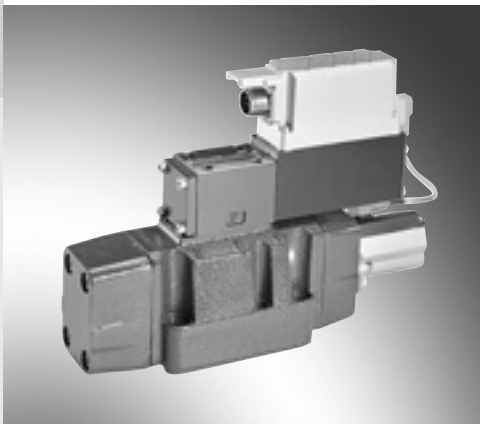
Rexroth
Bosch Group

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

**RE 29088/10.10** 1/18
Replaces: 01.09

**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

## 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

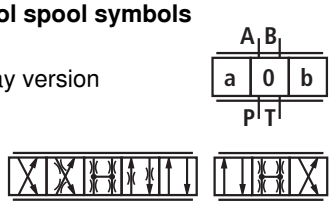
| 4WRL | E | | | | –3X/ | G24 | K0/ | | M | * |
|---|---|---|---|---|---|---|---|---|---|---|

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

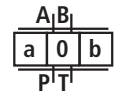
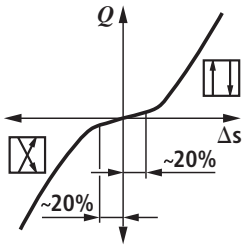
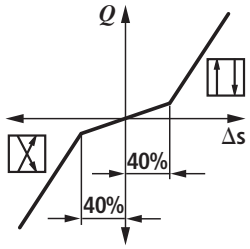
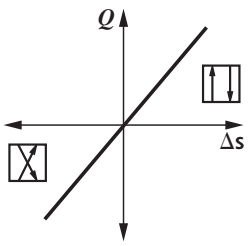
[1] NG27 is a high-flow version of NG25, ports P, A, B and T have ∅ 32 mm in the main stage. Contrary to standard ISO 4401-08-08-0-05, ports P, A, B and T may be drilled to max. ∅ 30 mm in the control block. These valves therefore offer higher flow rates $Q_A : Q_B$

[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 |
|  |  |  |  |

## Testing and service equipment

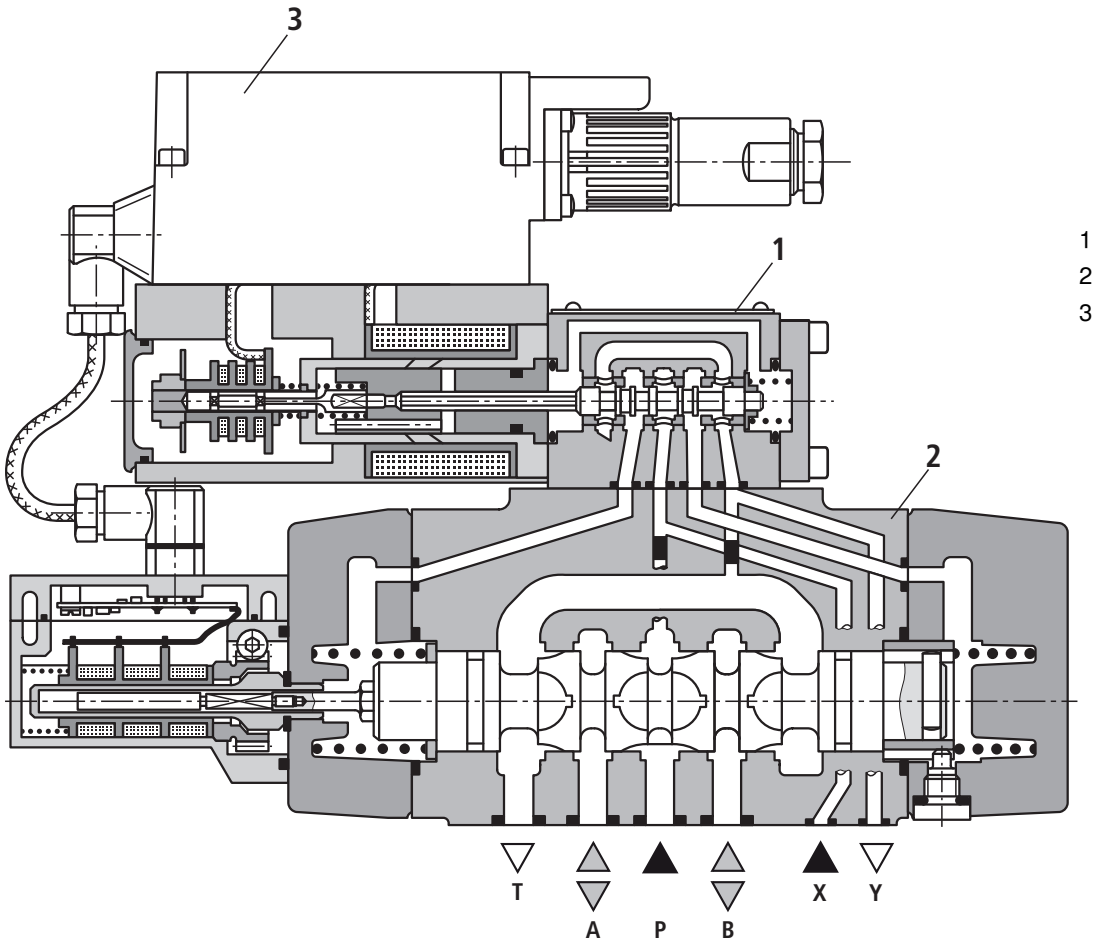
– Service case type VT-VETSY-1 with test device, see data sheet 29685
– Measuring adapter 6P+PE type VT-PA-2, see data sheet 30068

## 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.

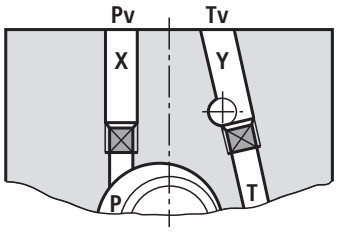
**Power failure**

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.

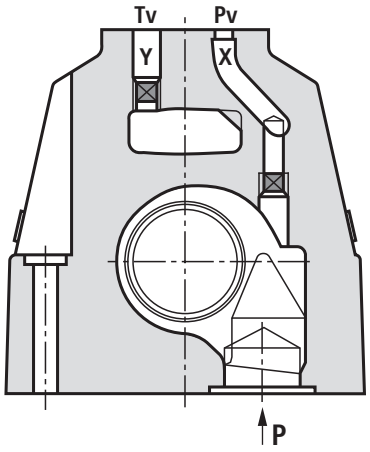
## Control oil supply

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

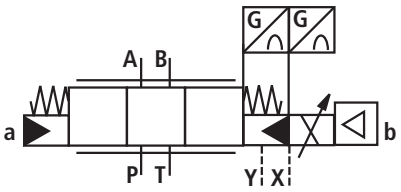
**NG10, 25, 27, 35**



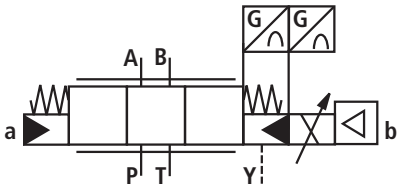

**NG16**



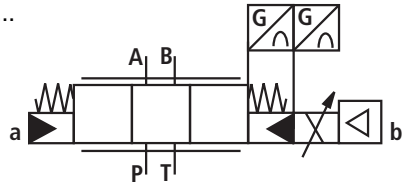

Type...–3X...



