

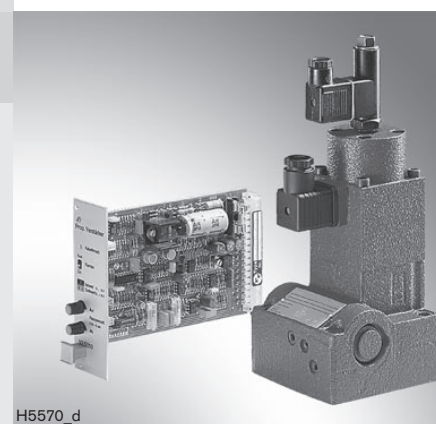
# Proportional flow control valve, 2-way version

**RE 29190/02.07**  
Replaces: 02.06

1/12

## Type 2FRE

Sizes 10 and 16  
Component series 4X  
Maximum operating pressure 315 bar  
Maximum flow 160 l/min



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## Features

- Valve with pressure compensator for the pressure-compensated control of a flow
- Actuation by means of proportional solenoid
- For subplate mounting:  
Porting pattern to ISO 6263, see page 10  
Subplates according to data sheet RE 45066 (separate order), see page 10
- With electrical closed-loop position control of the metering orifice
- The position transducer coil can be axially shifted, which simplifies zero point balancing of the metering orifice (electrical-hydraulic) without the need for intervening into the control electronics
- Low manufacturing tolerances of the valve and the electrical amplifier types VT-VRPA1-151-1X (analogue) and amplifier module Typ VT-MRPA1-151-1X (analogue), separate order, see page 5
- Flow control in both directions due to rectifier sandwich plate

Ordering code: Proportional flow control valve

2FRE

4X/

B

K4

\*

Size 10 = 10

Size 16 = 16

Component series 40 to 49 = 4X  
(40 to 49: unchanged installation and connection dimensions)

M =

V =

K4 =

B =

Further details in clear text

NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

FKM seals

**Electrical connection**

**Without** cable socket, with component plug to DIN EN 175301-803-A for proportional solenoid and GSA20 for position transducer

Cable sockets – separate order see page 6

With pressure compensator stroke limiter

| Nominal flow A → B / flow characteristics |       |                                                    |                 |        |  |
|-------------------------------------------|-------|----------------------------------------------------|-----------------|--------|--|
| Size 10                                   |       |                                                    | Size 16         |        |  |
| Linear                                    |       | Progressive with rapid speed<br>(fine control rng) | Linear          |        |  |
| Up to 10 l/min                            | = 10L | With rapid speed                                   | Up to 80 l/min  | = 80L  |  |
| Up to 16 l/min                            | = 16L |                                                    | Up to 100 l/min | = 100L |  |
| Up to 25 l/min                            | = 25L |                                                    | Up to 125 l/min | = 125L |  |
| Up to 50 l/min                            | = 50L |                                                    | Up to 160 l/min | = 160L |  |
| Up to 60 l/min                            | = 60L |                                                    |                 |        |  |
|                                           |       |                                                    |                 | = 5QE  |  |
|                                           |       |                                                    |                 | = 5Q   |  |
|                                           |       |                                                    |                 | = 10Q  |  |
|                                           |       |                                                    |                 | = 16Q  |  |
|                                           |       |                                                    |                 | = 25Q  |  |

Standard types

| Size 10            |                 | Size 16             |                 |
|--------------------|-----------------|---------------------|-----------------|
| Type               | material number | Type                | material number |
| 2FRE 10-4X/10LBK4M | R900915817      | 2FRE 16-4X/100LBK4M | R900915819      |
| 2FRE 10-4X/16LBK4M | R900915825      | 2FRE 16-4X/160LBK4M | R900915814      |
| 2FRE 10-4X/25LBK4M | R900915820      |                     |                 |
| 2FRE 10-4X/50LBK4M | R900915815      |                     |                 |

Ordering code: Rectifier sandwich plate

Z4S

2X/

\*

Size 10 = 10

Size 16 = 16

Component series 20 to 29 = 2X  
(20 to 29: unchanged installation and connection dimensions)

