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

Type 4WRVE 10...27, symbols V, V1

Sizes (NG) 10, 16, 25, 27
Unit series 2X
Maximum working pressure P, A, B 350 bar (NG27: 280 bar)
Nominal flow rate 40...430 l/min ($\Delta p = 10$ bar)

List of contents

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>1</td>
</tr>
<tr>
<td>Ordering data</td>
<td>2</td>
</tr>
<tr>
<td>Symbols, accessories</td>
<td>3</td>
</tr>
<tr>
<td>Function, sectional diagram</td>
<td>4</td>
</tr>
<tr>
<td>Control oil supply</td>
<td>5</td>
</tr>
<tr>
<td>Technical data</td>
<td>6 to 8</td>
</tr>
<tr>
<td>On-board electronics</td>
<td>9</td>
</tr>
<tr>
<td>Characteristic curves</td>
<td>10 and 12</td>
</tr>
<tr>
<td>Unit dimensions</td>
<td>13 to 15</td>
</tr>
</tbody>
</table>

Features

- Pilot operated High Response 4/3-way servo solenoid directional control valves NG10 to NG27, with control piston and sleeve in servo quality
- On-board electronics (OBE) with position controller for the pilot and main stages, 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 11P+PE
  - Signal input of differential amplifier with interface B5 ±10 V
- For subplate attachment, mounting hole configuration NG10 to ISO 4401-05-05-0-05, NG16 to ISO 4401-07-07-0-05 and NG25/27 to ISO 4401-08-08-0-05
- Subplates as per Technical Data Sheet, NG10 RE 45055, NG16 RE 45057 and NG25/27 RE 45059 (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

With on-board electronics = E
NG10 = 10
NG16 = 16
NG25 = 25
NG27 = 27

Control spool symbols
4/3-way version

With symbol V1:
P → A: qₐ
B → T: q_b/2
P → B: q_b/2
A → T: q_a

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

NG10
40 l/min = 40
55 l/min = 55
70 l/min = 70
85 l/min = 85

NG16
90 l/min = 90
120 l/min = 120
150 l/min = 150
200 l/min = 200

NG25
300 l/min = 300
370 l/min = 370

NG27
430 l/min = 430

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) Q_M: Flow characteristic “P”

3) Q_B: Flow characteristic “M” or “L”
Symbols

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0</td>
</tr>
<tr>
<td>b</td>
<td>P</td>
</tr>
</tbody>
</table>

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

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></td>
<td>4 x ISO 4762-M10 x 50-10.9-N67F82170</td>
<td>2 910 151 301</td>
<td></td>
</tr>
<tr>
<td>NG25/27</td>
<td>6 x ISO 4762-M12 x 60-10.9-N67F82170</td>
<td>2 910 151 354</td>
<td></td>
</tr>
</tbody>
</table>

Plug-in connector 11P+PE, also see RE 08008
KS 1 834 484 142

Testing and service equipment

- Test box type VT-PE-TB3, see RE 30065
- Test adapter 11P+PE type VT-PA-1, see RE 30067
Function, sectional diagram

Construction
The valve consists of three main assemblies:
- Pilot valve (1) with control spool and sleeve, return springs, dual-stroke solenoid and inductive position transducer
- Main stage (2) with centering springs and position feedback
- On-board trigger electronics (3)

Functional description
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 dual-stroke 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. When switched off, the pilot valve is undefined in P-B/A-T (preferable) or P-A/B-T, and the main stage can be 100% controlled.
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.

Type ... –3X ...

Type ... –3X ... E ...

Type ... –3X ... ET ...

Type ... –3X ... T ...

No designation =

E = “x” = internal “y” = external
ET = “x” = internal “y” = internal
T = “x” = external “y” = internal

Important

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. See technical data for details on “switch-off behavior”.