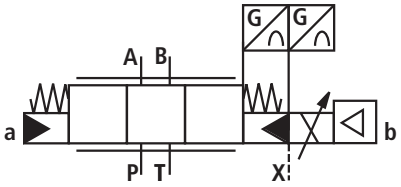

Type...–3X...E...



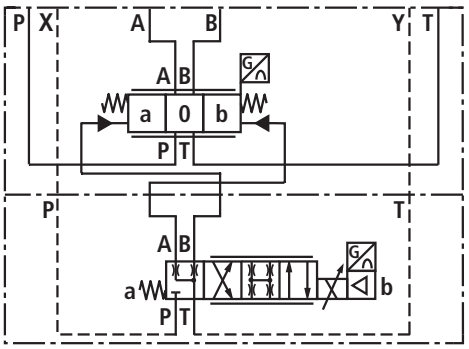

Type...–3X...ET...




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, $\vartheta_{oil}$ = 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 $\Delta p$ = 5 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 | | | | | | | | | | | | | |
| $Q_{max}$ | l/min | 170 | | | | 450 | | | | 900 | | 1000 | | 3500 | |
| $Q_N$ pilot valve | l/min | 4 | | | | 12 | | | | 24 | | 24 | | 40 | |
| Nominal flow of pilot valve at 100 bar | cm³/min | < 180 | | | | < 300 | | | | < 500 | | < 500 | | < 900 | |
| Nominal 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 °C | | | | |
| Zero adjustment | | Factory-set ±1 % | | | | |

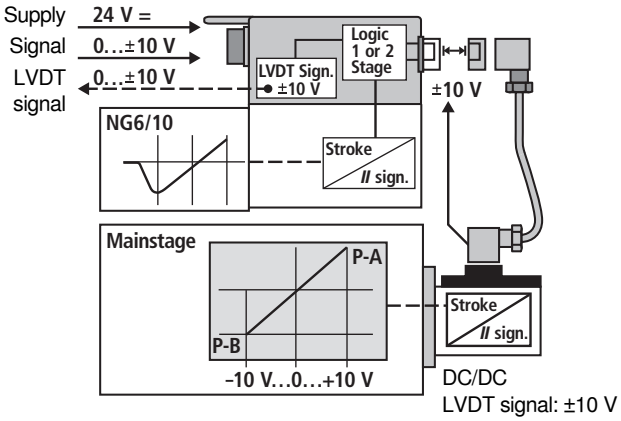
[1] The purity classes stated for the components must be complied with in hydraulic systems.
Effective filtration prevents problems and also extends the service life of components.
For a selection of filters, see www.boschrexroth.com/filter.

[2] Flow rate at a different $\Delta p$ $Q_x = Q_{nom} \bullet \sqrt{\frac{\Delta p_x}{35}}$

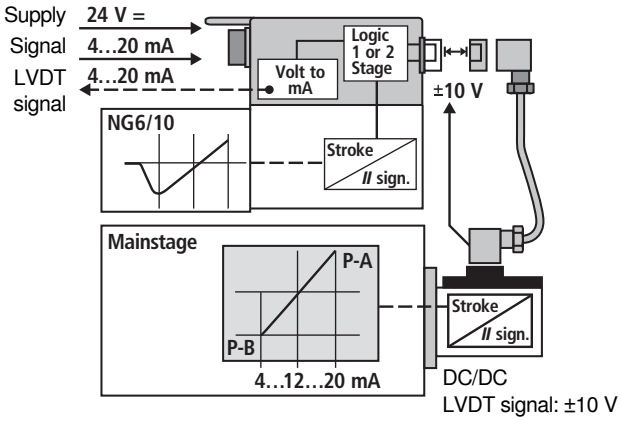
## Technical data

| **Electric pilot valve NG6,** trigger electronics integrated in the valve | |
|---|---|
| Cyclic duration factor % | 100 ED |
| Degree of protection | IP 65 to EN 60529 and IEC 14434/5 |
| Connection | Plug-in connector 6P+PE, DIN 43563 |
| Power supply<br>Terminal A:<br>Terminal B: 0 V | 24 V $DC_{nom}$<br>min. 21 V DC/max. 40 V DC<br>Ripple max. 2 V DC |
| Max. power consumption | 40 VA |
| External fuse | 2,5 $A_F$ |
| Input, “Standard” version<br>Terminal D: $U_E$<br>Terminal E: | Differential amplifier, $R_i$ = 100 kΩ<br>0... ±10 V<br>0 V |
| Input, “mA signal” version<br>Terminal D: $I_{D-E}$<br>Terminal E: $I_{D-E}$ | Burden, $R$sh = 200 Ω<br>4...(12)...20 mA<br>Current loop $I_{D-E}$ feedback |
| Max. differential input voltage at 0 V | D → B<br>E → B } max. 18 V DC |
| Test signal, “Standard” version<br>Terminal F: $U_{Test}$<br>Terminal C: | LVDT<br>0...±10 V<br>Reference 0 V |
| Test signal, “mA signal” version<br>Terminal F: $I_{F-C}$<br>Terminal C: $I_{F-C}$ | LVDT signal 4...20 mA at external load 200...500 Ω max.<br>4...20 mA output<br>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<br>EN 61000-6-3: 2007-01 |

### Version A1: Standard




### Version F1: mA signal

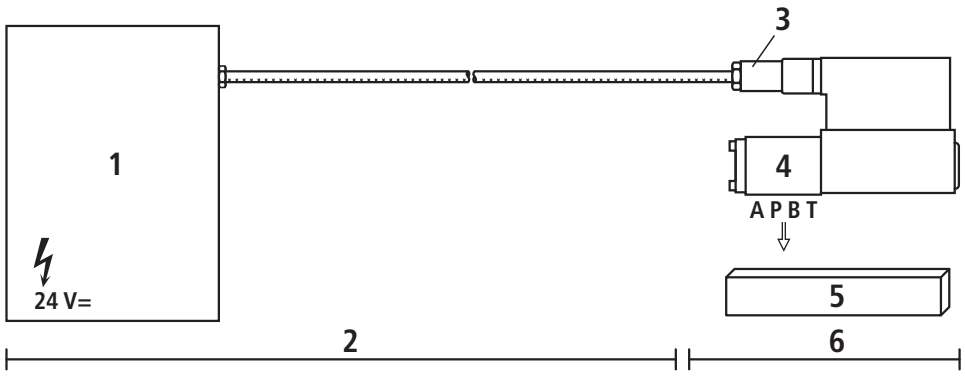



**Important**

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.