No code =

V =

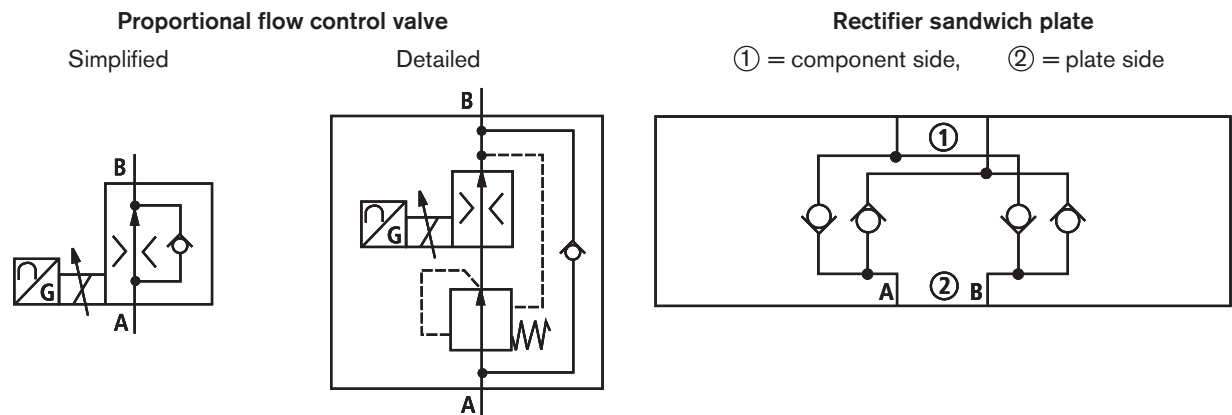
Further details in clear text

NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

FKM seals

| Size 10     |                 | Size 16     |                 |
|-------------|-----------------|-------------|-----------------|
| Type        | material number | Type        | material number |
| Z4S 10-2X/  | R900413377      | Z4S 16-2X/  | R900425901      |
| Z4S 10-2X/V | R900413379      | Z4S 16-2X/V | R900427362      |

## Symbols



## Function, section

Proportional flow control valves of type 2FRE ... feature a 2-way function. They can control a flow, which is determined by an electrical command value, in a pressure- and largely temperature-compensated way.

They basically consist of housing (1), proportional solenoid with inductive position transducer (2), metering orifice (3), pressure compensator (4), stroke limiter (5) and check valve (6).

The setting of the flow is determined by the setting (0 to 100 %) on the command value potentiometer. The selected command value causes metering orifice (3) to be adjusted via the amplifier and the proportional solenoid. The inductive position transducer senses the position of metering orifice (3). Any deviations from the command value are corrected by the closed-loop position control.

Pressure compensator (4) keeps the pressure differential across metering orifice (3) always at a constant value. This ensures pressure compensation of the flow.

If the current regulator is used only within a range, which is significantly smaller than the maximum nominal flow provided from the valve, the response time of pressure compensator (4) can be shortened by limiting the pressure compensator stroke. Thus, undesirable start-up jumps can be reduced.

If the grub screw of stroke limiter (5) is at the left-hand limit stop (turned out), the pressure compensator stroke is not limited.

The low temperature drift is a result of the favourable design of the metering orifice.

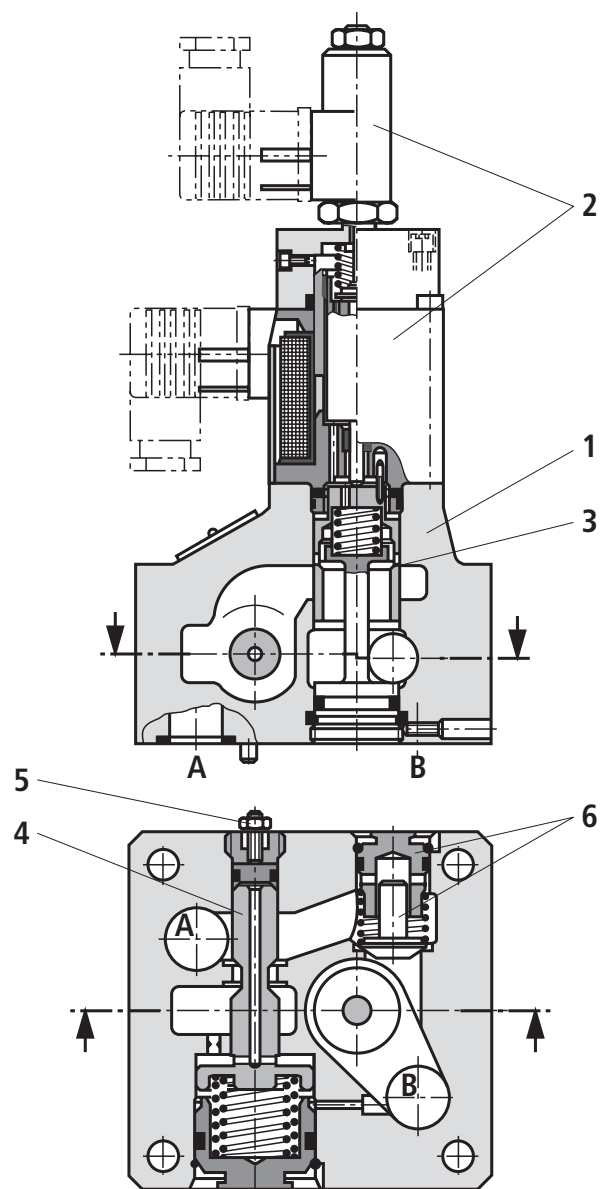
At a command value of 0 % the metering orifice is closed.

