

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

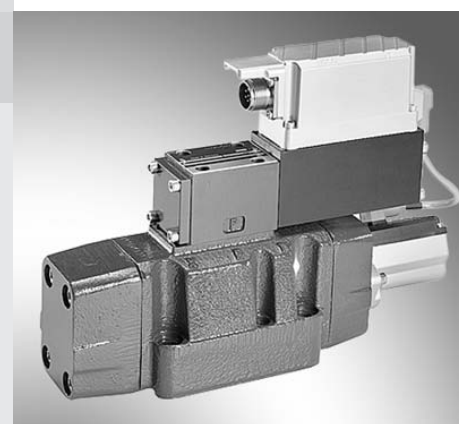
Type 4WRLE 10...35, symbols V/V1

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 ($\Delta p = 10$ bar)



Type 4WRLE 10...35

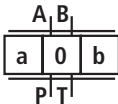
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Features

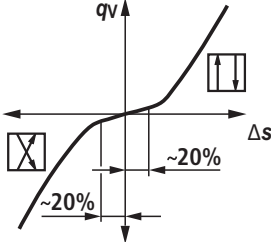
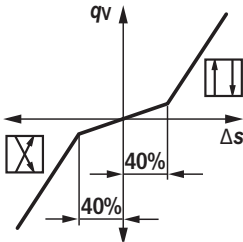
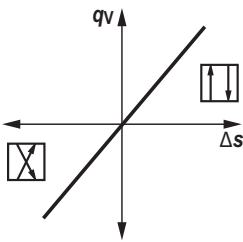
- Pilot operated 4/3-way servo solenoid directional control valves NG10 to NG35
- Pilot valve NG6, with control piston and sleeve in servo quality, actuated on one side, 4/4 fail-safe position when switched off
- Control solenoid with electric position feedback and on-board electronics (OBE), calibrated 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 ($R_{sh} = 200 \Omega$)

Ordering data

4WRL E -3X/ G24 K0/ M *									
With on-board electronics	= E								Further information in plain text
Sizes	= 10 = 16 = 25 = 27 ¹⁾ = 35 ²⁾								Seal material M = NBR seals, suitable for mineral oils (HL, HLP) to DIN 51524
Control spool symbols									Interface for trigger electronics A1 = Setpoint input ±10 V F1 = Setpoint input 4...20 mA
4/3-way version									Electrical connection K0 = without plug-in connector, with plug to DIN 43563-AM6 Order plug-in connector separately
 = V, V1									Control oil inlet "x" control oil return "y" No desg. = "x" = external "y" = external E = "x" = internal "y" = external ET = "x" = internal "y" = internal T = "x" = external "y" = internal
With V1: P → A: q_V B → T: $q_V/2$ P → B: $q_V/2$ A → T: q_V									Power supply of trigger electronics G24 = +24 V DC
Nominal flow rate at 10 bar valve pressure difference (5 bar per metering notch)									Flow characteristic M = Progressive with linear fine metering P = Non-linear curve, linear (kink at 40%) L = Linear
NG10 40 l/min ³⁾ = 40 55 l/min ⁴⁾ = 55 70 l/min ³⁾ = 70 85 l/min ⁴⁾ = 85									3X = Unit series 30 to 39 (installation and connection dimensions unchanged)
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									

- ¹⁾ NG27 is a high-flow version of NG25, ports P, A, B and T have Ø 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. Ø 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 Ø 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. Ø 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

A₁B₁ a0b P T	M: Progressive with fine metering	P: Non-linear, linear (40 %)	L: Linear
			

Testing and service equipment

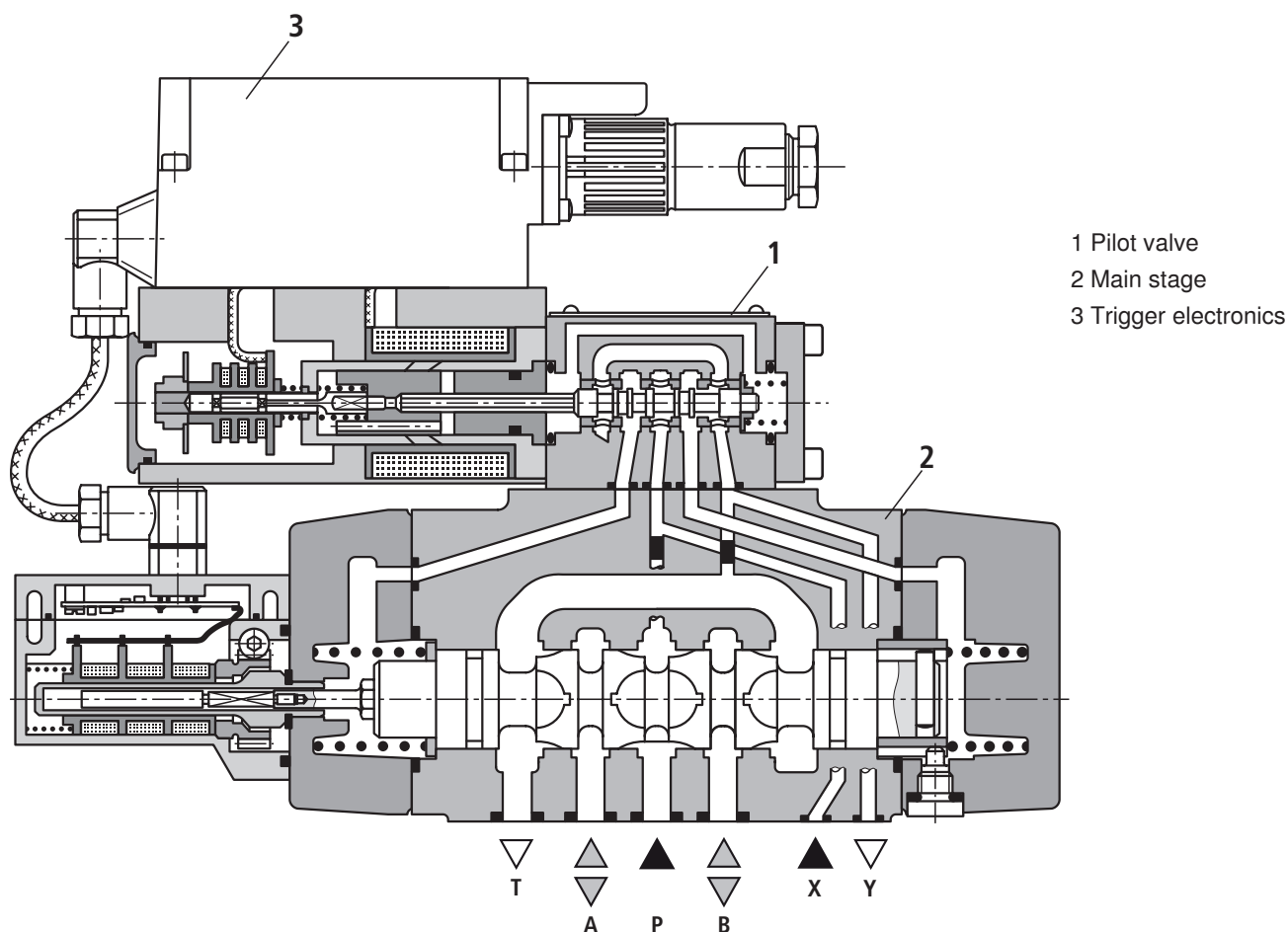
- Service case type VT-VETSY-1 with test device, see data sheet 29685
- Measuring adapter 6P+PE type VT-PA-2, see data sheet 30068

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)



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.