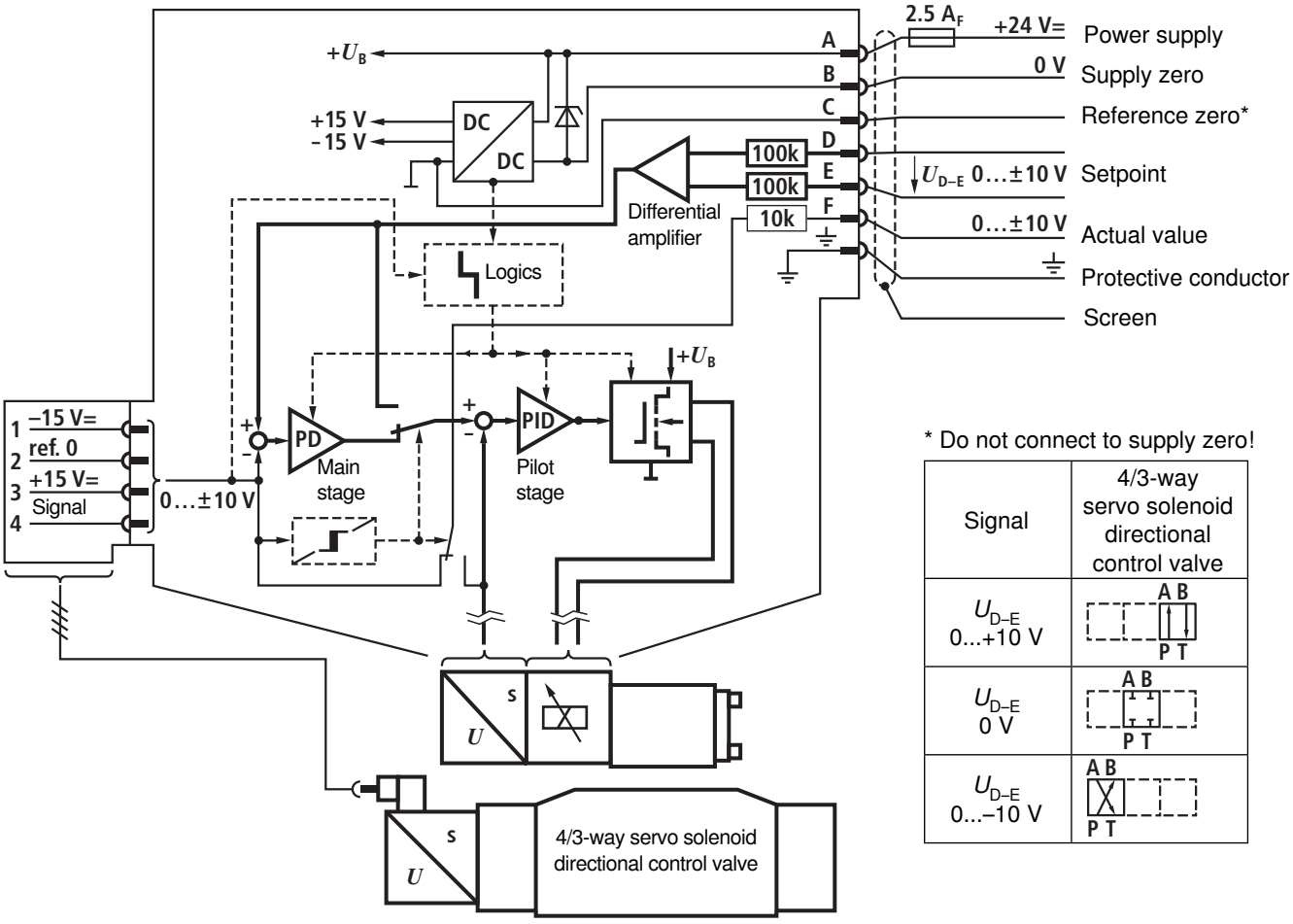
Electrical signals emitted via the trigger electronics (e.g. actual values) must not be used to shut down safety-relevant machine functions!