In the event of a power failure or cable break on the inductive position transducer, the metering orifice closes.

Starting from a 0 % command value, a jump-free start-up is possible. The metering orifice can be opened and closed with a delay provided by two ramps in the electrical amplifier.

Check valve (6) allows the free return flow from B to A.

The supply and return flow to and from the actuator can be controlled with the help of an additional rectifier sandwich plate of type Z4S... under the proportional flow control valve.



**Technical data** (for applications outside these parameters, please consult us!)**General**

|                           |                                   |              |           |
|---------------------------|-----------------------------------|--------------|-----------|
| Size                      | Size                              | <b>10</b>    | <b>16</b> |
| Weight                    | – Proportional flow control valve | kg           | 6.1       |
|                           | – Rectifier sandwich plate        | kg           | 3.2       |
| Installation orientation  |                                   | Optional     |           |
| Storage temperature range |                                   | °C           |           |
| Ambient temperature range |                                   | °C           |           |
|                           |                                   | – 20 to + 80 |           |
|                           |                                   | – 20 to + 70 |           |

**Hydraulic** – proportional flow control valve (measured with HLP46 and at  $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$ )

| Size                                                                                                |                                                     | Size  | 10                                                                         |    |    |    |    | 16      |     |     |     |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------|----------------------------------------------------------------------------|----|----|----|----|---------|-----|-----|-----|
| Max. operating pressure in port A                                                                   |                                                     | bar   | Up to 315                                                                  |    |    |    |    |         |     |     |     |
| Max. flow                                                                                           | – Linear                                            | l/min | 10                                                                         | 16 | 25 | 50 | 60 | 80      | 100 | 125 | 160 |
|                                                                                                     | – Progressive with rapid speed                      | l/min | 40                                                                         |    |    |    |    | –       |     |     |     |
| Minimum pressure differential                                                                       |                                                     | bar   | 3 to 8                                                                     |    |    |    |    | 6 to 10 |     |     |     |
| $\Delta p$ with free flow B → A                                                                     |                                                     | bar   | see diagram on page 9                                                      |    |    |    |    |         |     |     |     |
| Flow control                                                                                        |                                                     |       |                                                                            |    |    |    |    |         |     |     |     |
| Temperature drift                                                                                   | – Hydraulic + electrical $\Delta q_v$ /°C           | %     | 0.1 of $q_{Vmax}$                                                          |    |    |    |    |         |     |     |     |
|                                                                                                     | – Pressure-compensated (up to $\Delta p = 315$ bar) | %     | $\pm 2$ of $q_{Vmax}$                                                      |    |    |    |    |         |     |     |     |
| Hydraulic fluid                                                                                     |                                                     |       | Mineral oil (HL, HLP) to DIN 51524<br>Further hydraulic fluids on enquiry! |    |    |    |    |         |     |     |     |
| Hydraulic fluid temperature range                                                                   |                                                     | °C    | – 20 to + 80                                                               |    |    |    |    |         |     |     |     |
| Viscosity range                                                                                     |                                                     | mm²/s | 15 to 380                                                                  |    |    |    |    |         |     |     |     |
| Max. permissible degree of contamination of the hydraulic fluid - cleanliness class to ISO 4406 (c) |                                                     |       | Class 20/18/15 <sup>1)</sup>                                               |    |    |    |    |         |     |     |     |
| Hysteresis                                                                                          |                                                     | %     | $< \pm 1$ of $q_{Vmax}$                                                    |    |    |    |    |         |     |     |     |
| Repeatability                                                                                       |                                                     | %     | $< 1$ of $q_{Vmax}$                                                        |    |    |    |    |         |     |     |     |
| Manufacturing tolerance                                                                             | Valve                                               | %     | $\leq \pm 2$ at 33 % command value<br>$\leq \pm 5$ at 100 % command value  |    |    |    |    |         |     |     |     |
|                                                                                                     | – Amplifier VT-VRPA1-151 (analogue)                 | %     | Amplifier must be matched to valve <sup>2)</sup>                           |    |    |    |    |         |     |     |     |
|                                                                                                     | – Amplifier module VT-MRPA1-151 (analogue)          | %     | Amplifier must be matched to valve <sup>2)</sup>                           |    |    |    |    |         |     |     |     |