Symbol in detail (external control oil inlet and outlet)
## Technical data

### General

<table>
<thead>
<tr>
<th>Construction</th>
<th>Spool type valve, pilot operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuation</td>
<td>Servo solenoid directional control valve NG6 OBE, with position controller for pilot valve and main stage</td>
</tr>
<tr>
<td>Type of mounting</td>
<td>Subplate, mounting hole configuration NG10...27 to ISO 4401-...</td>
</tr>
<tr>
<td>Installation position</td>
<td>Optional</td>
</tr>
<tr>
<td>Ambient temperature range °C</td>
<td>-20...+50</td>
</tr>
<tr>
<td>Weight kg</td>
<td>NG10  8.0  NG16  10.4  NG25  18.2  NG27  18.2</td>
</tr>
<tr>
<td>Vibration resistance, test condition</td>
<td>Max. 25 g, shaken in 3 dimensions (24 h)</td>
</tr>
</tbody>
</table>

### Hydraulic (measured with HLP 46, \( \theta_{oil} = 40 \, ^\circ C \pm 5 \, ^\circ C \))

<table>
<thead>
<tr>
<th>Pressure fluid</th>
<th>Hydraulic oil to DIN 51524…535, other fluids after prior consultation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity range recommended mm²/s</td>
<td>20...100</td>
</tr>
<tr>
<td>max. permitted mm²/s</td>
<td>10...800</td>
</tr>
<tr>
<td>Pressure fluid temperature range °C</td>
<td>-20...+65</td>
</tr>
<tr>
<td>Maximum permissible degree of contamination of pressure fluid</td>
<td>Class 18/16/13 ¹</td>
</tr>
<tr>
<td>Purity class to ISO 4406 (c)</td>
<td>Class 18/16/13 ¹</td>
</tr>
<tr>
<td>Flow direction</td>
<td>See symbol</td>
</tr>
</tbody>
</table>

### Nominal flow at \( \Delta p = 5 \) bar per notch ²)

<table>
<thead>
<tr>
<th>Nominal flow at ( \Delta p = 5 ) bar per notch ²) l/min</th>
<th>NG10</th>
<th>NG16</th>
<th>NG25</th>
<th>NG27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. working pressure Ports P, A, B</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>280</td>
</tr>
<tr>
<td>External control oil inlet bar</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>280</td>
</tr>
<tr>
<td>Ports P, A, B Internal control oil inlet bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Ports T, X, Y bar</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Min. control oil pressure in “pilot stage” bar</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_{max} ) l/min</td>
<td>170</td>
<td>450</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td>( Q_{N} ) pilot valve l/min</td>
<td>8</td>
<td>24</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Leakage of pilot valve at 100 bar cm³/min</td>
<td>&lt;180</td>
<td>&lt;300</td>
<td>&lt;500</td>
<td>&lt;500</td>
</tr>
<tr>
<td>Leakage of main stage at 100 bar cm³/min</td>
<td>&lt;400</td>
<td>&lt;600</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
</tr>
</tbody>
</table>

### Static/Dynamic

<table>
<thead>
<tr>
<th>Hysteresis</th>
<th>%</th>
<th>&lt;0.1 scarcely measurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing tolerance for ( Q_{max} )</td>
<td>%</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Response time for signal change (at X = 100 bar) 0...100 %</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Response time for signal change (at X = 10 bar) 0...10 %</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Response time for signal change (at X = 10 bar) 0...100 %</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Response time for signal change (at X = 10 bar) 0...10 %</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Switch-off behavior</td>
<td>After electrical switch-off: Pilot valve undefined in P-B/A-T or P-A/B-T Main stage can be controlled 100% (PB/AT or PA/BT)</td>
<td></td>
</tr>
<tr>
<td>Thermal drift</td>
<td>Zero point displacement &lt;1 % at ( \Delta T = 40 , ^\circ C )</td>
<td></td>
</tr>
<tr>
<td>Zero adjustment</td>
<td>Factory-set ±1%</td>
<td></td>
</tr>
</tbody>
</table>

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 \( \Delta p \) \( Q_x = Q_{nom} \sqrt[5]{\frac{\Delta p_x}{5}} \)
## Technical data

### Electrical, trigger electronics integrated in the valve

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclic duration factor %</td>
<td>100, max. current input 30 VA (24 V DC)</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, 11P+PE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 V DC$_{nom}$</td>
<td>+24 V DC$_{nom}$ fuse 2.5 A$_F$ (output stages)</td>
</tr>
<tr>
<td></td>
<td>0 V power ground</td>
</tr>
</tbody>
</table>

| Input signal ±10 V                            | $U_{IN}$ differential amplifier, $R_i = 100$ kΩ |

| Feedback signal (LVDT)                        | ±10 V=, $R_s = 1$ kΩ  |
|                                                | 0 V, reference point |

| Enabling input                                 | > 8.5 V to 24 V DC$_{nom}$ (max. 40 V DC) |
|                                                | $R_i = 10$ kΩ          |

| Signals                                        | Enabling acknowledgement +24 V DC |
|                                                | Error signal: no error +24 V DC  |

| Protective conductor                           | Only connect when transformer of 24 V DC system does not conform to standard VDE 0551 |