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

## On-board electronics

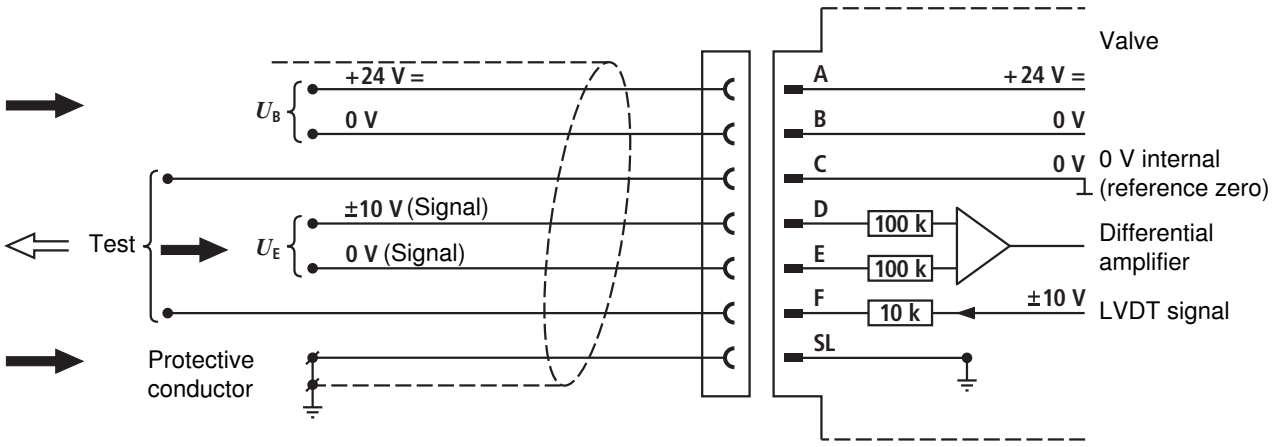
### Block diagram/pin assignment

Version A1: $U_{D-E}$ ±10 V




### Pin assignment 6P+PE

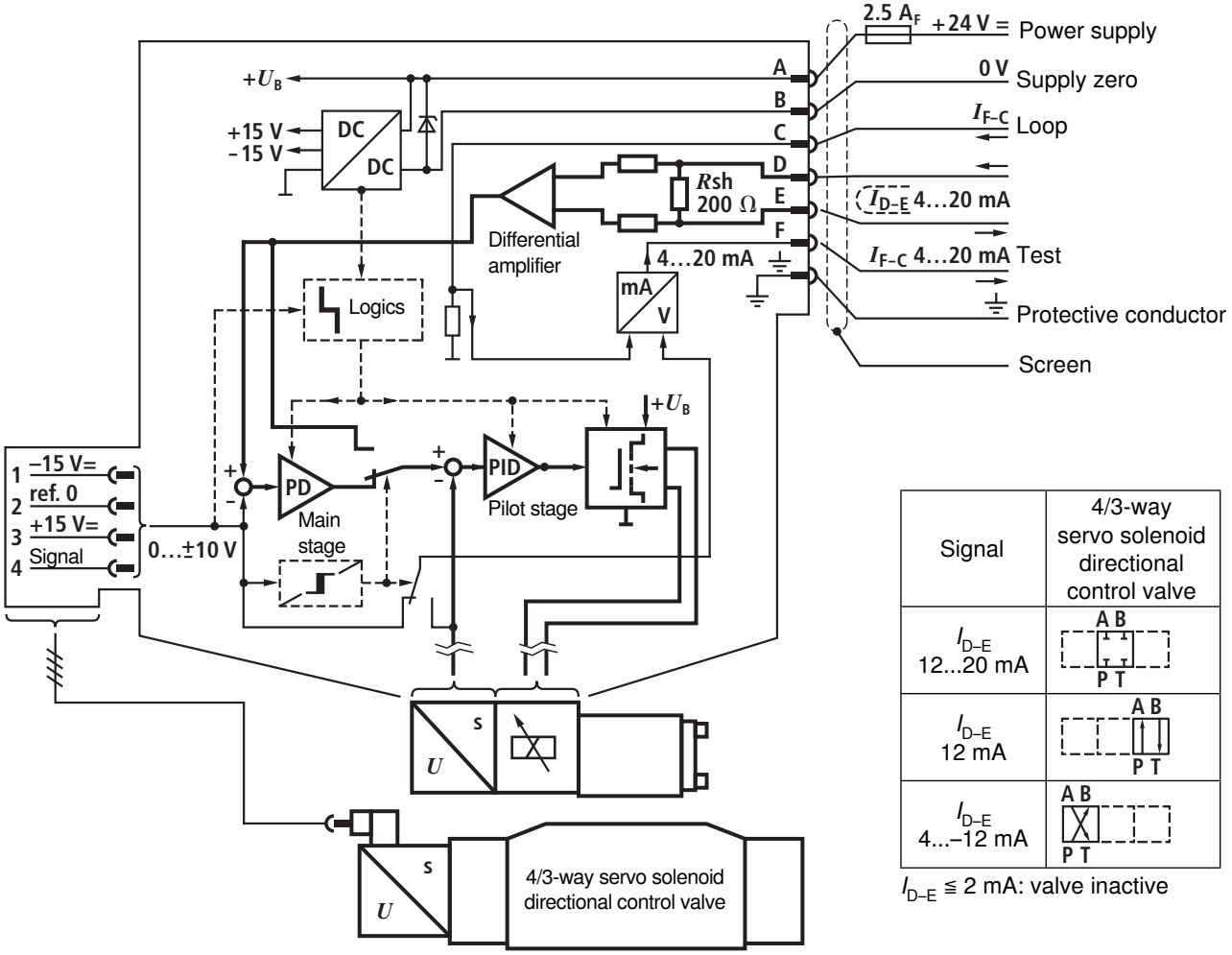
Version A1: $U_{D-E}$ ±10 V
($R_i$ = 100 kΩ)



## On-board electronics

**Block diagram/pin assignment**

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



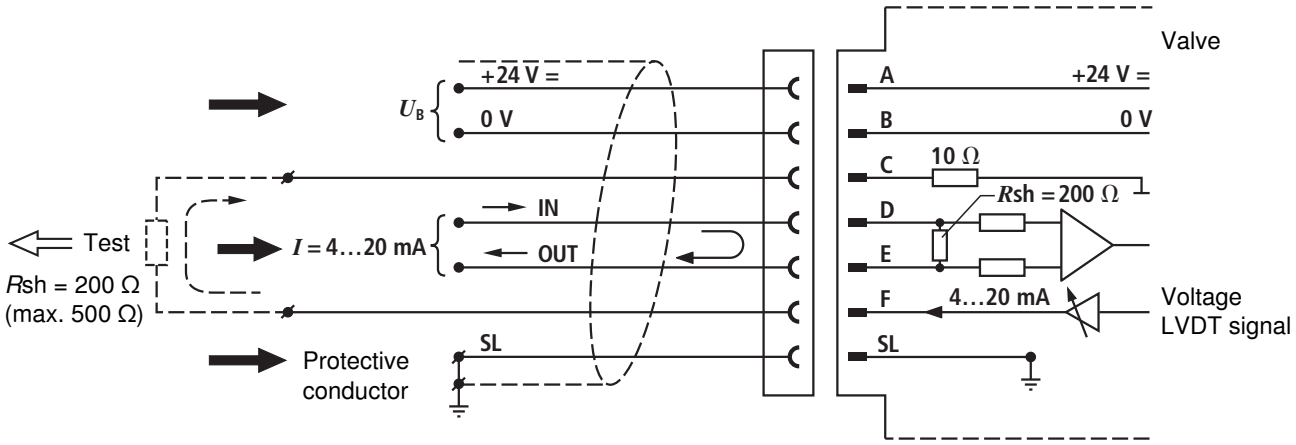

| Signal | 4/3-way servo solenoid directional control valve |
|---|---|
| $I_{D-E}$ 12...20 mA |  |
| $I_{D-E}$ 12 mA |  |
| $I_{D-E}$ 4...–12 mA |  |



$I_{D-E}$ ≦ 2 mA: valve inactive

**Pin assignment 6P+PE**

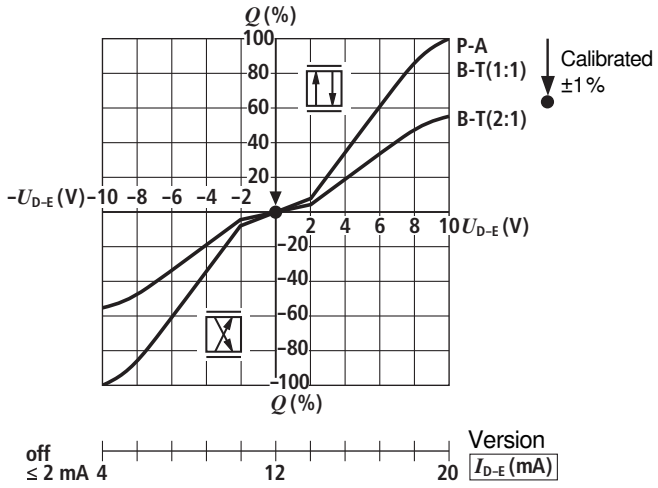
Version F1: $I_{D-E}$ 4...12...20 mA
(*R*sh = 200 Ω)