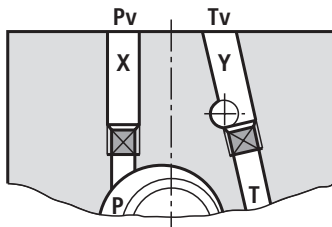
Power failure

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.

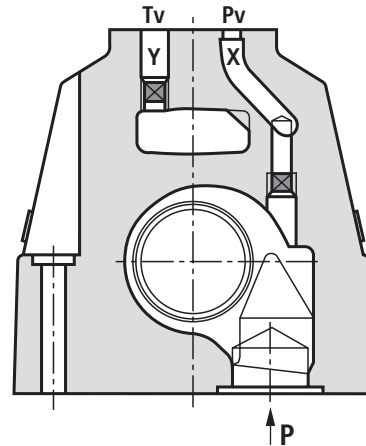
Control oil supply

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

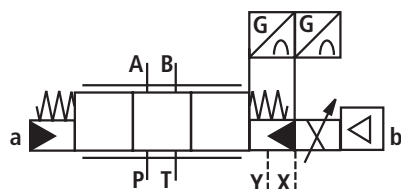
NG10, 25, 27, 35



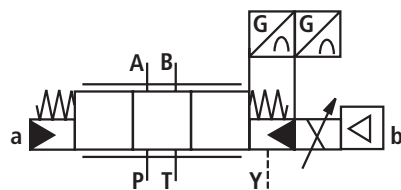
NG16



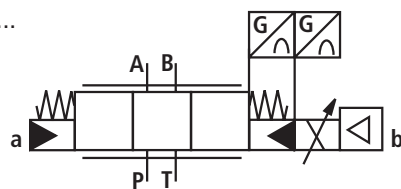
Type...-3X...



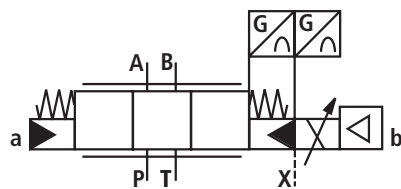
Type...-3X...E...



Type...-3X...ET...



Type...-3X...T...



No designation =

E =

ET =

T =

"x" = external

"x" = internal

"x" = internal

"x" = external

"y" = external

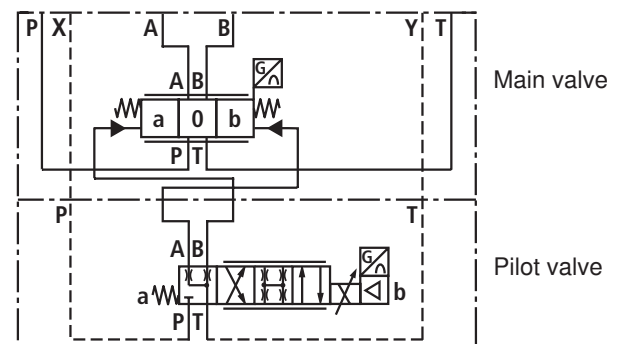
"y" = external

"y" = internal

"y" = internal

Symbol in detail

(external control oil inlet and outlet)



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, $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$)

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 $\Delta p = 5 \text{ bar per notch}^{2)}$			l/min	NG10				NG16				NG25		NG27	NG35
				40	55	70	85	90	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_{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 $\Delta T = 40\text{ }^{\circ}\text{C}$				
Zero adjustment		Factory-set $\pm 1\text{ }\%$				

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.

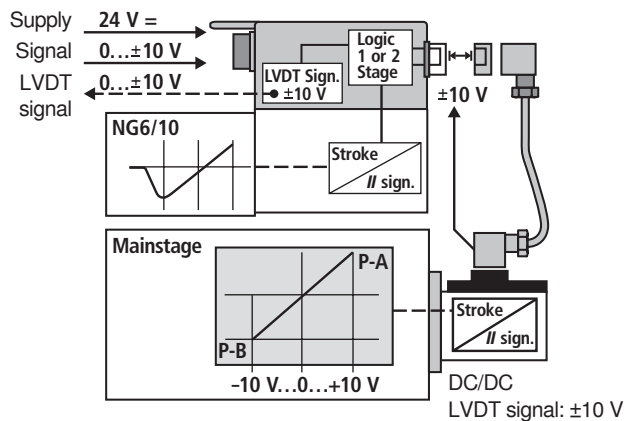
²⁾ Flow rate at a different Δp $q_{Vx} = q_{Vnom} \cdot \sqrt{\frac{\Delta p_x}{5}}$

Technical data

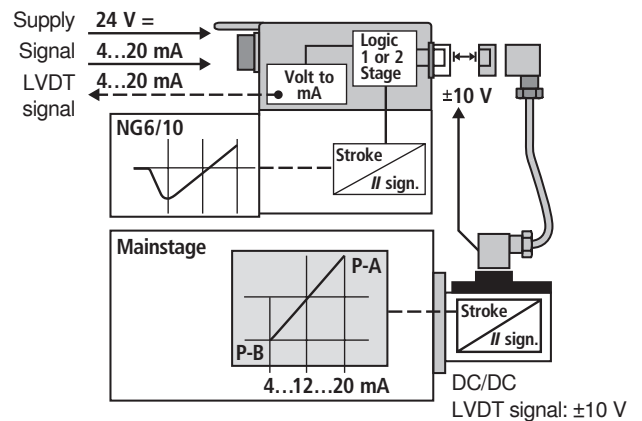
Electric pilot valve NG6, trigger electronics integrated in the valve

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		24 V DC _{nom}
Terminal A:		min. 21 V DC/max. 40 V DC
Terminal B: 0 V		Ripple max. 2 V DC
Max. power consumption		40 VA
External fuse		2,5 A _F
Input, "Standard" version		Differential amplifier, $R_i = 100 \text{ k}\Omega$
Terminal D: U_E		0... $\pm 10 \text{ V}$
Terminal E:		0 V
Input, "mA signal" version		Burden, $R_{sh} = 200 \Omega$
Terminal D: I_{D-E}		4...(12)...20 mA
Terminal E: I_{D-E}		Current loop I_{D-E} feedback
Max. differential input voltage at 0 V		$\left. \begin{array}{l} D \rightarrow B \\ E \rightarrow B \end{array} \right\} \text{ max. } 18 \text{ V DC}$
Test signal, "Standard" version		LVDT
Terminal F: U_{Test}		0... $\pm 10 \text{ V}$
Terminal C:		Reference 0 V
Test signal, "mA signal" version		LVDT signal 4...20 mA at external load 200...500 Ω max.
Terminal F: I_{F-C}		4...20 mA output
Terminal C: I_{F-C}		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