**Hydraulic** – rectifier sandwich plate

|                    |       |           |           |
|--------------------|-------|-----------|-----------|
| Size               | Size  | <b>10</b> | <b>16</b> |
| Operating pressure | bar   | Up to 315 |           |
| Cracking pressure  | bar   | 1.5       |           |
| Nominal flow       | l/min | 60        | 160       |

<sup>1)</sup> The cleanliness classes specified for components must be adhered to in hydraulic systems. Effective filtration prevents malfunction and, at the same time, prolongs the service life of components.

For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081, RE 0086 and RE 50088.

<sup>2)</sup> Due to tolerances of the oscillator frequency (position transducer supply), amplifiers are subject to tolerances. When installing new systems or replacing an amplifier, the amplifier settings may have to be adjusted.

**Technical data** (for applications outside these parameters, please consult us!)**Electrical** – proportional solenoid

|                                |                       |      |                                                            |
|--------------------------------|-----------------------|------|------------------------------------------------------------|
| Type of voltage                |                       |      | DC                                                         |
| Coil resistance                | – Cold value at 20 °C | Ω    | 10                                                         |
|                                | – Max. hot value      | Ω    | 13.9                                                       |
| Duty cycle                     | %                     | 100  |                                                            |
| Max. current per solenoid      | A                     | 1.51 |                                                            |
| Electrical connection          |                       |      | With component plug to DIN EN 175301-803-A                 |
|                                |                       |      | Cable socket to DIN EN 175301-803-A <sup>1)</sup>          |
| Type of protection to EN 60529 |                       |      | IP 65 <sup>2)</sup> , with cable socket mounted and locked |

**Electrical** – inductive position transducer

|                                      |                                   |                                                            |                     |                     |
|--------------------------------------|-----------------------------------|------------------------------------------------------------|---------------------|---------------------|
| Coil resistance                      | Total resistance of coils between | 1 and 2                                                    | 2 and $\frac{1}{2}$ | $\frac{1}{2}$ and 1 |
| at 20 °C (see page 6)                | Ω                                 | 31.5                                                       | 45.5                | 31.5                |
| Electrical connection                |                                   | With component plug GSA20                                  |                     |                     |
|                                      |                                   | Cable socket GM209N (Pg 9) <sup>1)</sup>                   |                     |                     |
| Inductance                           | mH                                | 6 to 8                                                     |                     |                     |
| Oscillator frequency                 | kHz                               | 2.5                                                        |                     |                     |
| Electrical position measuring system |                                   | Differential throttle                                      |                     |                     |
| Nominal stroke                       | mm                                | 4                                                          |                     |                     |
| Type of protection to EN 60529       |                                   | IP 65 <sup>2)</sup> , with cable socket mounted and locked |                     |                     |

**Control electronics** (separate order)

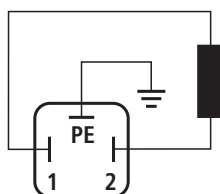
|                                          |                                                        |
|------------------------------------------|--------------------------------------------------------|
| Associated amplifier in Euro-card format | Type VT-VRPA1-151-1X (analogue) to data sheet RE 30118 |
| Associated amplifier module              | Type VT-MRPA1-151-1X (analogue) to data sheet RE 30221 |

<sup>1)</sup> Separate order, see page 6<sup>2)</sup> Due to the surface temperatures of solenoid coils, observe European standards DIN EN563 and DIN EN982!