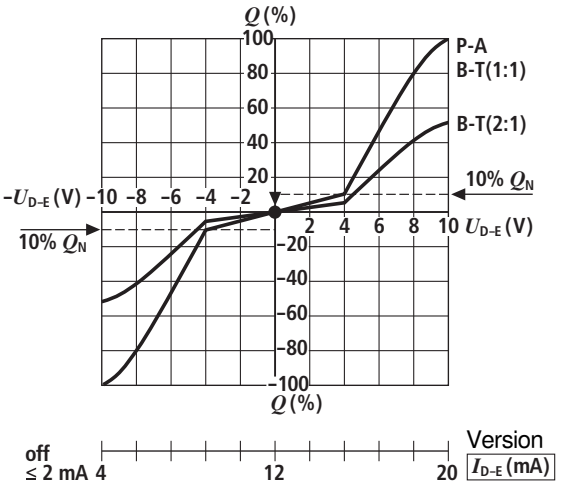
## Characteristic curves (measured with HLP 46, $\vartheta_{oil}$ = 40 °C ±5 °C)

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

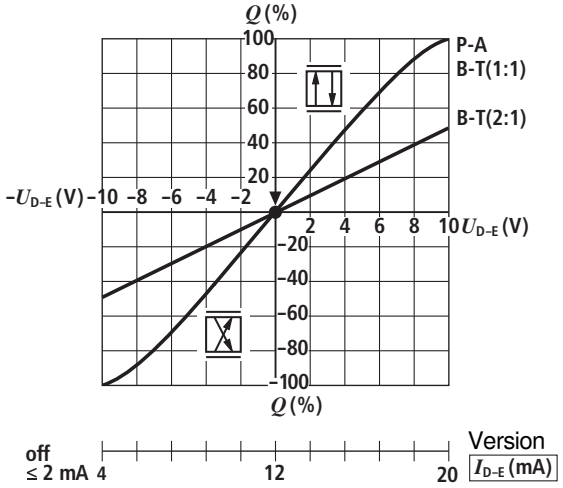
Flow characteristic M



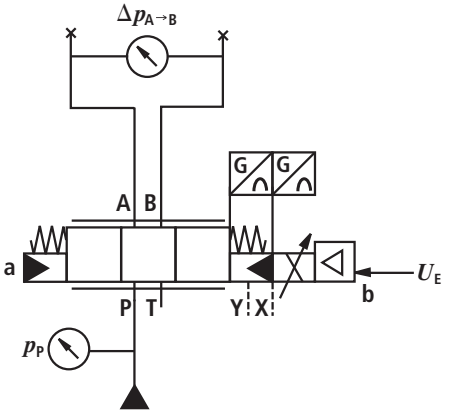

Flow characteristic P

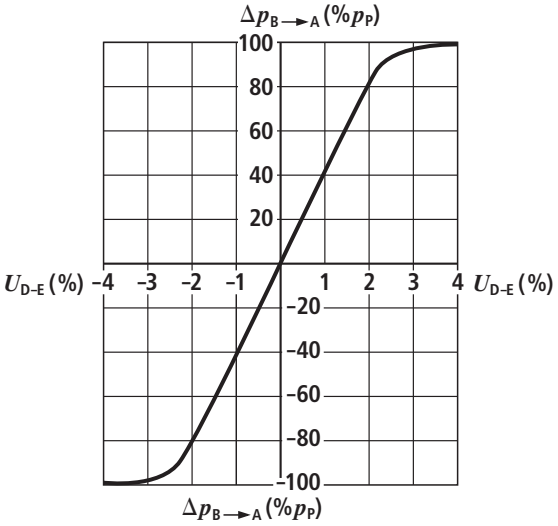



Flow characteristic L




**Pressure gain**

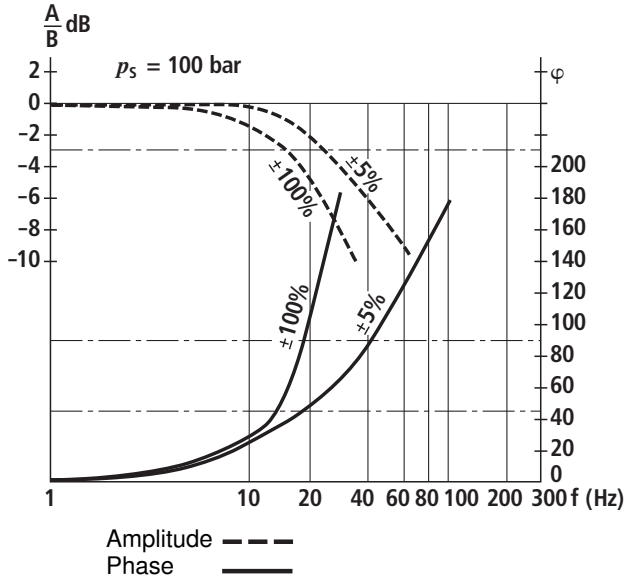


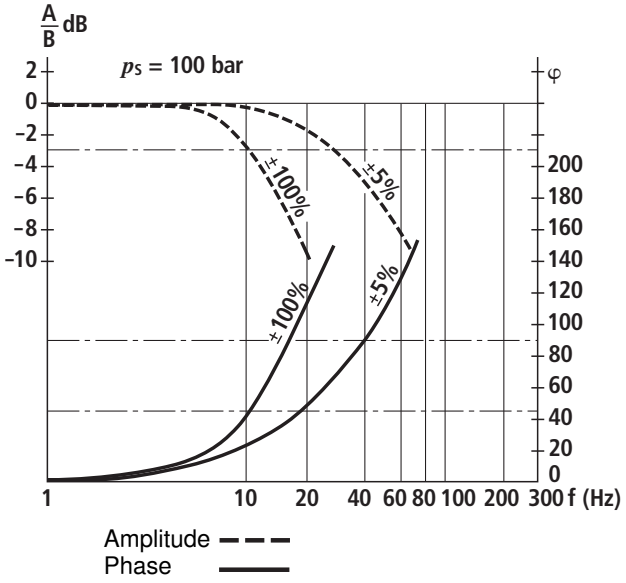
## **Characteristic curves** (measured with HLP 46, $\vartheta_{oil}$ = 40 °C ±5 °C)