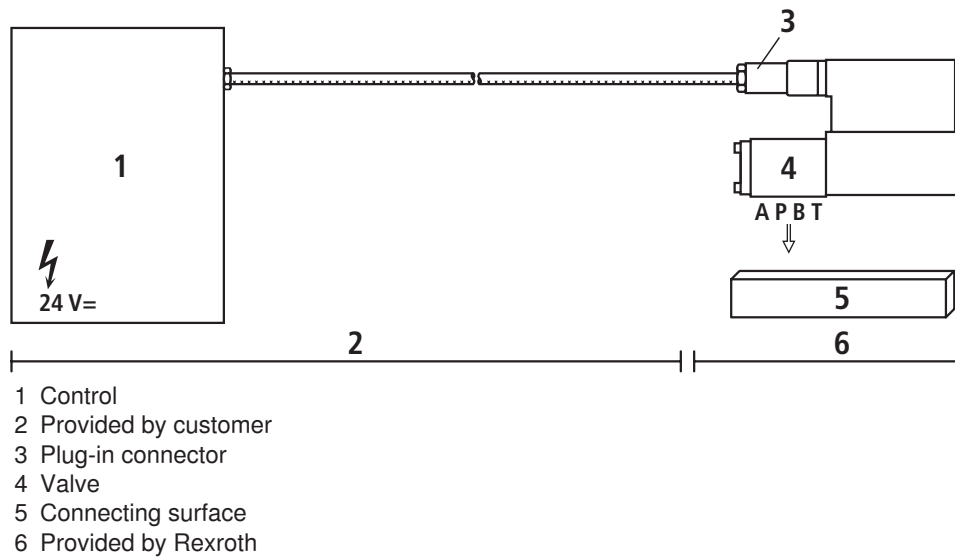


Important

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



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 mm² to 20 m length
 - 1.0 mm² 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:

$I_{D-E} \geq 3 \text{ mA}$ – valve is active

$I_{D-E} \leq 2 \text{ mA}$ – valve is deactivated.

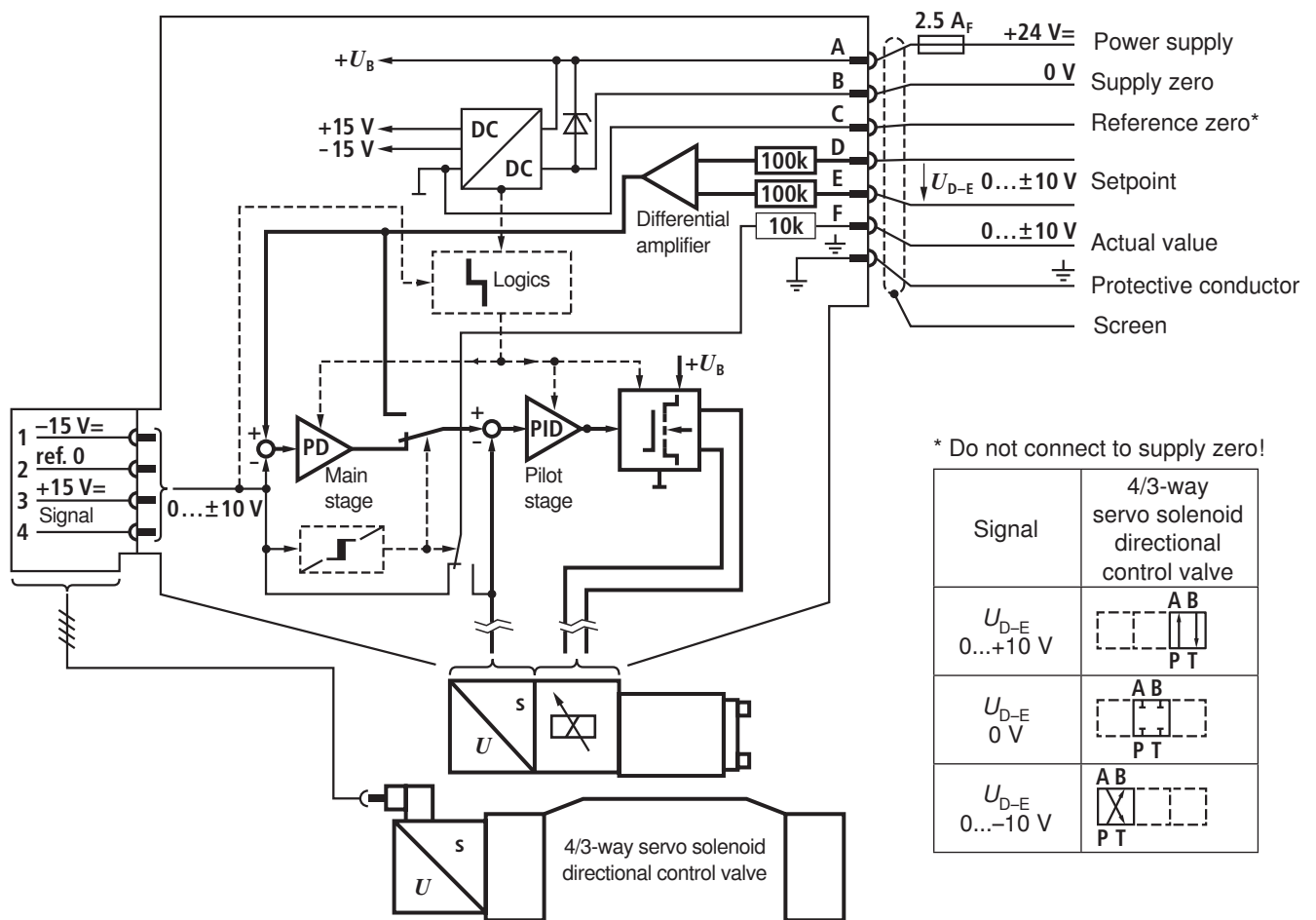
Electrical signals emitted via the trigger electronics (e.g. actual values) must not be used to shut down safety-relevant machine functions!

