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

Type 4WRLE 10...35, symbols E./W.

Sizes (NG) 10, 16, 25, 27, 35
Unit series 3X
Maximum working pressure P, A, B 350 bar (NG27: 280 bar)
Nominal flow rate 50...1100 l/min (Δp = 10 bar)

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Features

- Pilot operated 4/3-way servo solenoid directional control valves NG10 to NG35, with approx. 20% overlap
- 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 on-board electronics (OBE), calibrated at the factory
- Main stage with position feedback
- Electronically calibrated and compensated overlap
- Spool with linear travel, with anti-rotation element
- Flow characteristic
  - S = Progressive
  - NG16, 25 and 27 with load tap C1/C2
- 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 43563-AM6, see Technical Data Sheet RE 08008 (order separately)

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

4WRL E S J 3X G24 K0/A1 M *

With on-board electronics = E
NG10 = 10
NG16 = 16
NG25 = 25
NG27 1) = 27
NG35 2) = 35

Control spool symbols

With symbol E1, E1(Z), E4, W1(Z), W4:
P → A: qv B → T: qv/2
P → B: qv/2 A → T: qv

With load tap C1/C2 (NG16, 25, 27) = Z

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 \( Q_A : Q_B \)

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 \( Q_A : Q_B \)
**Accessories, not included in delivery**

<table>
<thead>
<tr>
<th>Fastening bolts</th>
<th>NG10</th>
<th>4 x ISO 4762-M6 x 40-10.9-N67F82170</th>
<th>2 910 151 209</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG16</td>
<td>2 x ISO 4762-M6 x 45-10.9-N67F82170</td>
<td>2 910 151 211</td>
<td></td>
</tr>
<tr>
<td>NG25/27</td>
<td>4 x ISO 4762-M10 x 50-10.9-N67F82170</td>
<td>2 910 151 301</td>
<td></td>
</tr>
<tr>
<td>NG35</td>
<td>6 x ISO 4762-M12 x 60-10.9-N67F82170</td>
<td>2 910 151 354</td>
<td></td>
</tr>
<tr>
<td>NG25/27</td>
<td>6 x ISO 4762-M20 x 90-10.9-N67F82170</td>
<td>2 910 151 532</td>
<td></td>
</tr>
</tbody>
</table>

Plug-in connectors 6P+PE, also see RE 08008

| KS              | 1 834 482 022 |
| MS              | 1 834 482 024 |
| MS              | 1 834 482 026 |

**Testing and service equipment**

- Test box type VT-PE-TB3, see RE 30065
- Test adapter 6P+PE type VT-PA-2, see RE 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 its spring-centered mid position.

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 spool stroke is controlled proportionately to the setpoint of 0.5...10 V between 20...100%. If the input setpoint is < ±0.5 V, the control spool is held in the spring-centered, overlapped 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

**Type...–3X...**

![Diagram of Type...–3X...](image)

**Type...–3X.E...**

![Diagram of Type...–3X.E...](image)

**Type...–3X.ET...**

![Diagram of Type...–3X.ET...](image)

**Type...–3X.T...**

![Diagram of Type...–3X.T...](image)

### NG16

**Symbol in detail**

(external control oil inlet and outlet)

![Diagram of NG16](image)

**Main valve**

**Pilot valve**

---

**No designation** =

- "x" = external
- "y" = external
- "X" = internal
- "Y" = internal

**E**

- "x" = internal
- "y" = external

**ET**

- "x" = internal
- "y" = internal

**T**

- "x" = external
- "y" = internal
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 |
| 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, \( \theta_{\text{oil}} = 40 ^\circ \text{C} \pm 5 ^\circ \text{C} \))**

