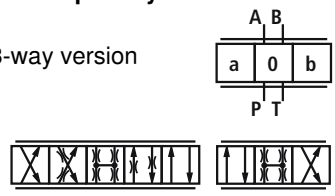
M = Progressive with linear fine metering
P = Non-linear curve, linear (kink at 40 %)
L = Linear

For **external** trigger electronics **= no desig.**

NG10	**= 10**
NG16	**= 16**
NG25	**= 25**
NG27 [1]	**= 27**
NG35 [2]	**= 35**

Control spool symbols

4/3-way version



= V, V1

With symbol 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	
55 l/min [4]	**= 55**
70 l/min [3]	**= 70**
85 l/min [4]	**= 85**
NG16	
100 l/min [3]	**= 55**
120 l/min [4]	**= 70**
150 l/min [3]	**= 85**
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**

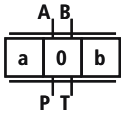
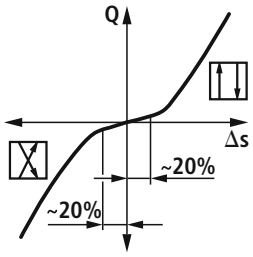
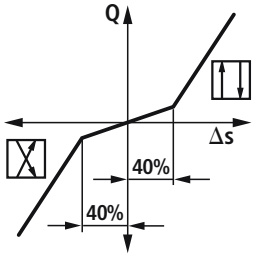
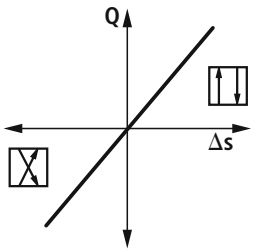
[1] NG27 is a high-flow version of NG25, ports P, A, B and T have ∅ 32 mm in the main stage. Contrary to standard ISO 4401-08-08-0-05, ports P, A, B and T may be drilled to max. ∅ 30 mm in the control block. These valves therefore offer higher flow rates Q_A : Q_B

[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_A : Q_B

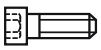
[3] Q_N: Flow characteristic “P”

[4] Q_N: Flow characteristic “M” or “L”

Symbols

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

Accessories, not included in delivery

Valve fastening bolts 	NG10	4 x ISO 4762-M6 x 40-10.9-N67F821 70	**2 910 151 209**
	NG16	2 x ISO 4762-M6 x 45-10.9-N67F821 70	**2 910 151 211**
		4 x ISO 4762-M10 x 50-10.9-N67F821 70	**2 910 151 301**
	NG25/27	6 x ISO 4762-M12 x 60-10.9-N67F821 70	**2 910 151 354**
	NG35	6 x ISO 4762-M20 x 90-10.9-N67F821 70	**2 910 151 532**
	VT-VRRA1-527-20/V0/2STV, see RE 30045		**0 811 405 063**
	VT-VRRA1-527-20/V0/K40-AGC-2STV, see RE30043		**0 811 405 068**
	2P+PE (M16 x 1.5) and 4P (Pg7) included in delivery, also see RE 08008		

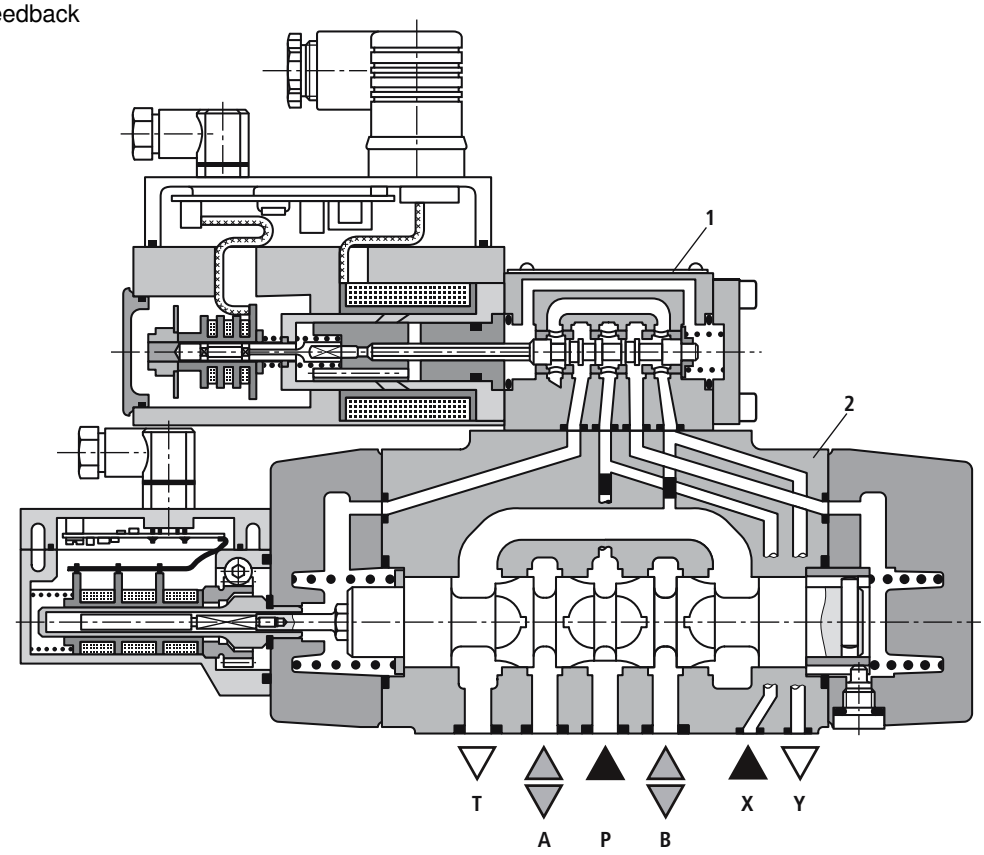
Testing and service equipment

– Test box type VT-PE-TB2, see RE 30064
– Test adapter type VT-PA-3, see RE 30070

Function, sectional diagram

Construction

The valve consists of two 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



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 mid 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.

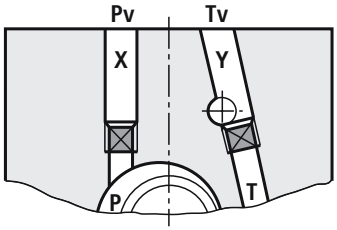
Power failure

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 mid position.