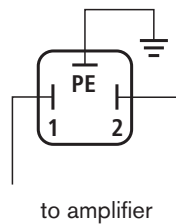
## Electrical connection, cable sockets (nominal dimensions in mm)

### Proportional solenoid

Connection to component plug

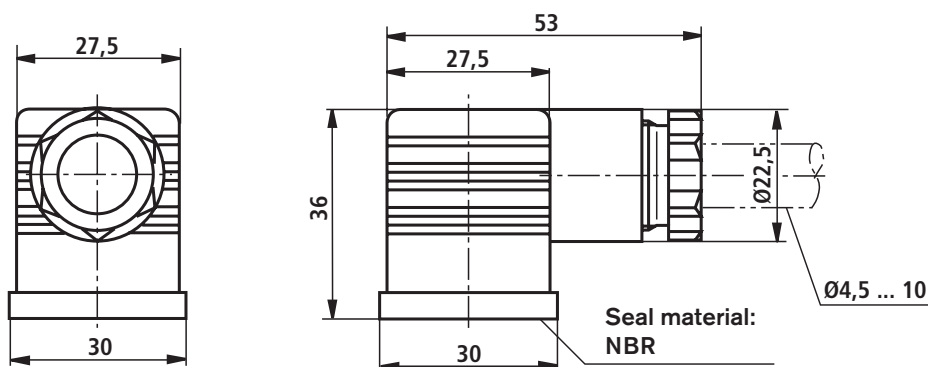


Connection to cable socket

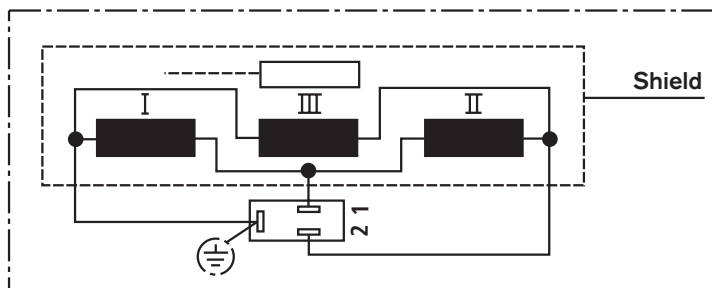


Cable socket to DIN EN 175301-803-A

Separate order stating material no. **R901017011**  
(plastic version)