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

On-board electronics

Block diagram/pin assignment

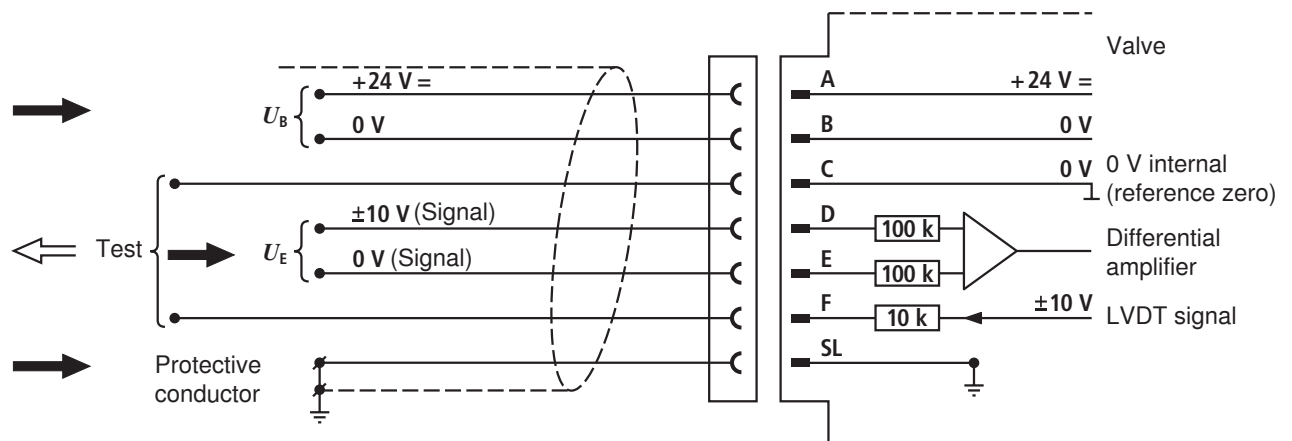
Version A1: $U_{D-E} \pm 10 \text{ V}$



Pin assignment 6P+PE

Version A1: $U_{D-E} \pm 10 \text{ V}$

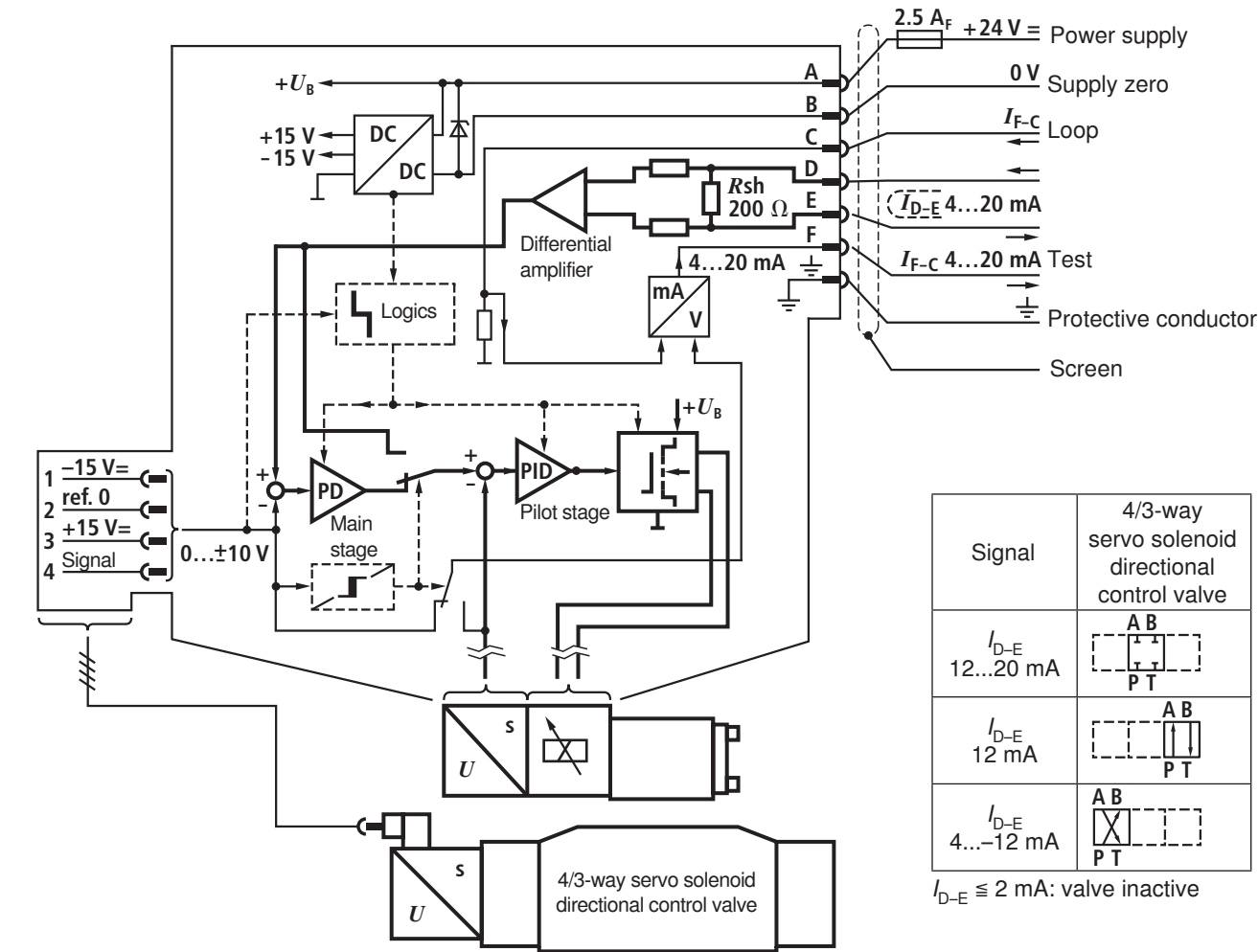
($R_i = 100 \text{ k}\Omega$)