**Bode diagram**

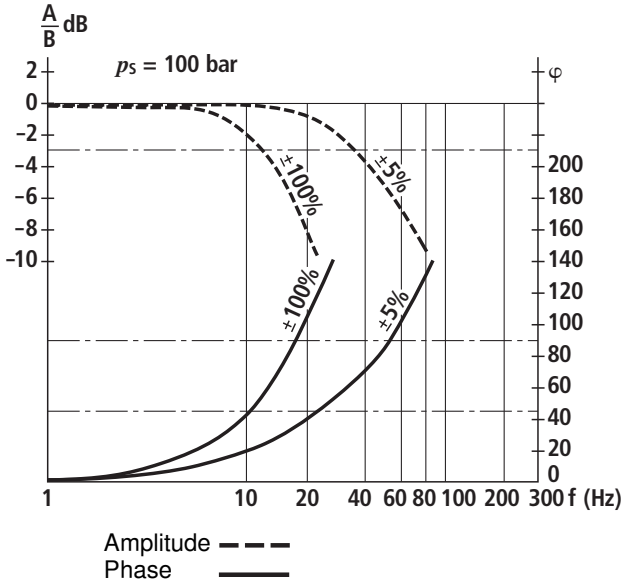
**NG10**



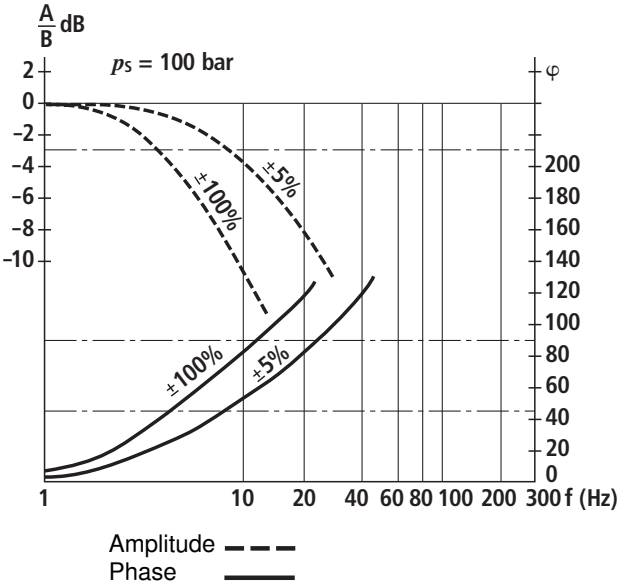

**NG16**



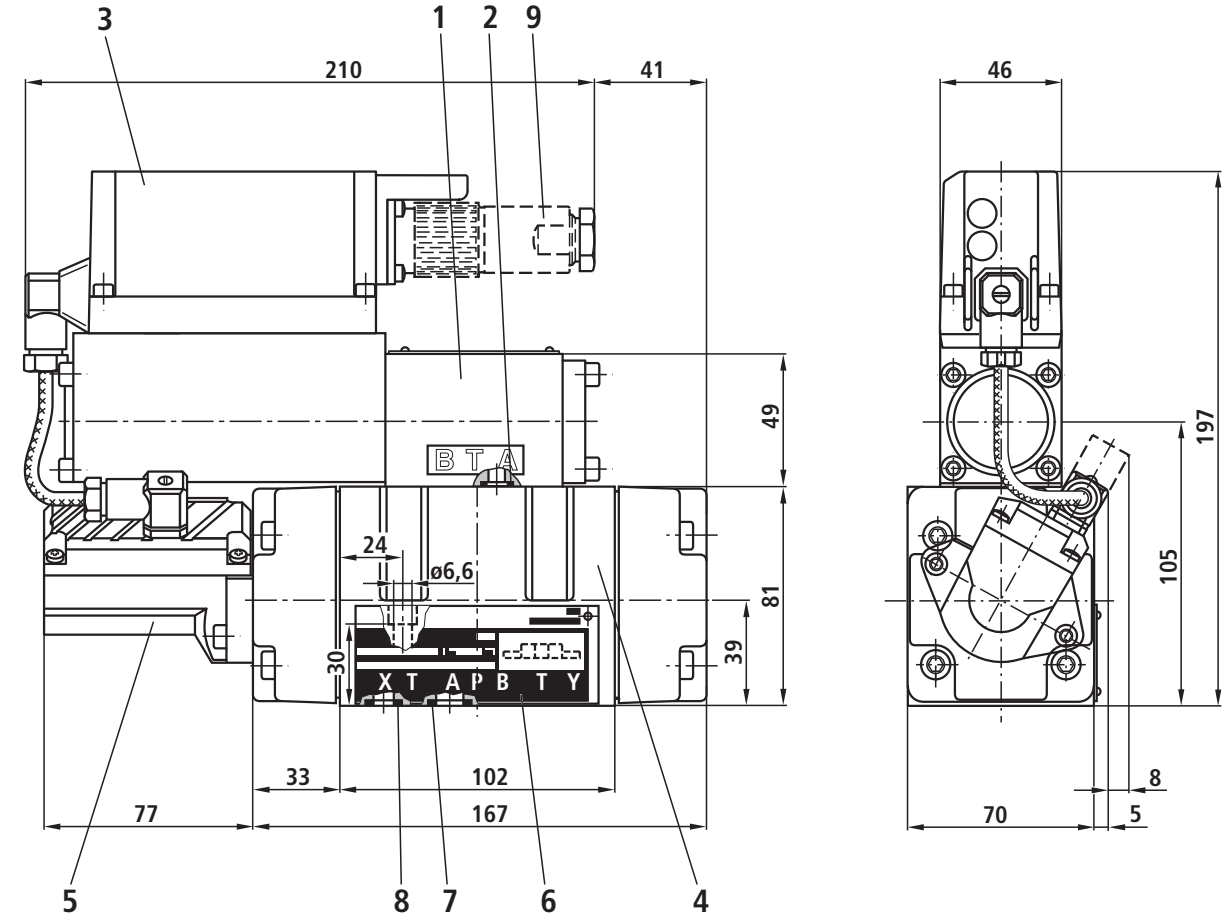

**NG25/27**

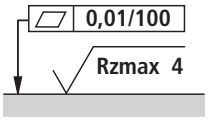



**NG35**

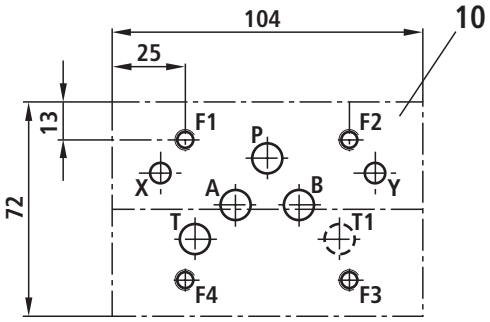


## Unit dimensions NG10 (dimensions in mm)




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 45055 (order separately)