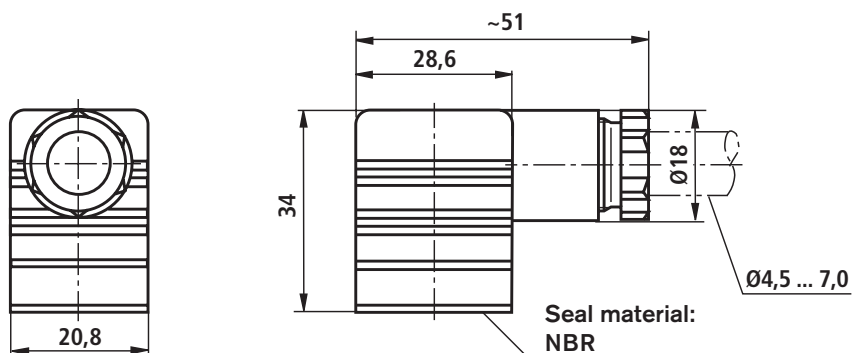


### Inductive position transducer



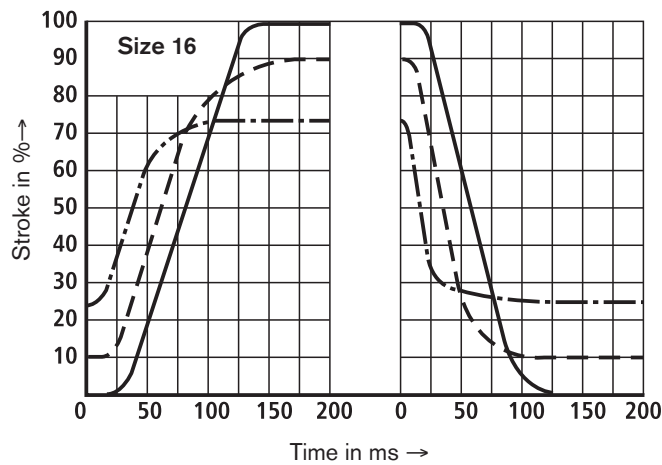
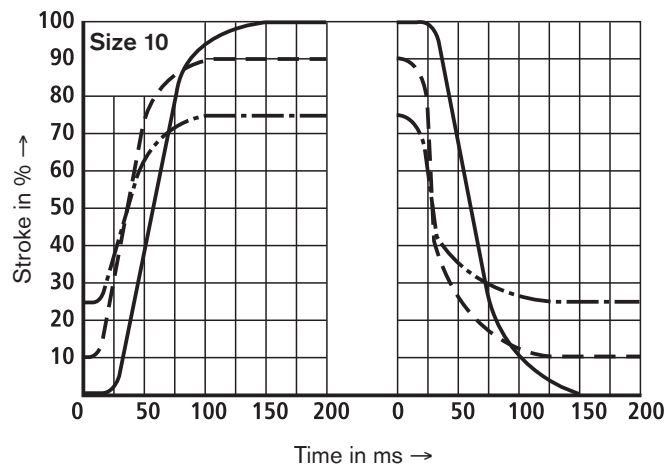
Cable socket Pg 9

Separate order stating material no. **R900013674**  
(plastic version)

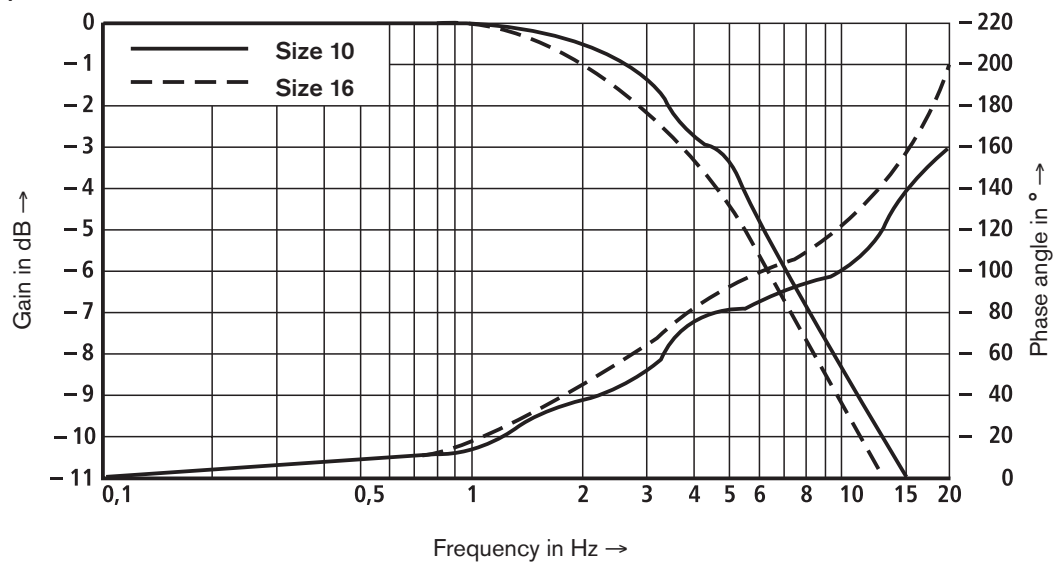


**Characteristic curves** (measured at  $v = 41 \text{ mm}^2/\text{s}$  and  $\vartheta = 50 \text{ }^\circ\text{C}$ ;  $p_{\text{nom}} = 50 \text{ bar}$ ;  
Amplitude 0  $\rightarrow$  100 %; size 10 type 60L / size 16 type 160L)