On-board electronics

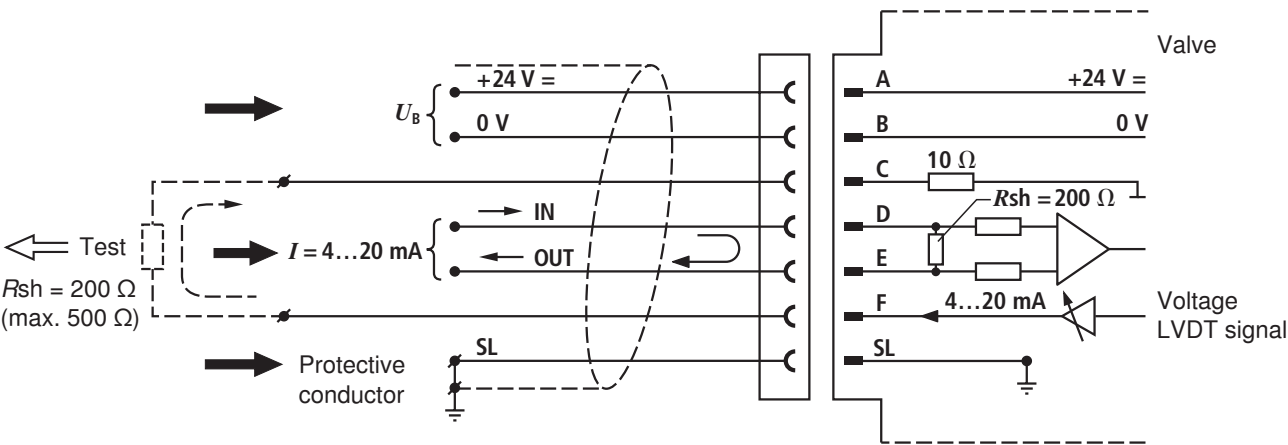
Block diagram/pin assignment

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



Pin assignment 6P+PE

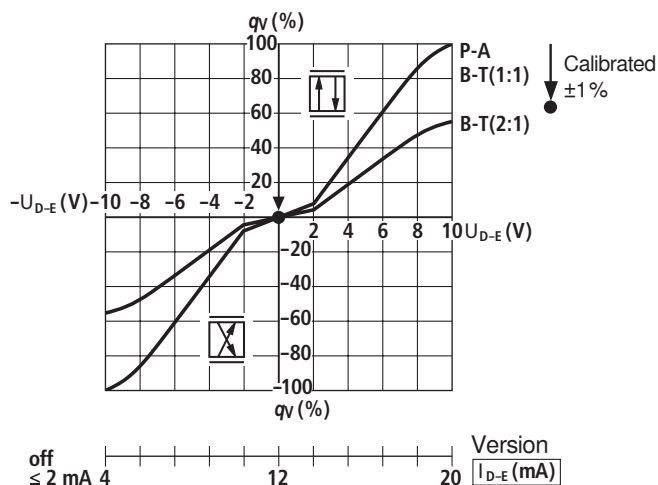
Version F1: I_{D-E} 4...12...20 mA
($R_{sh} = 200\ \Omega$)



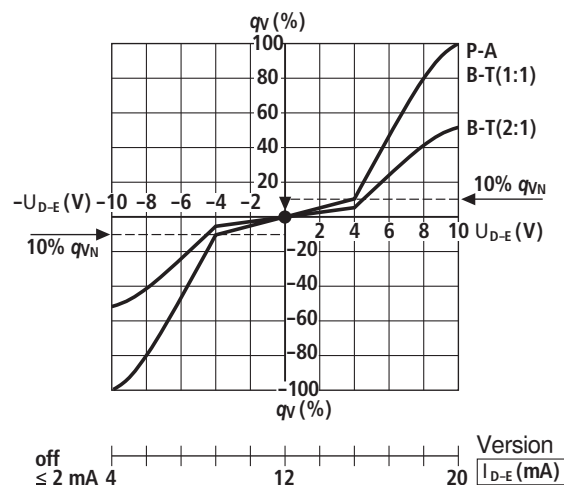
Characteristic curves (measured with HLP 46, $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$)

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

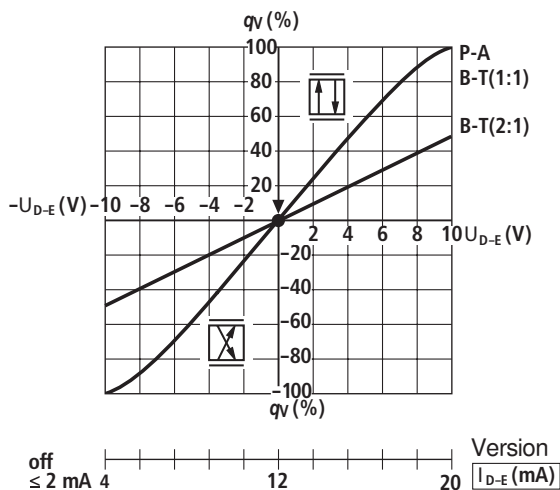
Flow characteristic M



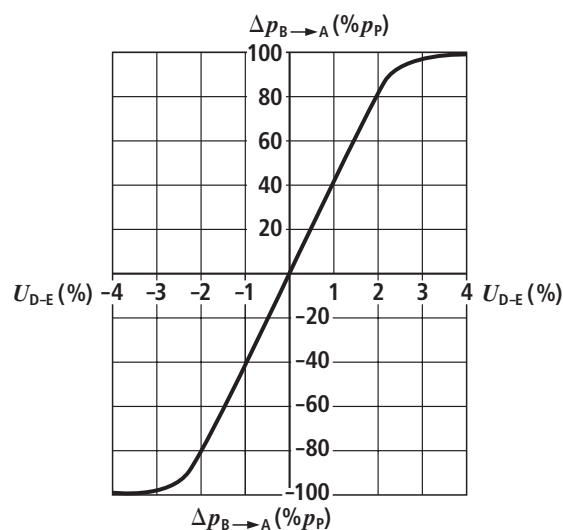
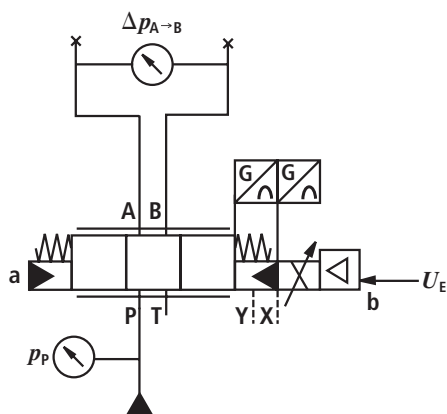
Flow characteristic P



Flow characteristic L



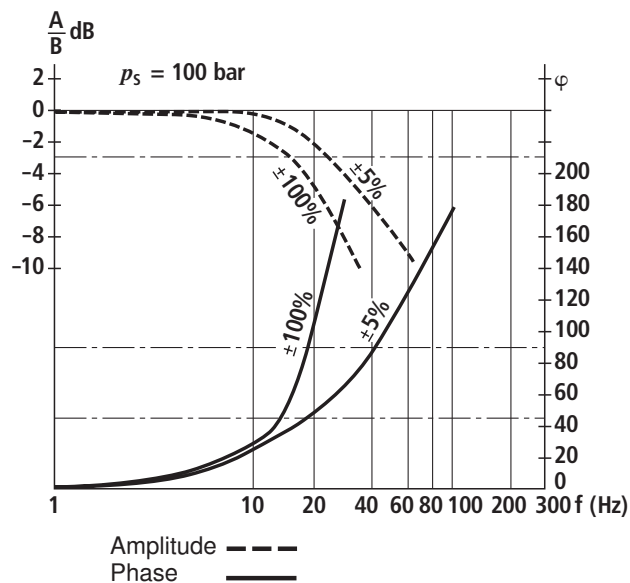
Pressure gain



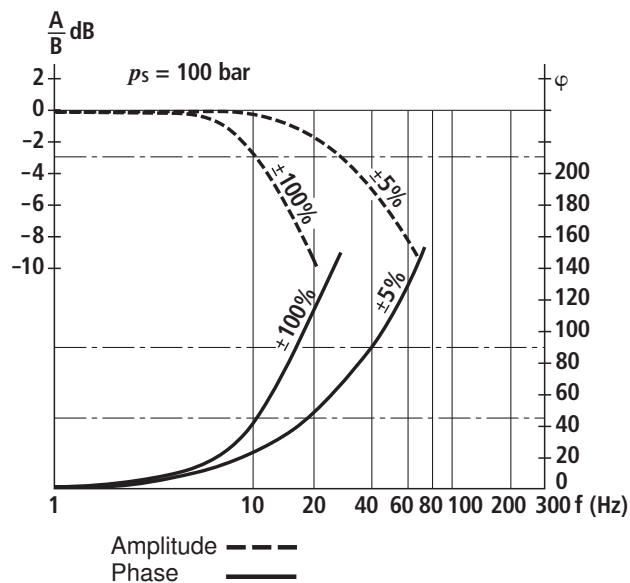
Characteristic curves (measured with HLP 46, $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$)