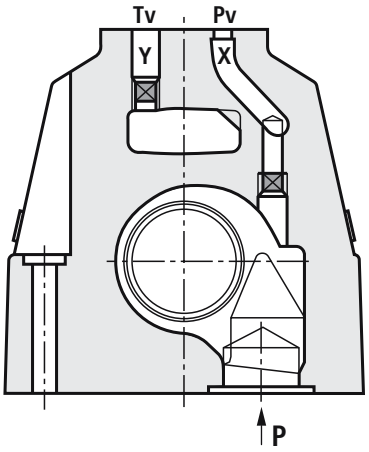
Control oil supply

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

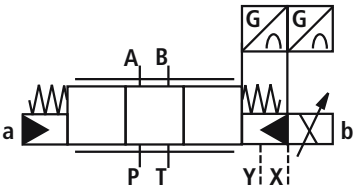
NG10, 25, 27, 35



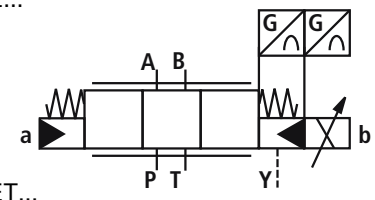
NG16



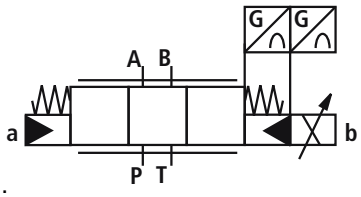
Type...–3X...



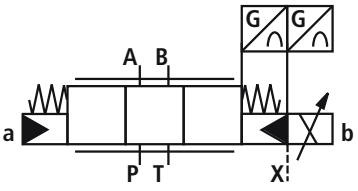
Type...–3X...E...



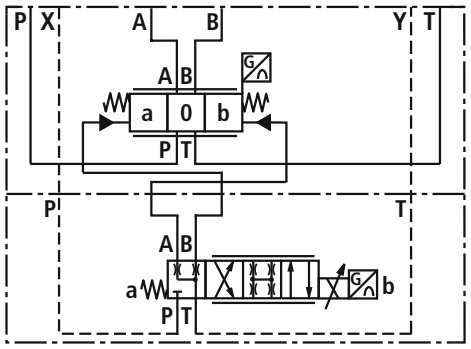
Type...–3X...ET...



Type...–3X...T...



Symbol in detail
(external control oil inlet and outlet)



Main valve

Pilot valve

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, with position controller for pilot valve and main stage, external electric amplifier				
Type of mounting		Subplate, mounting hole configuration NG10...35 to ISO 4401-...				
Installation position		Optional				
Ambient temperature range	°C	–20...+50				
Weight	kg	**NG10** 8.35	**NG16** 10	**NG25** 18	**NG27** 18	**NG35** 80
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...+80													
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**			**NG16**				**NG25**		**NG27**	**NG35**			
			55	70	85	100	120	150	200	300	370	430	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_{max}		l/min	170			450				900		1000	3500			
Q_N pilot valve		l/min	4			12				24		24	40			
Leakage of pilot valve at 100 bar		cm³/min	<180			<300				<500		<500	<900			
Leakage 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			40				45		45	130			
	0...10%		15			18				20		20	60			
Response time for signal change (at X = 10 bar)	0...100%		85			90				150		150	500			
	0...10%		50			40				80		80	200			
Switch-off behavior			After electrical switch-off: pilot valve in fail-safe Main stage moves to spring-centered “mid position”: 1…6% P-B/A-T													
Thermal drift			Zero point displacement <1% at ΔT = 40 °C													
Zero adjustment			Adjustable ±5% via valve amplifier													

[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 Technical Data Sheets RE 50070, RE 50076 and RE 50081.

[2] Flow rate at a different Δp $Q_x = Q_{nom} \cdot \sqrt{\frac{\Delta p_x}{5}}$

Technical data

Electrical

Cyclic duration factor	%	100 ED	
Power supply		24 V DC_{nom} (external electric amplifier)	
Degree of protection		IP 65 to DIN 40050	
Solenoid connector		Connector DIN 43560/ISO 4400 M16x1.5 (2P+PE)	
Position transducer connector		Connector Pg7 (4P)	
Max. solenoid current	A	2.7	
Coil resistance R_{20}	Ω	2.5	
Max. power consumption at 100% load and operating temperature	VA	40	
Position transducer DC/DC technology		Supply: +15 V/35 mA –15 V/25 mA	Signal: 0...±10 V ($R_L \geqq 10$ kΩ)