| 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 |

<table>
<thead>
<tr>
<th>Nominal flow at ( \Delta p = 5 \text{ bar per notch} ) l/min</th>
<th>NG10</th>
<th>NG16</th>
<th>NG25</th>
<th>NG27</th>
<th>NG35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. working pressure Ports P, A, B cm²/min</td>
<td>350</td>
<td>350</td>
<td>280</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>Max. working pressure Ports P, A, B, X cm²/min</td>
<td>350</td>
<td>350</td>
<td>280</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>Min. control oil pressure in “pilot stage” bar</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_{\text{max}} ) Pilot valve (inlet) l/min</td>
<td>170</td>
<td>450</td>
<td>900</td>
<td>1000</td>
<td>3500</td>
</tr>
<tr>
<td>( Q_{\text{p}} ) Pilot valve (inlet) ( \Delta p = 35 \text{ bar} ) l/min</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Leakage of pilot valve at ( X = 100 \text{ bar} ) cm³/min</td>
<td>&lt;150</td>
<td>&lt;180</td>
<td>&lt;350</td>
<td>&lt;500</td>
<td>&lt;1100</td>
</tr>
<tr>
<td>Leakage of main stage control spool symbols “E” at ( P = 100 \text{ bar} ) l/min</td>
<td>&lt;0.25</td>
<td>&lt;0.4</td>
<td>&lt;0.6</td>
<td>&lt;0.6</td>
<td>&lt;1.1</td>
</tr>
</tbody>
</table>

**Static/Dynamic**

| Overlap in mid position | \( \approx 18...22 \% \) of spool stroke, electrically compensated for \( U_{D,E} \pm 0.5 \text{ V} \) |
| Spool stroke, main stage ± mm | 4 | 7 | 10 | 10 | 12,5 |
| Control oil volume of main stage 100% cm³ | 1.1 | 4.3 | 11.3 | 11.3 | 41.5 |
| Control oil requirement 0...100%, (at \( X = 100 \text{ bar} \)) l/min | 2.2 | 4.7 | 11.7 | 11.7 | 15.6 |
| Hysteresis % | <0.1, scarcely measurable |
| Manufacturing tolerance % | \( <\pm 5 \left( Q_{\text{max}} \right) \) |
| Response time for 0...100%, (at \( X = 100 \text{ bar} \)) ms | <40 | <80 | <80 | <80 | <130 |
| Response time for 0...100%, (at \( X = 10 \text{ bar} \)) ms | <150 | <250 | <250 | <250 | <500 |
| Switch-off behavior | After electrical switch-off (pilot valve in fail-safe) Main stage moves to spring-centered overlapped mid position |
| Thermal drift | <1% at \( \Delta T = 40 ^\circ \text{C} \) |
| Calibration | At the factory ±1%, see flow curve |
| Electromagnetic compatibility | EN 61000-6-2: 2002-08 |
| | EN 61000-6-3: 2002-08 |

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 \( \Delta p \) \( Q_{x} = Q_{\text{nom}} \cdot \sqrt{\frac{\Delta p}{5}} \)
Technical data

Electric pilot valve NG6, trigger electronics integrated in the valve

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Cyclic duration factor</td>
<td>% 100 ED</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 65 to DIN 40050 and IEC 14434/5</td>
</tr>
<tr>
<td>Connection</td>
<td>Plug-in connector 6P+PE, DIN 43563</td>
</tr>
<tr>
<td>Power supply</td>
<td>24 V DC&lt;sub&gt;nom&lt;/sub&gt; min. 21 V DC</td>
</tr>
<tr>
<td>Ripple max. 2 V DC</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>Solenoid ∇ 45 mm = 40 VA max.</td>
</tr>
<tr>
<td>External fuse</td>
<td>2.5 A&lt;sub&gt;c&lt;/sub&gt;</td>
</tr>
<tr>
<td>Input, “Standard” version</td>
<td>Differential amplifier, R&lt;sub&gt;i&lt;/sub&gt; = 100 kΩ</td>
</tr>
<tr>
<td>Terminal D: U&lt;sub&gt;E&lt;/sub&gt;</td>
<td>0...±10 V</td>
</tr>
<tr>
<td>Terminal E:</td>
<td>0 V</td>
</tr>
<tr>
<td>Max. differential input voltage</td>
<td>D → B max. 18 V DC</td>
</tr>
<tr>
<td>at 0 V</td>
<td>E → B</td>
</tr>
<tr>
<td>Test signal, “Standard” version</td>
<td>LVDT</td>
</tr>
<tr>
<td>Terminal F: U&lt;sub&gt;Test&lt;/sub&gt;</td>
<td>0...±10 V</td>
</tr>
<tr>
<td>Terminal C:</td>
<td>Reference 0 V</td>
</tr>
<tr>
<td>Protective conductor and screen</td>
<td>See pin assignment</td>
</tr>
<tr>
<td>Recommended cable</td>
<td>See pin assignment</td>
</tr>
<tr>
<td></td>
<td>up to 20 m 7 x 0.75 mm&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>up to 40 m 7 x 1 mm&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Calibration</td>
<td>Overlap and P–A at +8 V, calibrated at the factory, see valve characteristic curve</td>
</tr>
</tbody>
</table>