Bode diagram

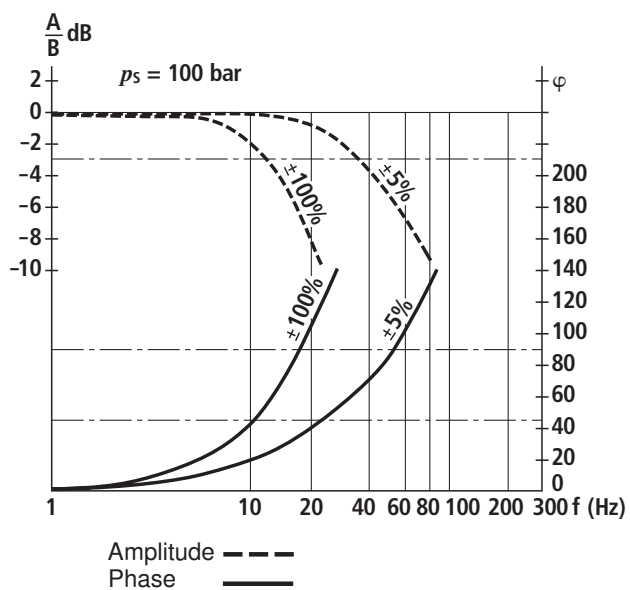
NG10



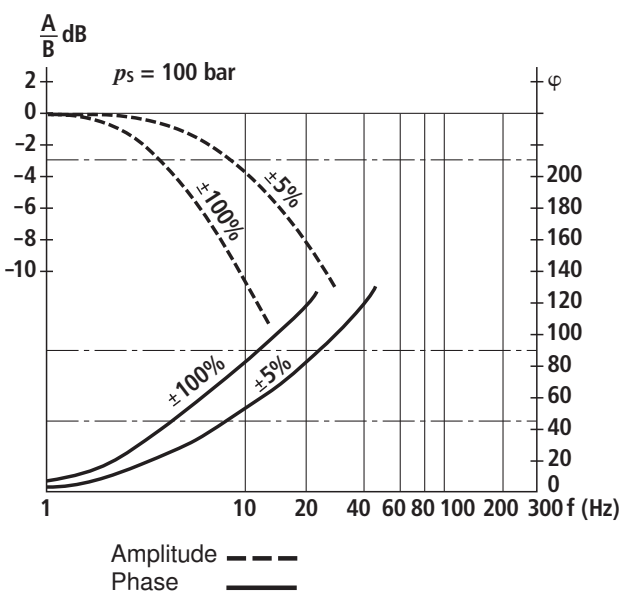
NG16



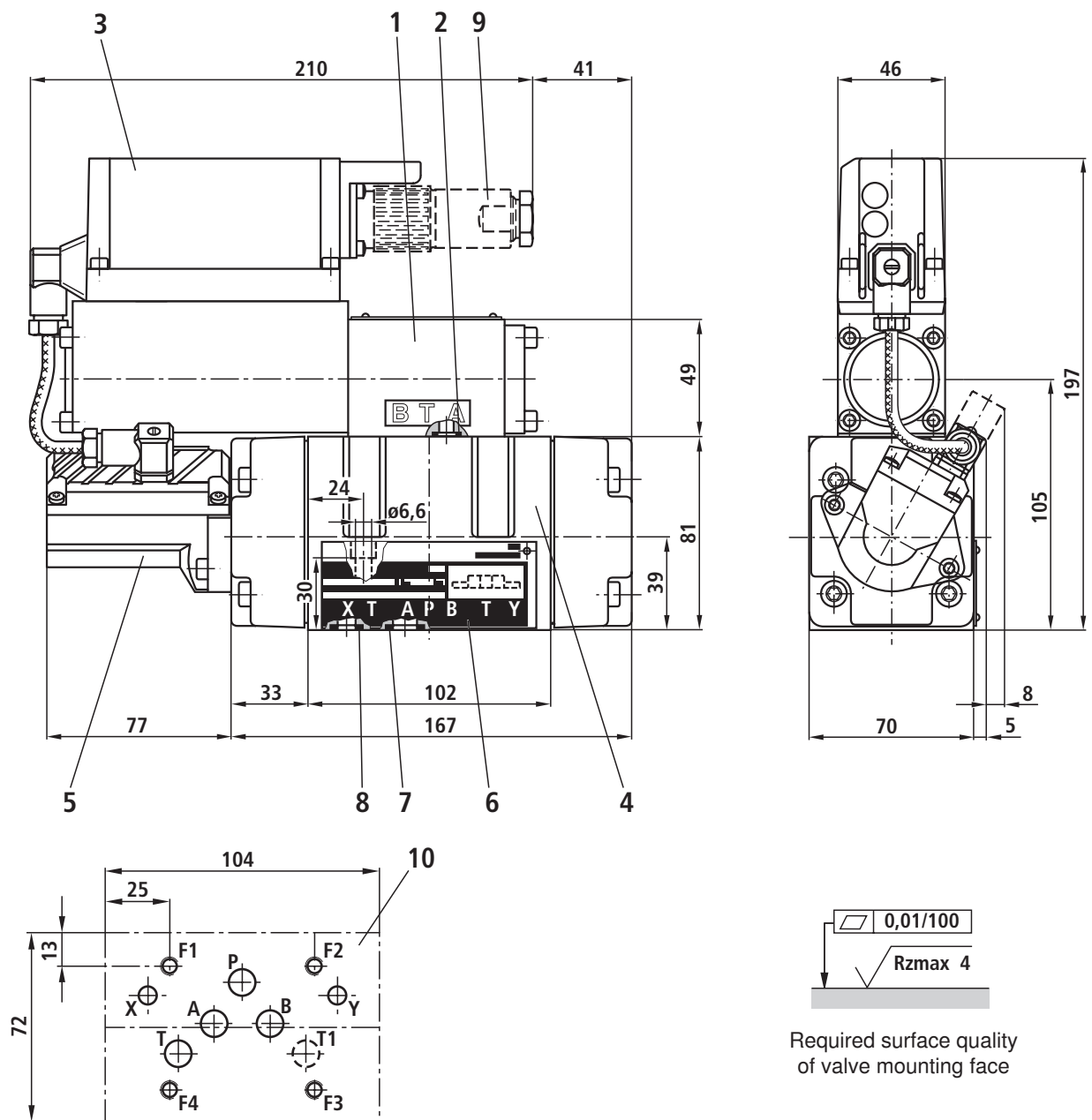
NG25/27



NG35



Unit dimensions NG10 (dimensions in mm)