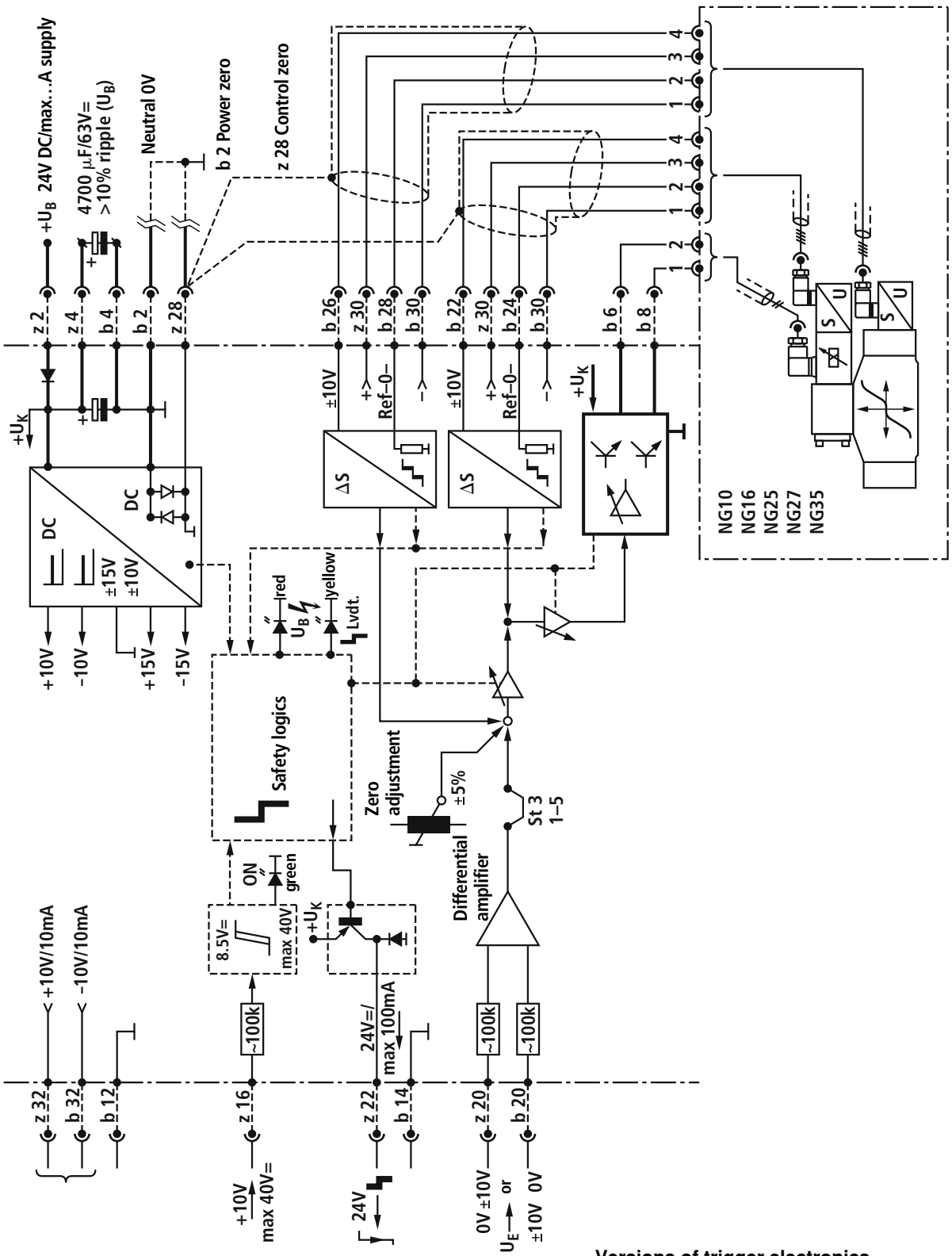
All characteristics only in connection with valve amplifier 0 811 405 063

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.

Valve with external trigger electronics (standard linear curve: M, L)

Block diagram/pin assignment

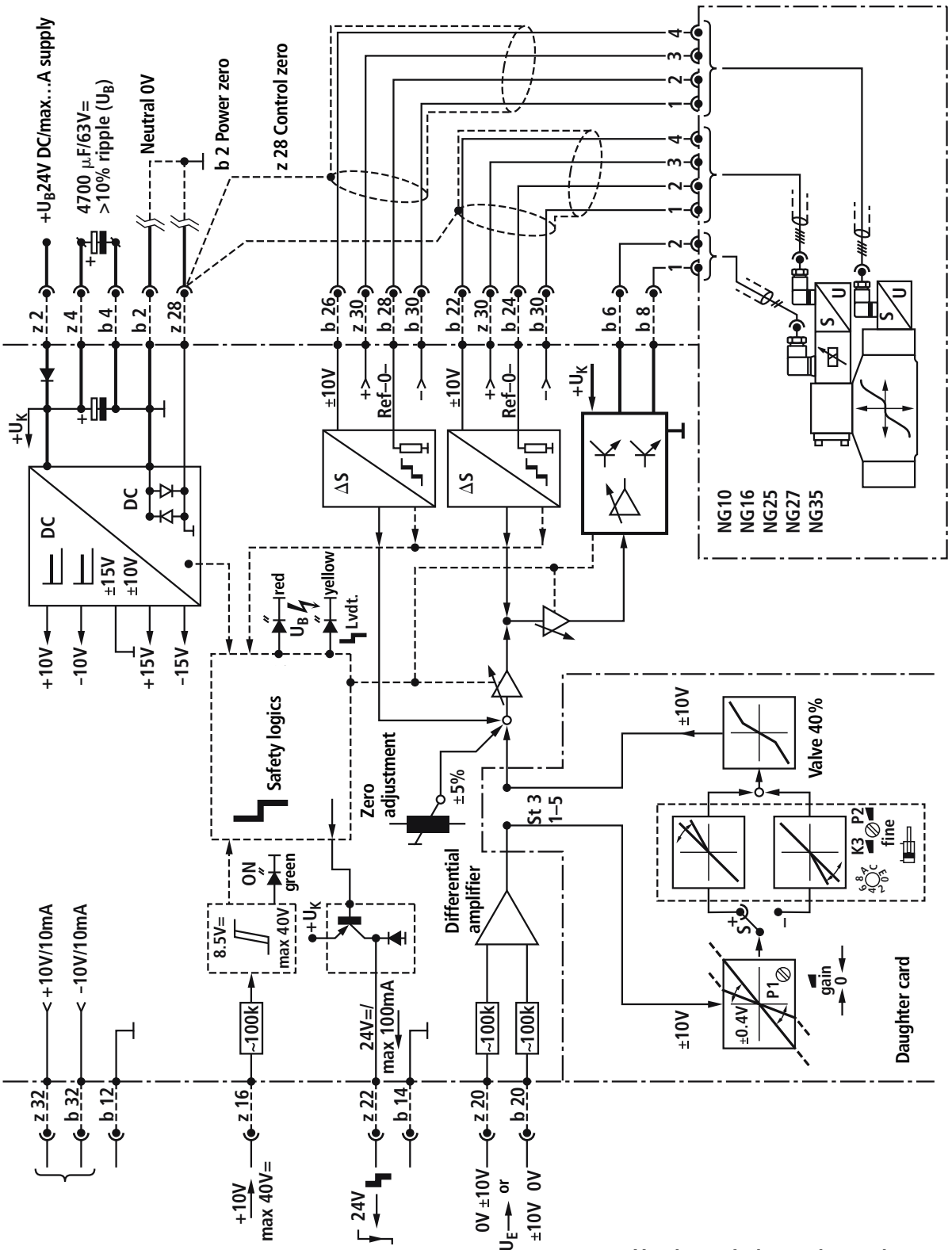


Versions of trigger electronics

- With non-linear curve and surface area compensation, see RE 30043
- With integrated p/Q controller, see RE 30058