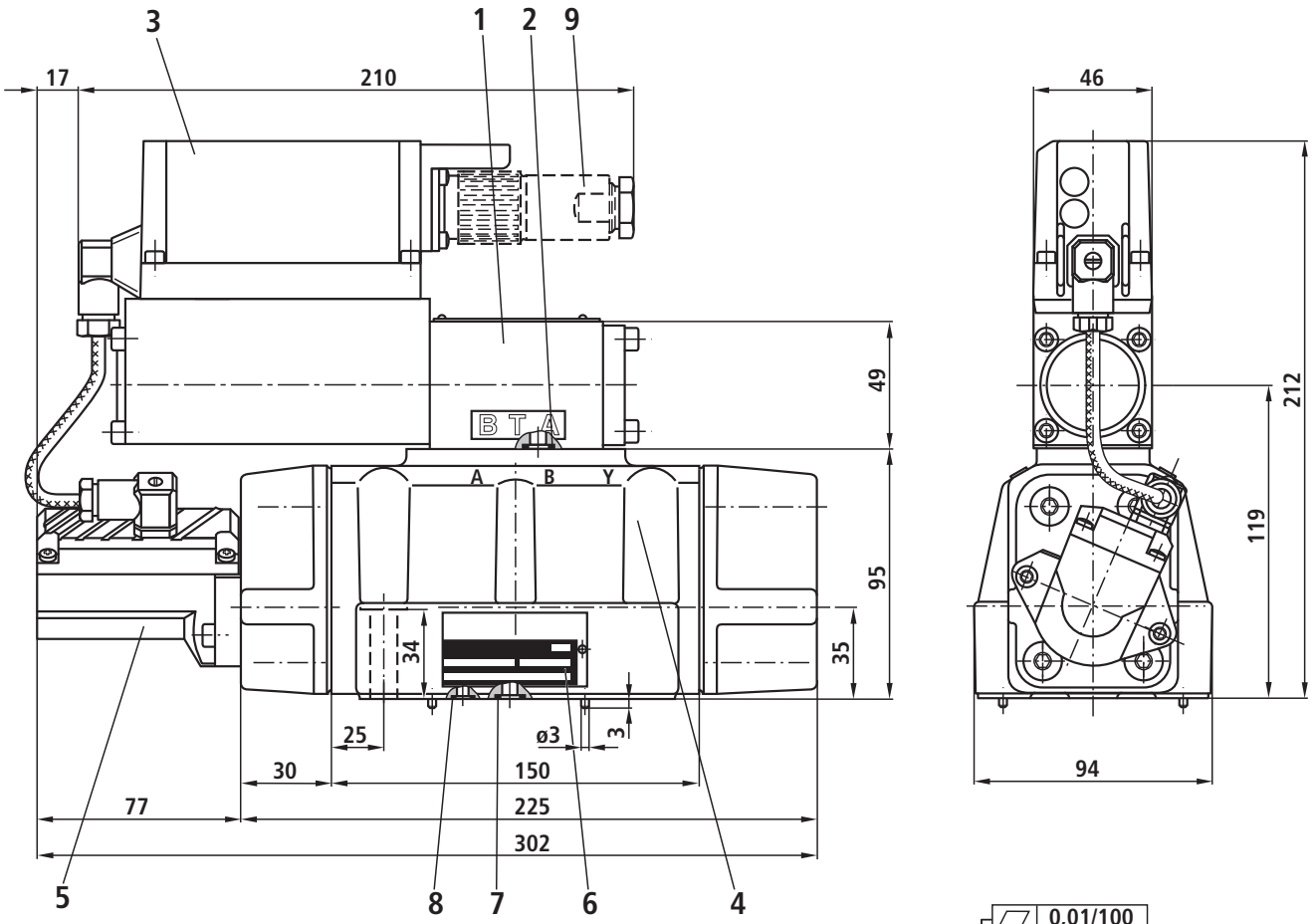
**Valve fastening bolts** (order separately)
The following valve fastening bolts are recommended:

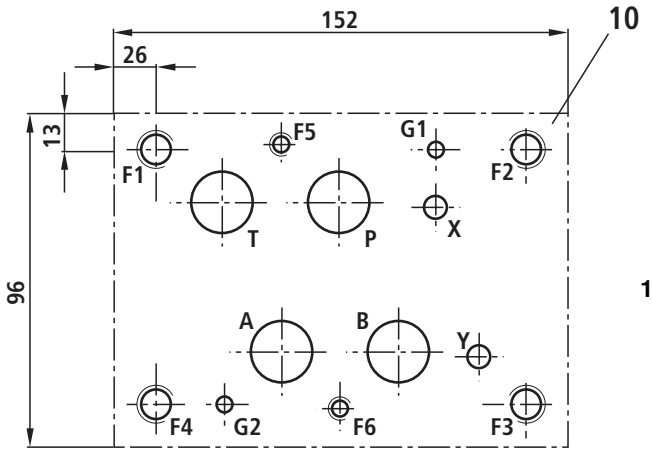
**4 cheese-head bolts ISO 4762-M6x40-10.9-N67F821 70**
(galvanized in accordance with Bosch standard N67F821 70)

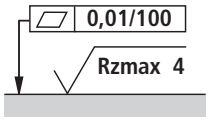
Tightening torque $M_A$ = 11+3 Nm

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:

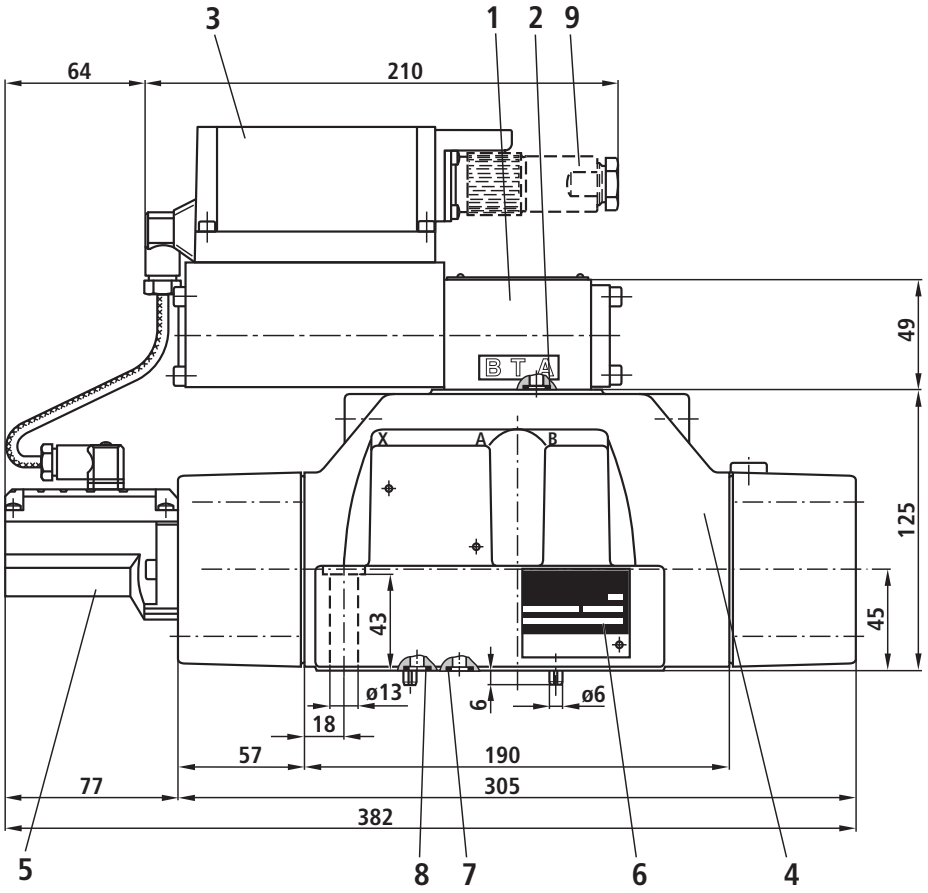
**2 cheese-head bolts ISO 4762-M6x45-10.9-N67F821 70**
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque $M_A$ = 11+3 Nm