Important

Pilot operated 4/3-way servo solenoid directional control valves with positive overlap perform their function in open or closed-loop-controlled axes and have approx. 20 % overlap when switched off. This condition does not constitute an active fail-safe position. For this reason, many applications require the use of “external check valves” or certain sandwich-mounted valves, which must be taken into account during the On/Off switching sequence.
Connection

For electrical data, see page 6

[Diagram]

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 type 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

Important

Voltage supply 24 V DCnom.
if voltage drops below 18 V DC, rapid shutdown resembling
“Enable OFF” takes place internally.

In addition, with the “mA signal” version:

- $I_{D-E} \geq 3$ mA – valve is active
- $I_{D-E} \leq 2$ 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: $U_{D-E} = \pm 10$ V

Pin assignment 6P+PE
Version A1: $U_{D-E} = \pm 10$ V
($R_i = 100$ kΩ)
Characteristic curves (measured with HLP 46, $\theta_{oil} = 40^\circ C \pm 5^\circ C$)

Flow rate – signal function

$$Q = f(U_{D-E})$$

Symbol $E(Z), W(Z)$ ($Q_A : Q_B = 1 : 1$)

Symbol $E_1(Z), W_1(Z)$ ($Q_A : Q_B = 2 : 1$)

Control spool with asymmetric metering notches

Control spools with asymmetric metering notches are available in a ratio of 2:1 for the purpose of adaptation to differential cylinders.

Flow in mid position, “leakage oil pressure relief”

With symbol "E", leakage oil in the two work chambers A and B of the control piston gives rise to a build-up of pressure in A or B, which then causes a connecting cylinder to drift out of position.

In many cases, the “W” symbol is a better solution. With a setpoint of “0”, the control piston moves into the overlapped mid position. In this mid position, pressure is then relieved from ports A and B with 1 % $\pm$ 0.5 % $Q_N$ to T.

This also supports the function of external check valves.

Control spools in a differential circuit

In order to produce differential circuits, valve spools with a 4th position are available.

It is sufficient to install a check valve in the consumer lines.

In addition, a control spool (symbol) with internal B-P connection is employed for certain branch-oriented solutions. However, we recommend that you consult the BRH Application Center with regard to these special symbols, as a simulation or knowledge of this type of system is usually required.

* Comp. $U_{D-E} \pm 0.5$ V factory setting $\pm 1$

** $Q_{P-A}$ at $+8$ V $[U_{D-E}]$ manufacturing tolerance $Q_{max} \pm 5\%$
**Characteristic curves** (measured with HLP 46, $\theta_{\text{oil}} = 40 \, ^\circ\text{C} \pm 5 \, ^\circ\text{C})$

**Load tap C1/C2**

To compensate for fluctuations in the load or supply pressure, 4/3-way servo solenoid directional control valves are combined with pressure compensators. The load is tapped via a shuttle valve for the NG10 and 35, and via two additional ports C1 and C2 for the NG16, 25 and 27.

The pressure compensator therefore always receives the correct pressure signal even in the event of negative load. When using pressure compensators, an external control oil supply should always be selected.

NG10, 35

NG16, 25, 27
**Characteristic curves** (measured with HLP 46, \( \theta_{\text{oil}} = 40^\circ\text{C}\pm5^\circ\text{C} \))

**Response time** (at \( X = 100 \) bar)

**NG10**

**Open**

**Close**

**NG16**

**NG25/27**

**NG35**
Unit dimensions NG10 (nominal 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 (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 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-N67F82170
(galvanized in accordance with Bosch standard N67F82170)
Tightening torque $M_n = 11 \pm 3$ Nm
Material no. 2910151209
**Unit dimensions NG16** (nominal 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, C1, C2)
9. Plug-in connector not included in delivery (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 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

**Required surface quality of mating component**

- $R_{zmax} = 4$
Unit dimensions NG25/27 (nominal 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, C1, C2)
9 Plug-in connector not included in delivery (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 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 $M_A = 90\pm 15$ Nm

Material no. 2910151354
Unit dimensions NG35 (nominal 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 (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 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-N67F82170
   (galvanized in accordance with Bosch standard N67F821 70)
   Tightening torque $M_A = 450 + 110$ Nm

Material no. 2910151532
Notes