Valve with external trigger electronics (non-linear curve: P)

Block diagram/pin assignment



Versions of trigger electronics

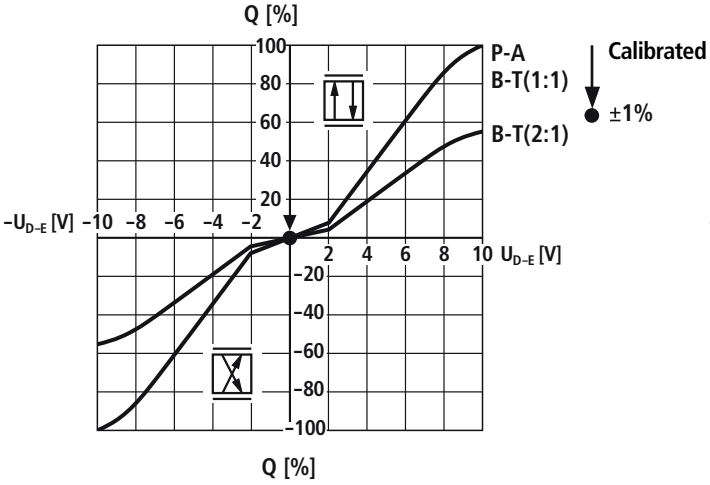
– With standard linear curve, see RE 30045

– With integrated *p/Q* controller, see RE 30058

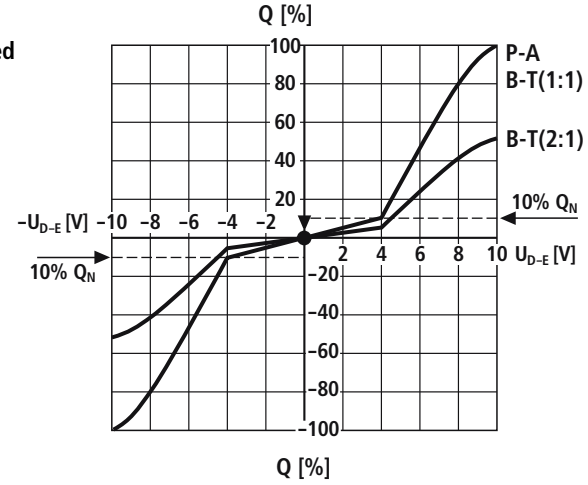
Characteristic curves (measured with HLP 46, ϑ_{oil} = 40 °C ±5 °C)