- 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 $\varnothing 10.5$ mm

Minimum thread depth: Ferrous metal 1.5 x $\varnothing$
Non-ferrous 2 x $\varnothing$

Subplates, see data sheet 45054 (order separately)

Valve fastening bolts (order separately)

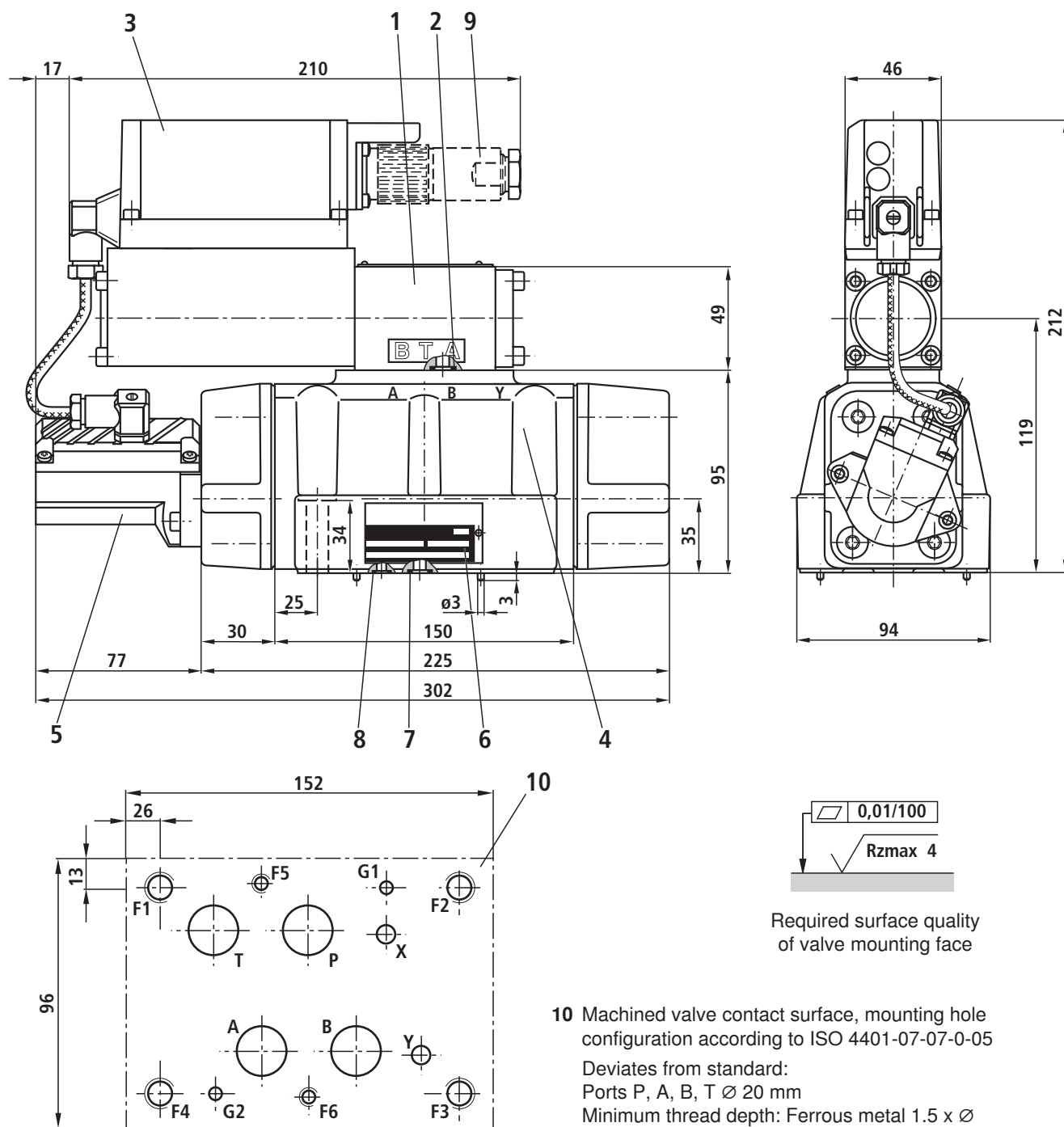
The following valve fastening bolts are recommended:

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

Tightening torque $M_A = 11 \pm 3$ Nm

Material no. **2910151209**

Unit dimensions NG16 (dimensions in mm)



- 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)