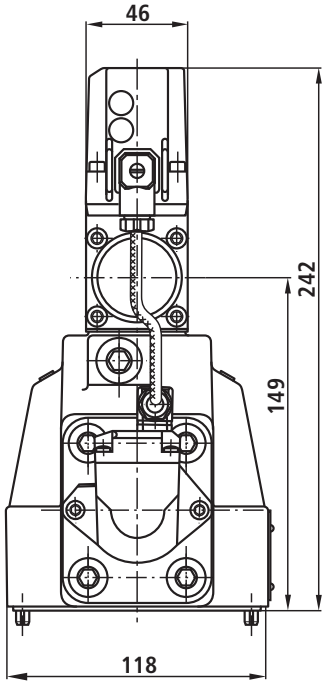
Material no. **2910151211**

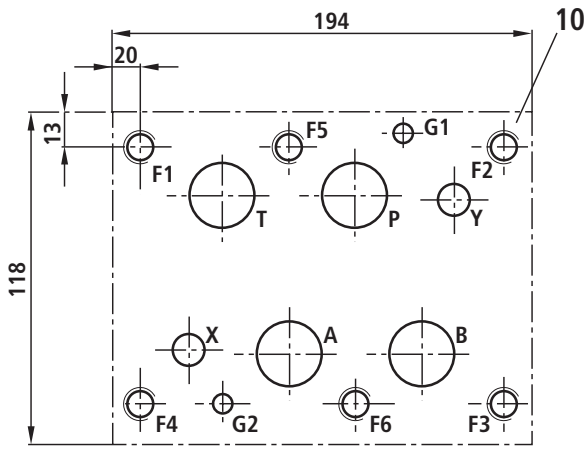
**4 cheese-head bolts ISO 4762-M10x50-10.9-N67F821 70**
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque $M_A$ = 50+10 Nm

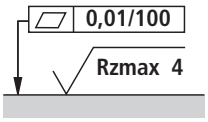
Material no. **2910151301**

## 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 ∅

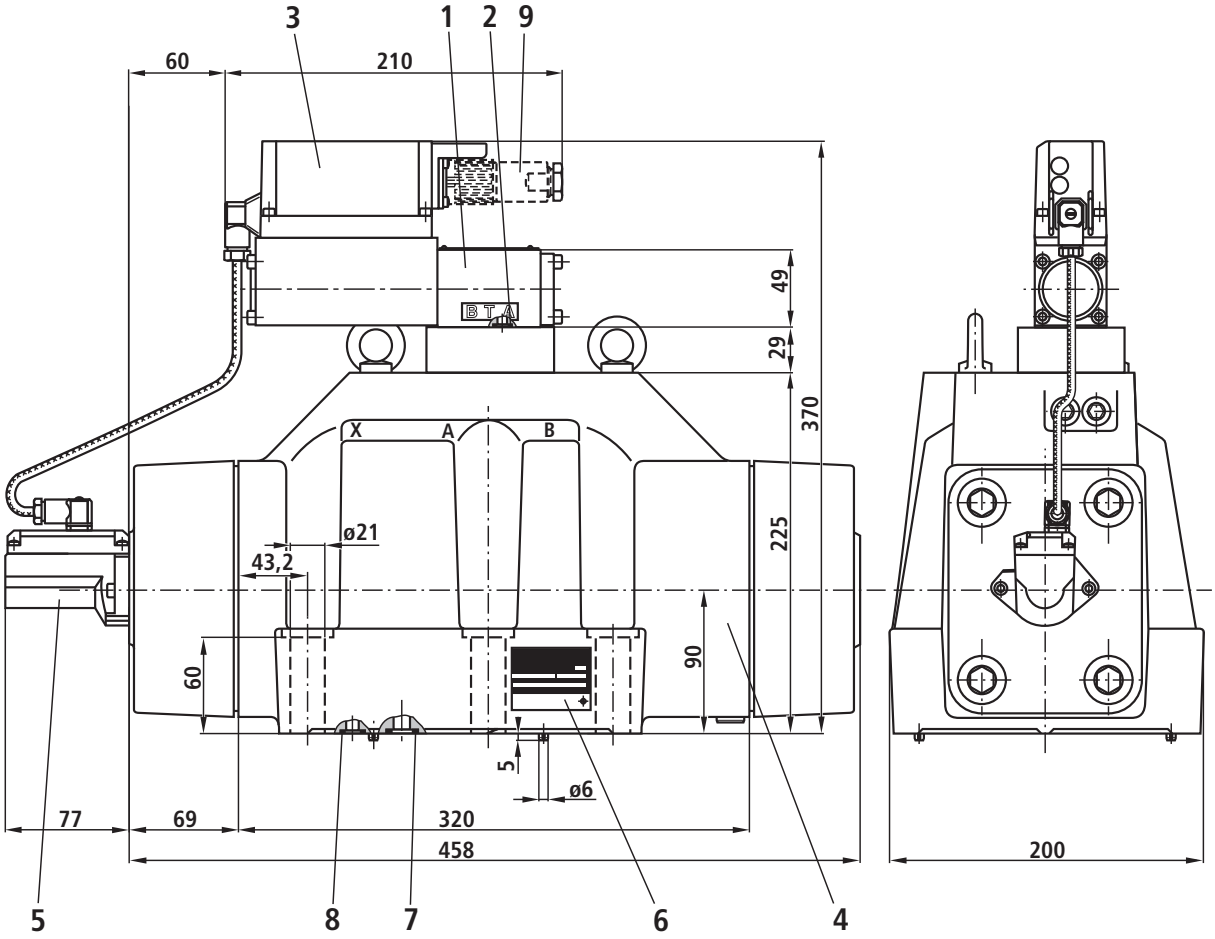
**Subplates,** see data sheet 45059 (order separately)

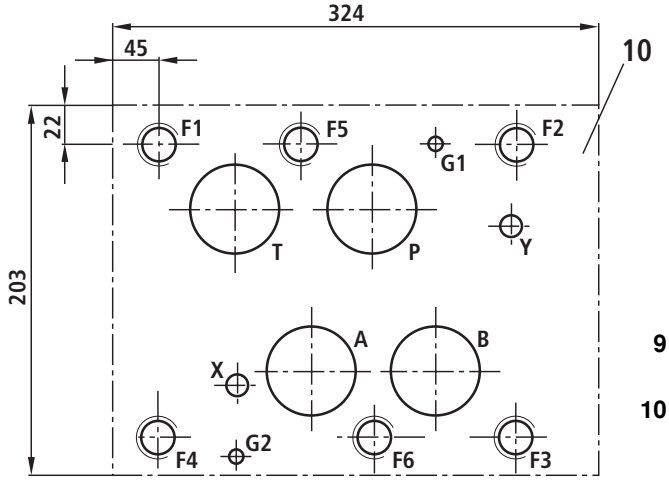
**Valve fastening bolts** (order separately)
The following valve fastening bolts are recommended:

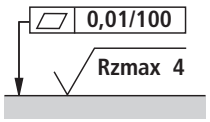
**6 cheese-head bolts ISO 4762-M12x60-10.9-N67F821 70**
(galvanized in accordance with Bosch standard N67F821 70)
Tightening torque NG25 $M_A$ = 90+30 Nm,
NG27 $M_A$ = 90±15 Nm

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

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