Flow rate – signal function $Q = f(U_E)$

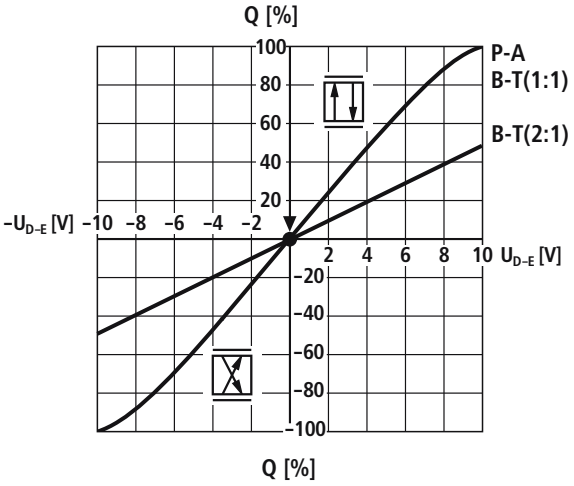
Flow characteristic M



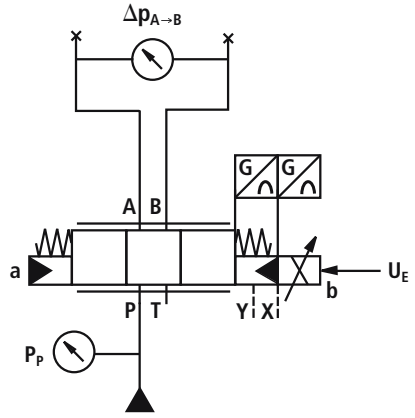
Flow characteristic P

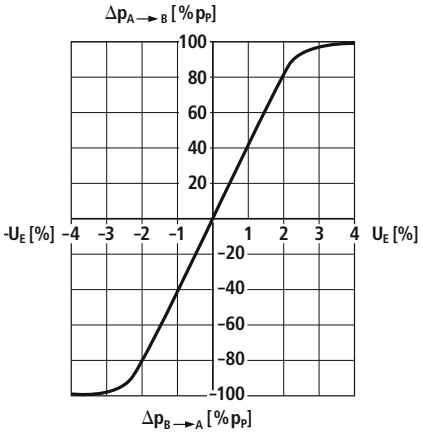


Flow characteristic L



Pressure gain

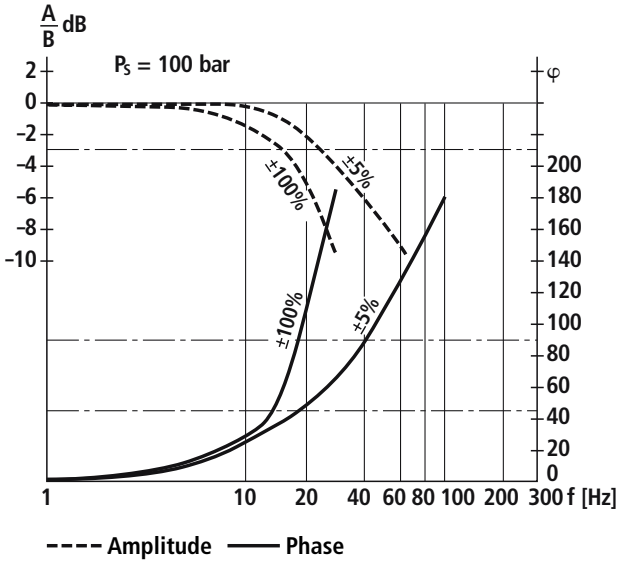




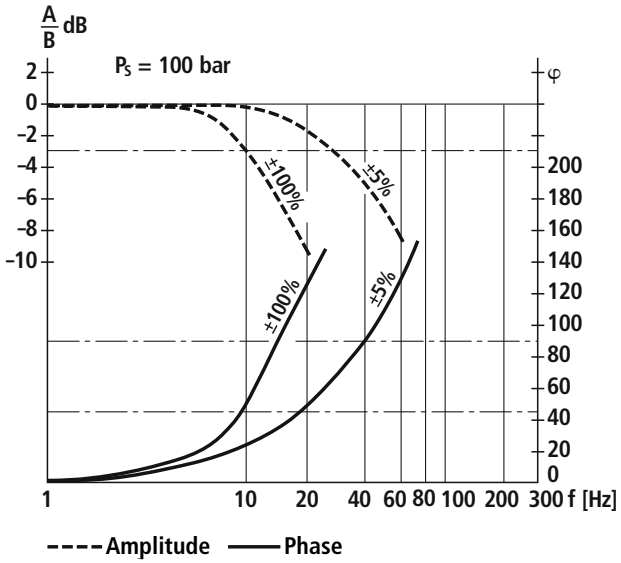
Characteristic curves (measured with HLP 46, ϑ_{oil} = 40 °C ±5 °C)