<table>
<thead>
<tr>
<th>Connecting cable</th>
<th>Recommended Ø 12...14 mm: screened</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>max. 20 m 0.75 mm$^2$</td>
</tr>
<tr>
<td></td>
<td>max. 40 m 1.0 mm$^2$</td>
</tr>
</tbody>
</table>

24 V DC$_{nom}$ = min. 21 V DC
- max. 40 V DC

1) $U_B$ (Pin 1) = output stage supply
   - Valve “OFF” < 13.4 V DC
   - Valve “ON” > 16.8 V DC
   No error signal (Pin 11)

2) $U_S$ (Pin 9) = electronics supply
   - Valve “OFF” < 16.8 V DC
   Error signal (Pin 11)
   - Valve “ON” > 19.5 V DC
   No error signal (Pin 11)

3) Inputs: dielectric strength to withstand up to max. 50 V

4) Signals can bear a load of max. 20 mA and are resistant to shorts to ground.

### 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 “additional check valves”, which must be taken into account during the On/Off switching sequence.
Connection

See page 7 for electrical data

![Connection 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

Type:
- 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

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 B5: $U_E \pm 10 \text{ V}$

Pin assignment 11P+PE
Version B5: $U_E \pm 10 \text{ V}$
($R_i = 100 \text{ k}\Omega$)
Characteristic curves (measured with HLP 46, θ<sub>oil</sub> = 40 °C±5 °C)

Flow rate/Signal function \( Q = f (U_E) \)

Flow characteristic M

Flow characteristic P

Flow characteristic L
**Characteristic curves** (measured with HLP 46, $\theta_{\text{oil}} = 40{\,}^\circ\text{C} \pm 5{\,}^\circ\text{C}$)

**Pressure gain $\Delta = f(U_e)$**

\[
\Delta p_{A-B} [\%p_p] = f(U_e)
\]

**Response time** $0 \rightarrow 100\%$

**NG10**

\[
U_{\text{vol}, \text{int}} [%] = f(\Delta p_{A-B}, T)
\]

**NG16**

\[
U_{\text{vol}, \text{int}} [%] = f(\Delta p_{A-B}, T)
\]

**NG25/27**

\[
U_{\text{vol}, \text{int}} [%] = f(\Delta p_{A-B}, T)
\]
Characteristics curves (measured with HLP 46, $\theta_{oil} = 40 \degree C \pm 5 \degree C$)

Bode diagram

**NG10**

- Frequency: 42 Hz, Phase: $-90\degree$
- Frequency: 79 Hz, Phase: $-103\degree$
- Frequency: 103 Hz, Phase: $-90\degree$

**NG16**

- Frequency: 42 Hz, Phase: $-90\degree$
- Frequency: 80 Hz, Phase: $-100\degree$
- Frequency: 100 Hz, Phase: $-90\degree$

**NG25/27**

- Frequency: 35 Hz, Phase: $-90\degree$
- Frequency: 53 Hz, Phase: $-103\degree$
- Frequency: 60 Hz, Phase: $-90\degree$

Amplitude and Phase diagrams for different models.
**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 ∅ 10.5 mm
  - Minimum thread depth: Ferrous metal 1.5 x ∅ Non-ferrous 2 x ∅

**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 $M_A = 11 \pm 3$ Nm
  - Material no. **2910151209**

**Required surface quality of mating component**
Unit dimensions NG16 (nominal dimensions in mm)

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-N67F82170
   (galvanized in accordance with Bosch standard N67F82170)
   Tightening torque $M_T = 11+3$ Nm
   Material no. 2910151211

4 cheese-head bolts ISO 4762-M10x50-10.9-N67F82170
   (galvanized in accordance with Bosch standard N67F82170)
   Tightening torque $M_T = 50+10$ Nm
   Material no. 2910151301

---

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 (order separately)

Required surface quality of mating component

 Courtesy of CMA/Flodyne/Hydradyne ▪ Motion Control ▪ Hydraulic ▪ Pneumatic ▪ Electrical ▪ Mechanical ▪ (800) 426-5480 ▪ www.cmafh.com
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)
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-N67F82170
   (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
Notes

© This document, as well as the data, specifications and other information set forth in it, are the exclusive property of Bosch Rexroth AG. It may not be reproduced or given to third parties without its consent. The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.