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 $M_A = 11 \pm 3$ Nm

Material no. **2910151211**

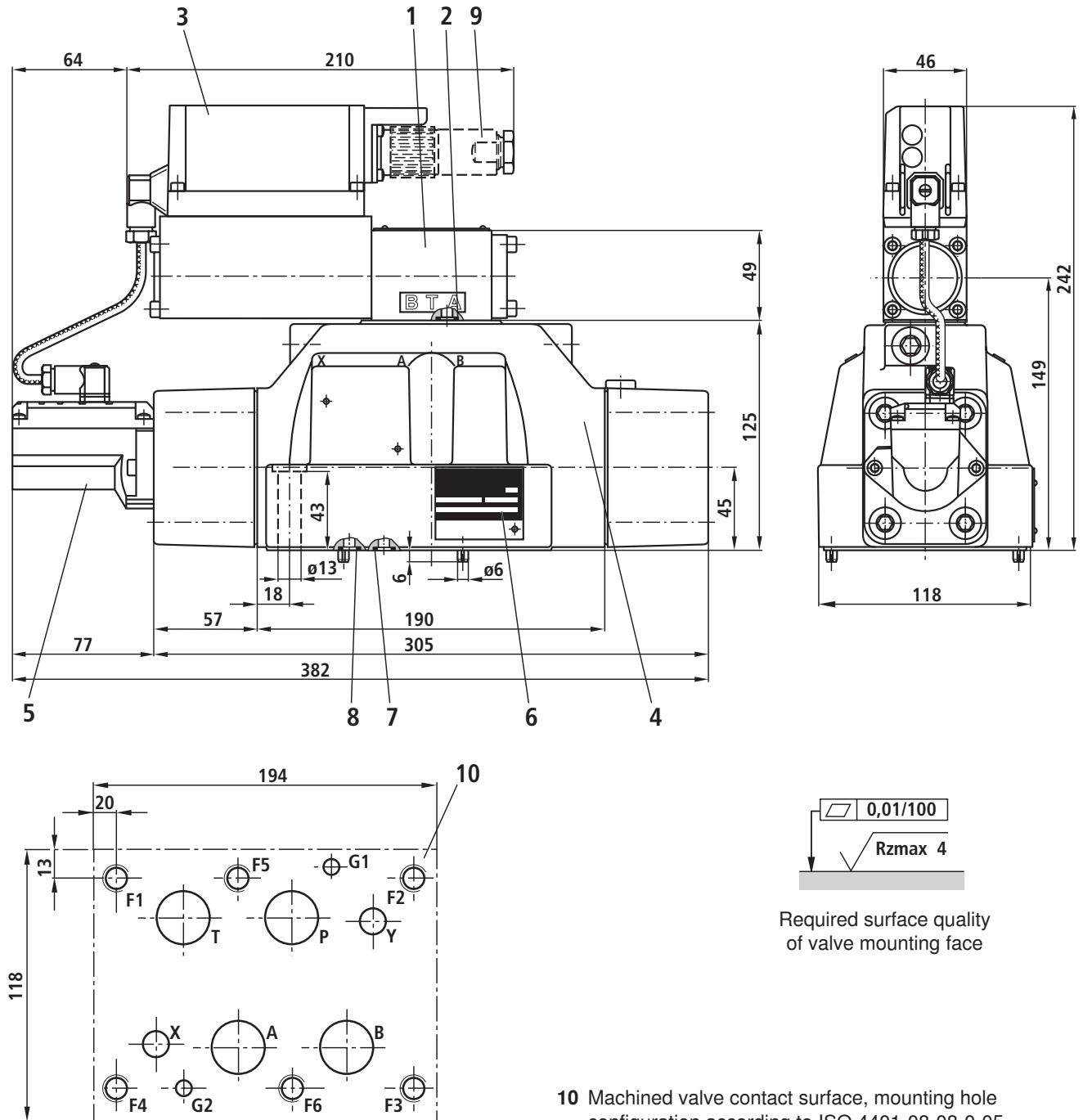
4 cheese-head bolts ISO 4762-M10x50-10.9-N67F821 70

(galvanized in accordance with Bosch standard N67F821 70)

Tightening torque $M_A = 50 \pm 10$ Nm

Material no. **2910151301**

Unit dimensions NG25/27 (dimensions in mm)



- 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 $\varnothing$ 25 mm

NG27: Ports P, A, B, T $\varnothing$ 32 mm

Minimum thread depth: Ferrous metal 1.5 x $\varnothing$
Non-ferrous 2 x $\varnothing$

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)

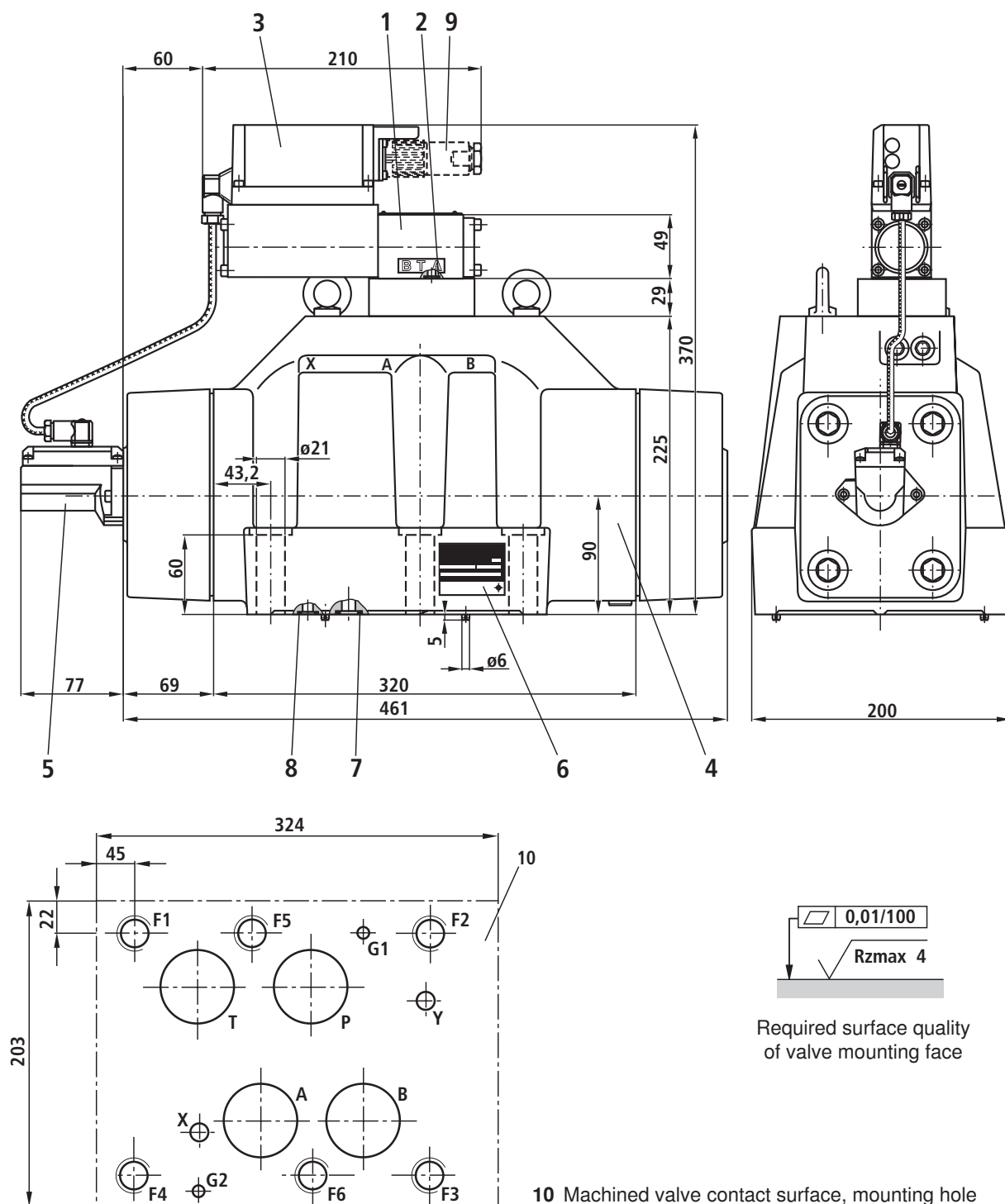
Tightening torque NG25 $M_A = 90 \pm 30$ Nm,

NG27 $M_A = 90 \pm 15$ Nm

Material no. **2910151354**

0,01/100
Rzmax 4
Required surface quality
of valve mounting face

Unit dimensions NG35 (dimensions in mm)



- 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 $\varnothing 48$ mm

Minimum thread depth: Ferrous metal $1.5 \times \varnothing$

Non-ferrous $2 \times \varnothing$

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

Notes

Bosch Rexroth AG
Hydraulics
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Notes