Transient function at stepped command value change

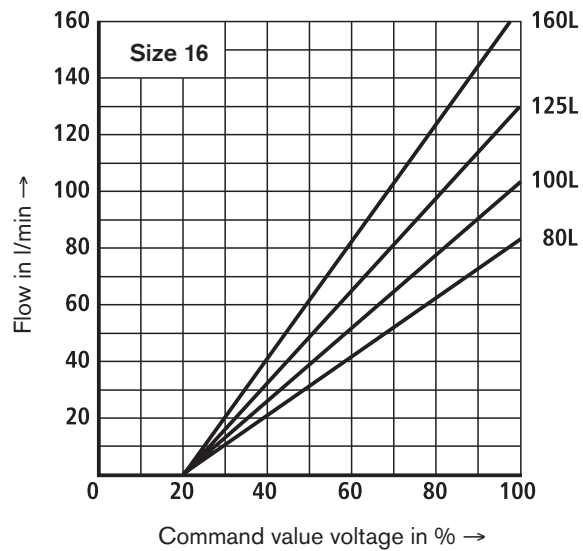
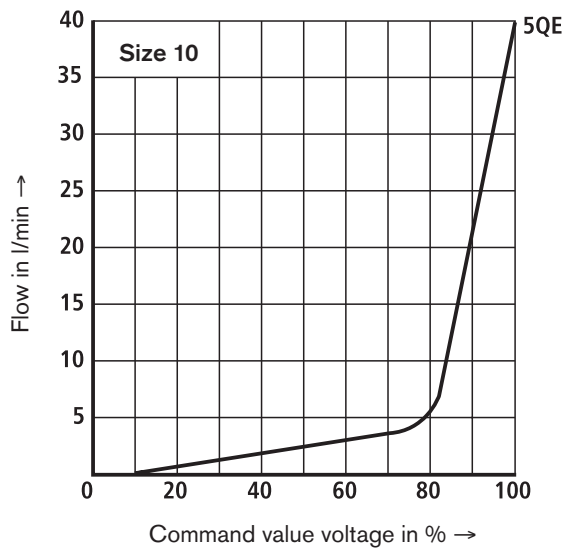
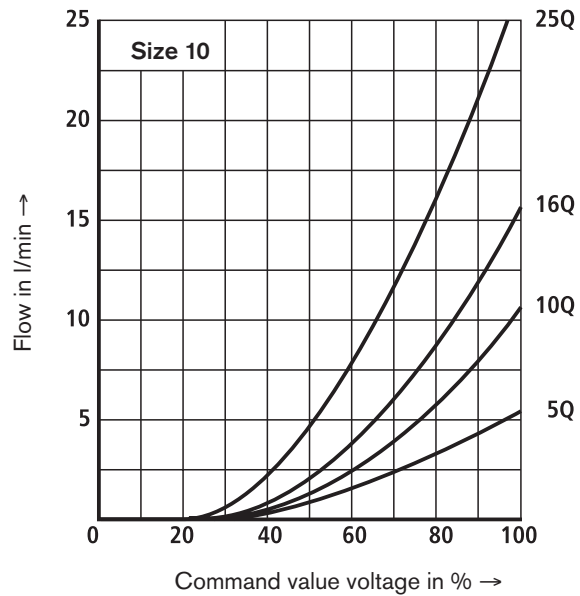
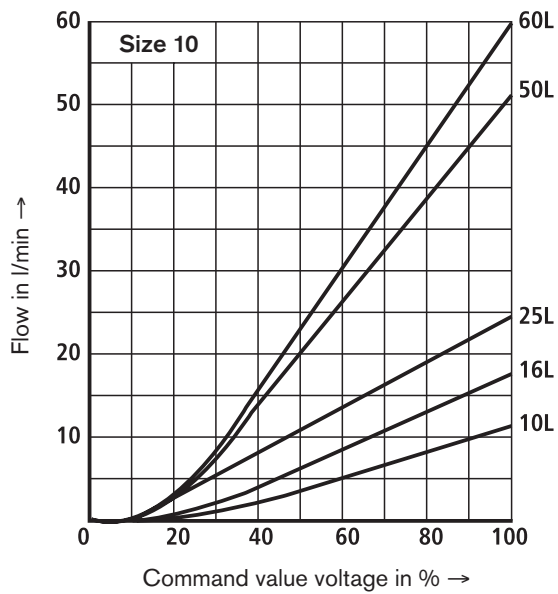