Bode diagram

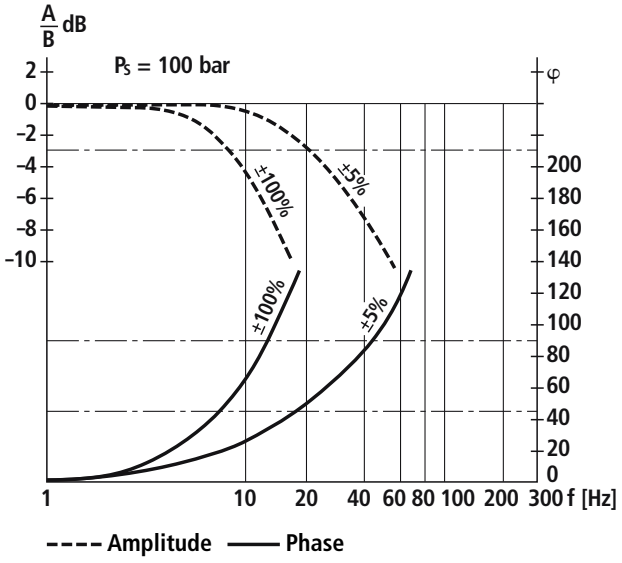
NG10



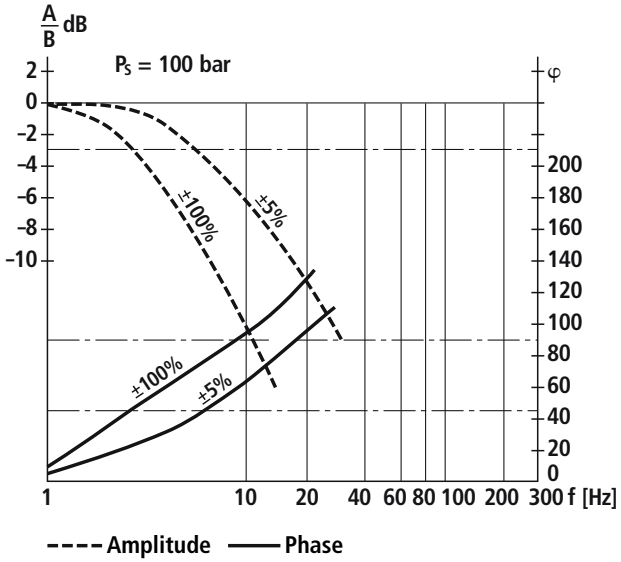
NG16



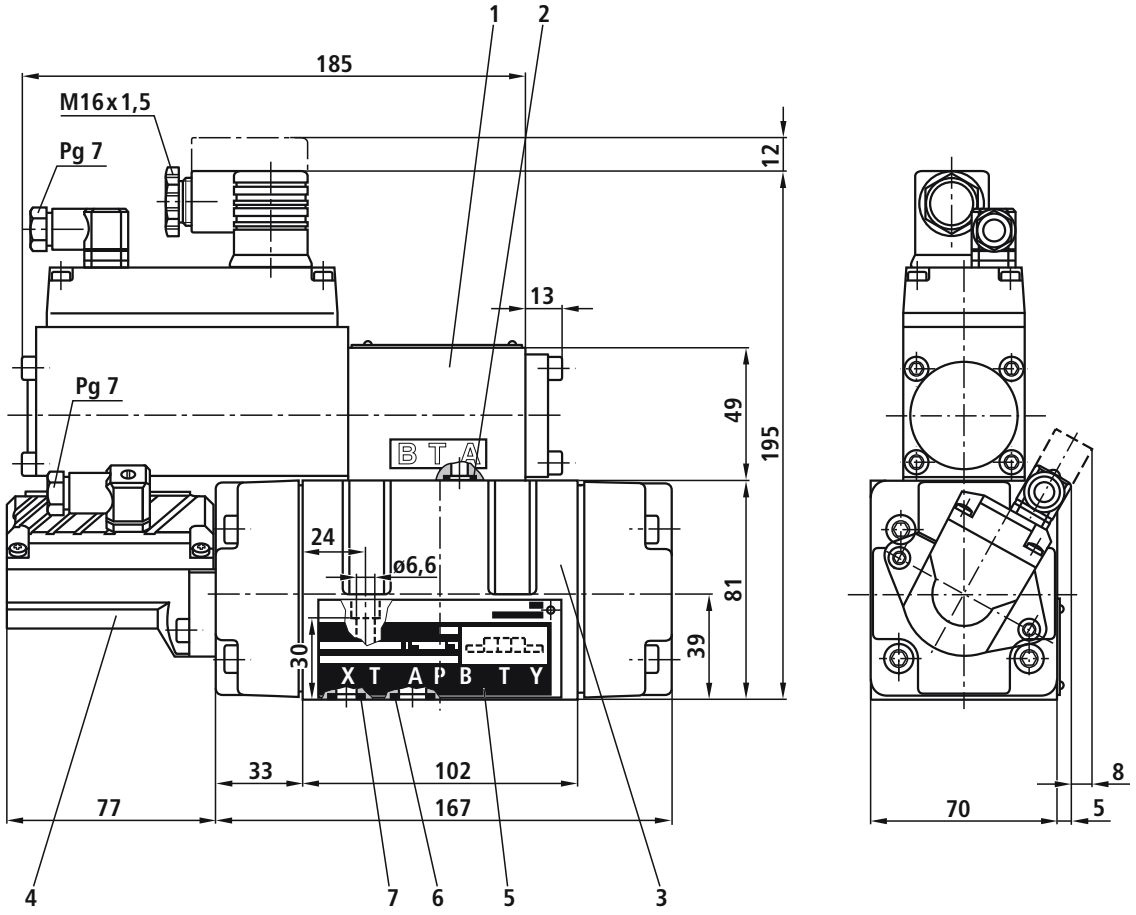
NG25/27

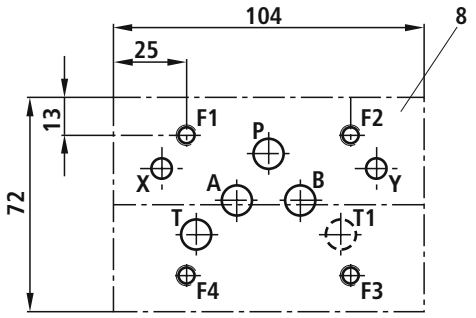


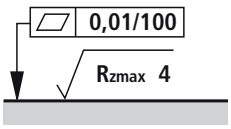
NG35



Unit dimensions NG10 (nominal dimensions in mm)







Required surface quality of mating component

1 Pilot valve

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

3 Main valve

4 Inductive position transducer (main valve)

5 Nameplate

6 O-ring 12 x 2 (ports P, A, B, T, T1)

7 O-ring 10 x 2 (ports X, Y)

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

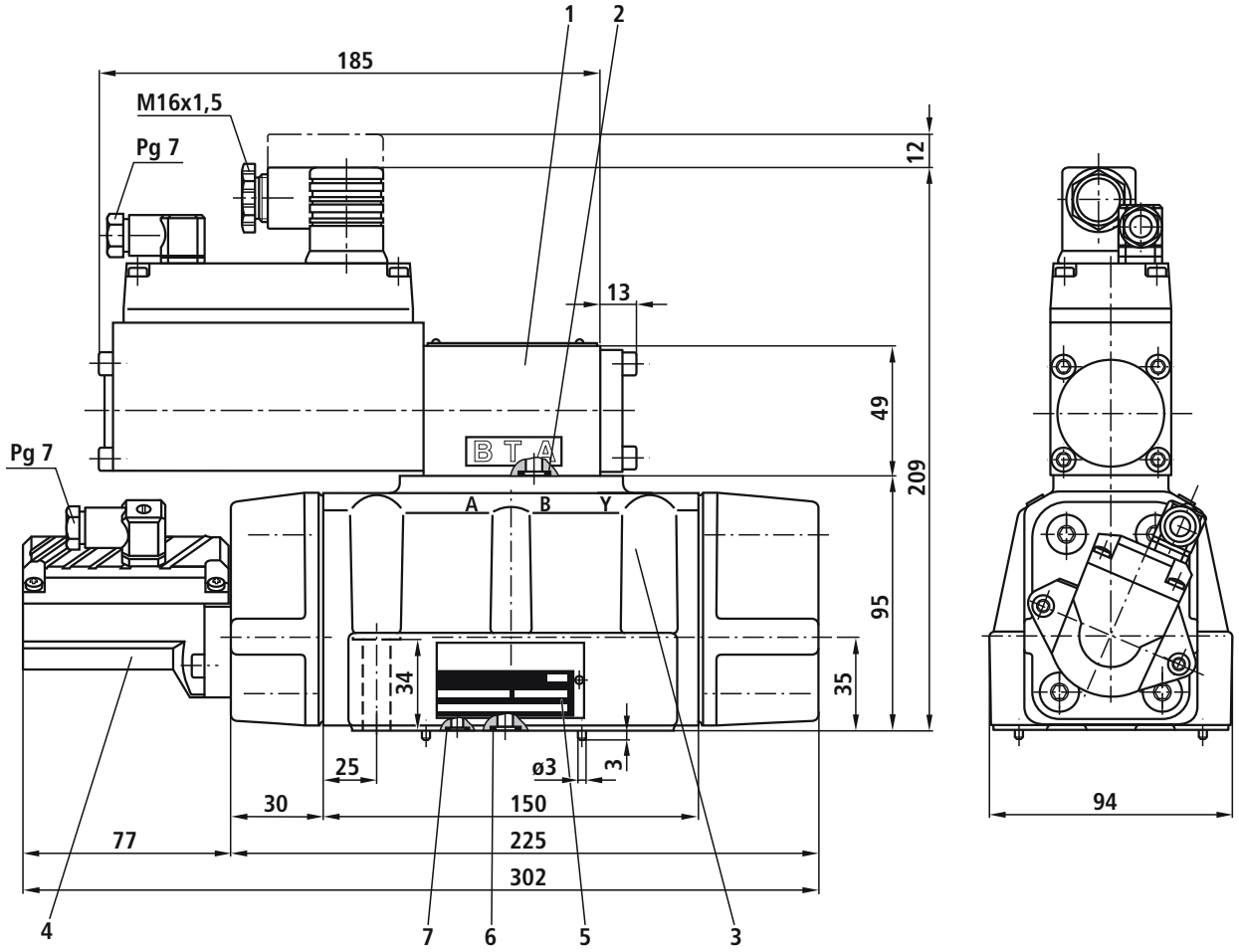
Subplates, see Technical Data Sheet RE 45055

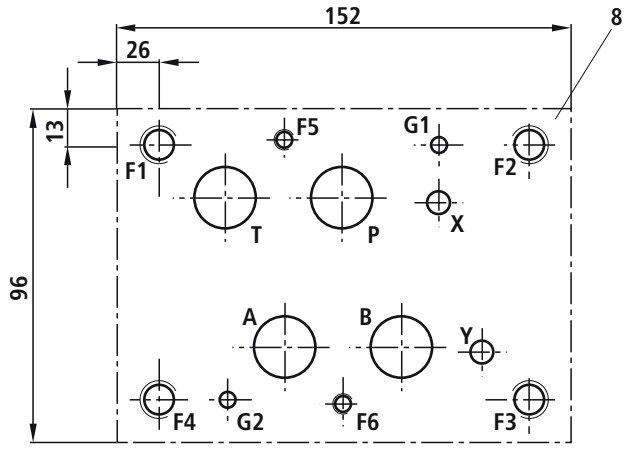
Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

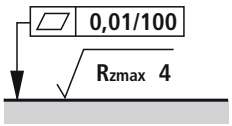
4 cheese-head bolts ISO 4762-M6x40-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 11+3 Nm

Material no. **2910151209**

Unit dimensions NG16 (nominal dimensions in mm)







Required surface quality of mating component

1 Pilot valve

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

3 Main valve

4 Inductive position transducer (main valve)

5 Nameplate

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

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

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

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

Subplates, see Technical Data Sheet RE 45057

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

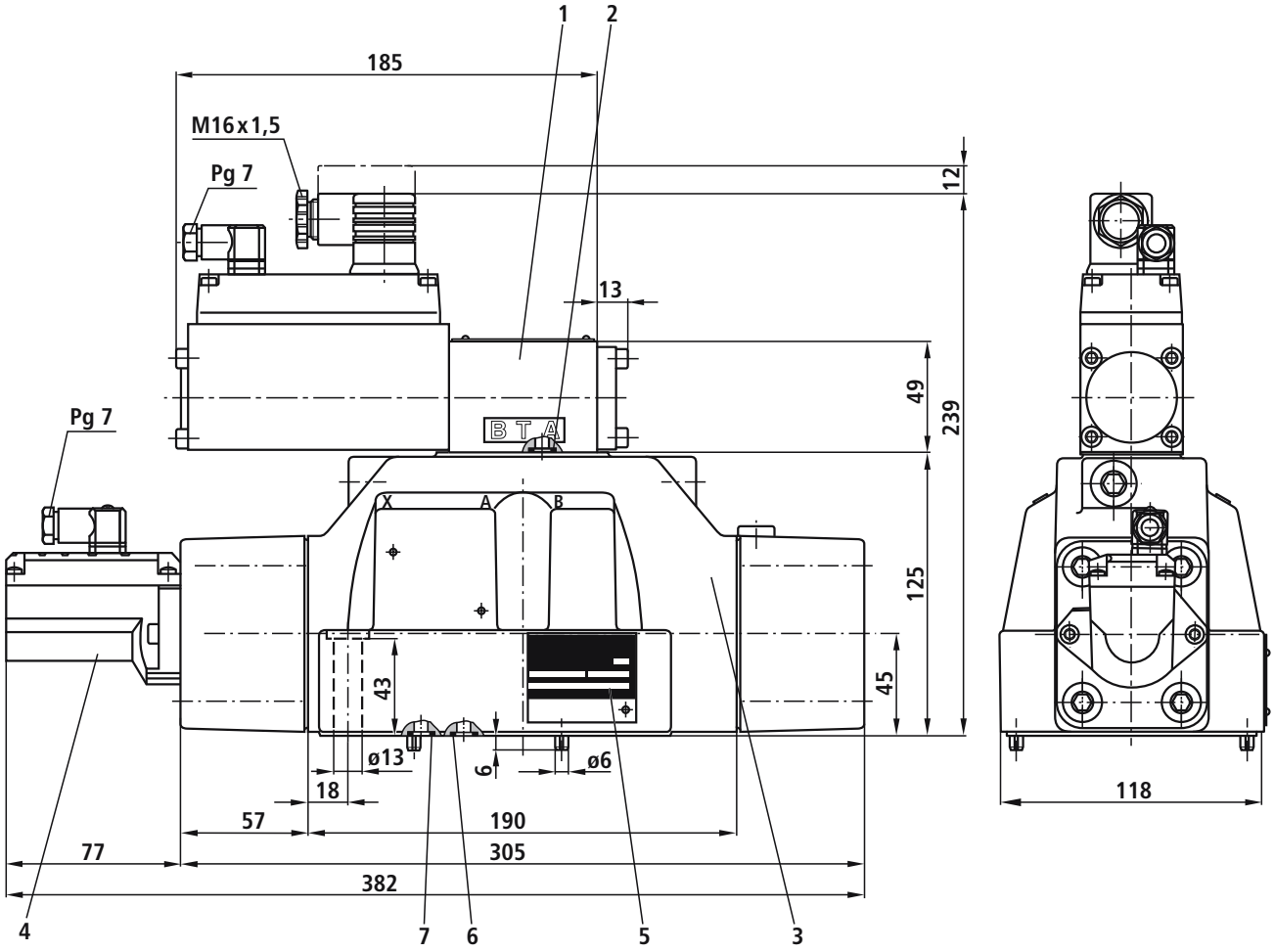
2 cheese-head bolts ISO 4762-M6x45-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 11+3 Nm

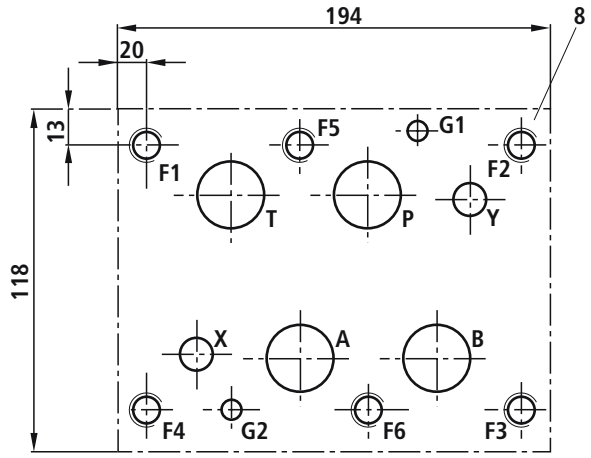
Material no. **2910151211**

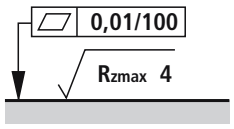
4 cheese-head bolts ISO 4762-M10x50-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque M_A = 50+10 Nm

Material no. **2910151301**

Unit dimensions NG25/27 (nominal dimensions in mm)







Required surface quality of mating component

1 Pilot valve

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

3 Main valve

4 Inductive position transducer (main valve)

5 Nameplate

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

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

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

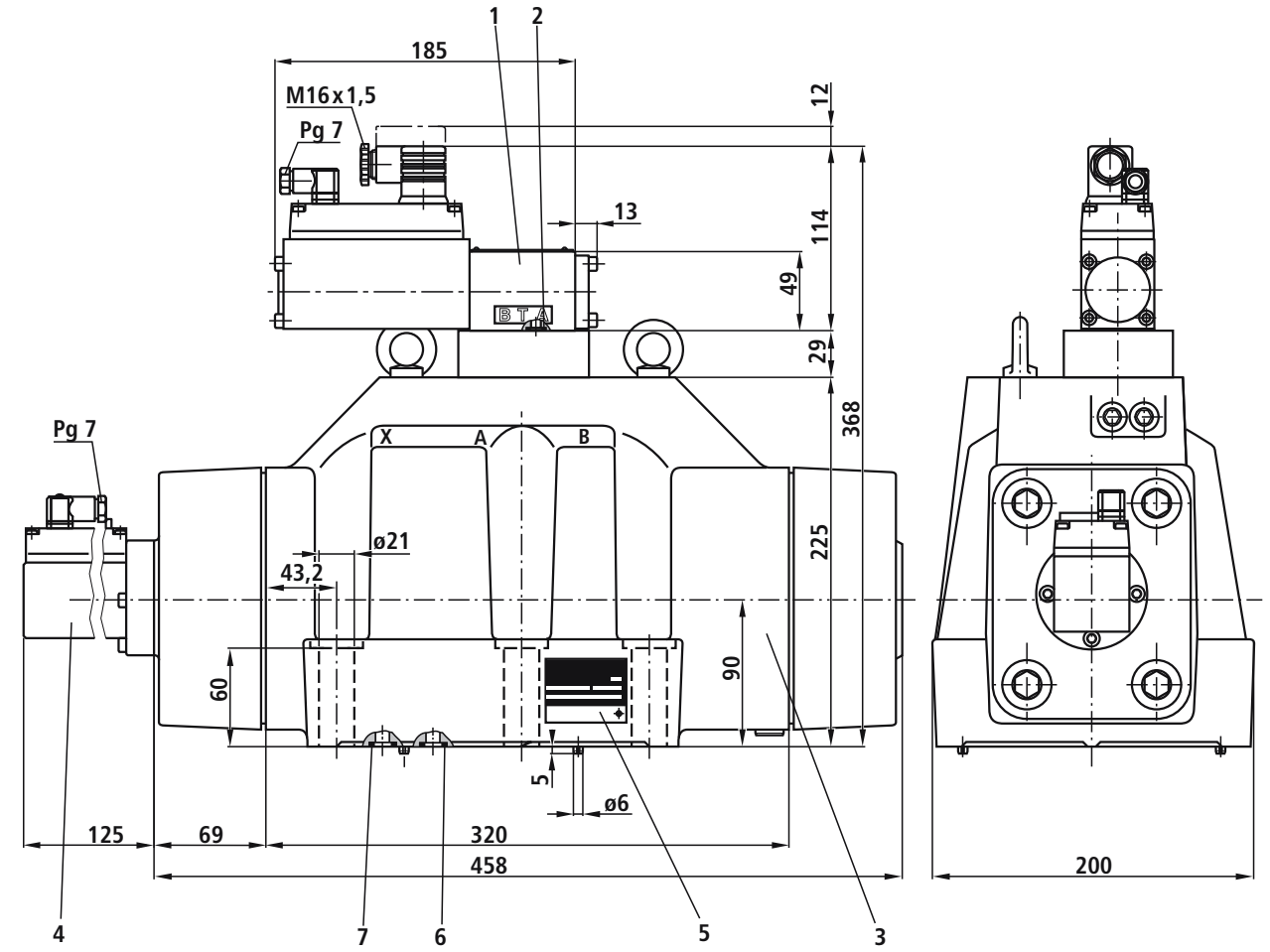
Subplates, see Technical Data Sheet RE 45059

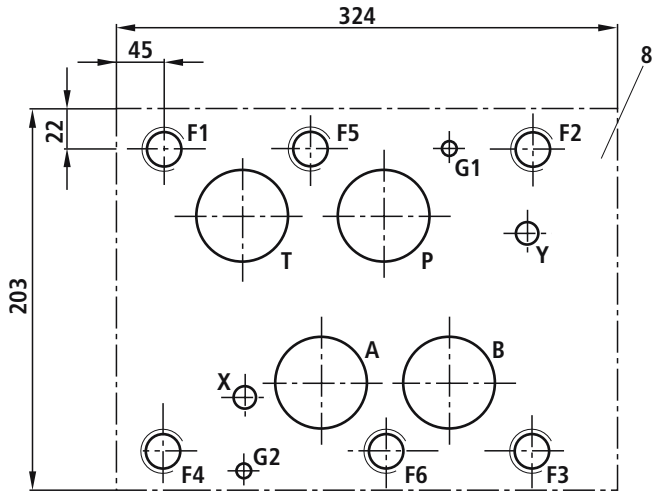
Valve fastening bolts (order separately)
The following valve fastening bolts are recommended:

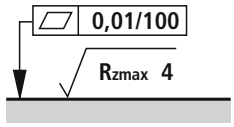
6 cheese-head bolts ISO 4762-M12x60-10.9-N67F821 70
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque NG25 M_A = 90+30 Nm,
NG27 M_A = 90±15 Nm

Material no. **2910151354**

Unit dimensions NG35 (nominal dimensions in mm)







Required surface quality of mating component

1 Pilot valve

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

3 Main valve

4 Inductive position transducer (main valve)

5 Nameplate

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

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

8 Machined valve contact surface, mounting hole configuration according to ISO 4401-10-09-0-05
Deviates from standard:
Ports P, A, B, T Ø 48 mm
Minimum thread depth: Ferrous metal 1.5 x Ø
Non-ferrous 2 x Ø

Subplates, see Technical Data Sheet RE 45060

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

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