Frequency response characteristic curves



## Characteristic curves (measured at $v = 41 \text{ mm}^2/\text{s}$ and $\vartheta = 50 \text{ }^\circ\text{C}$ )

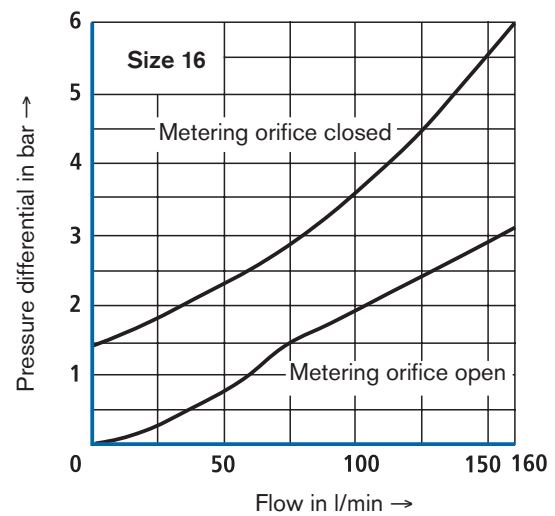
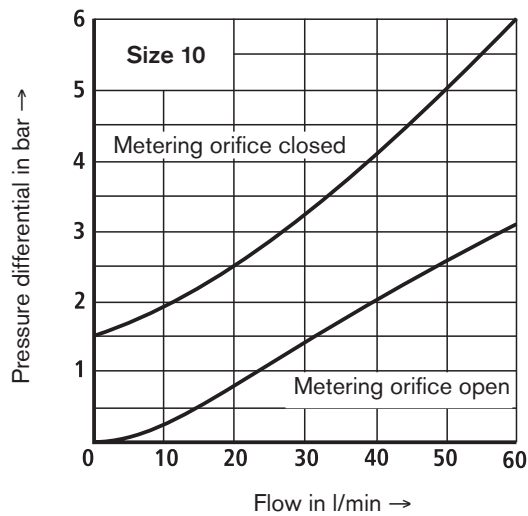
Dependence of flow on command value voltage (flow control from A  $\rightarrow$  B)



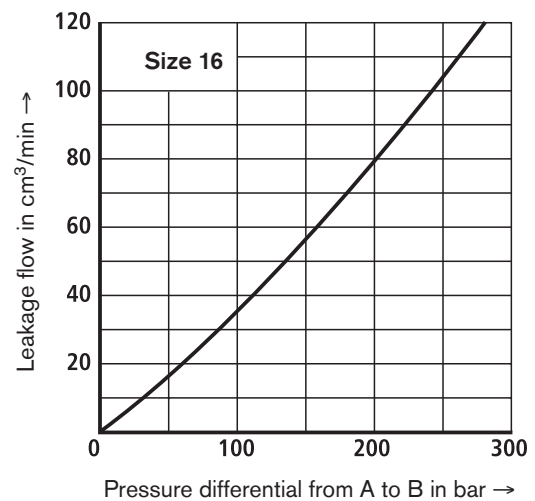
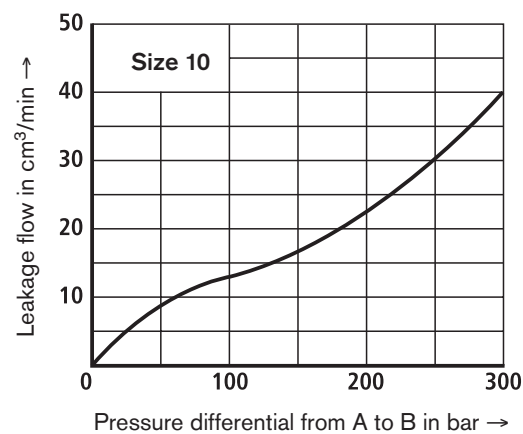


## Characteristic curves (measured at $v = 41 \text{ mm}^2/\text{s}$ and $\vartheta = 50 \text{ }^\circ\text{C}$ )

Pressure differential across check valve B → A

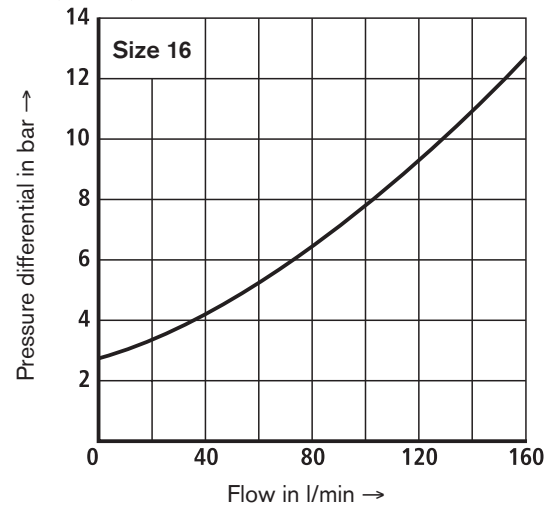
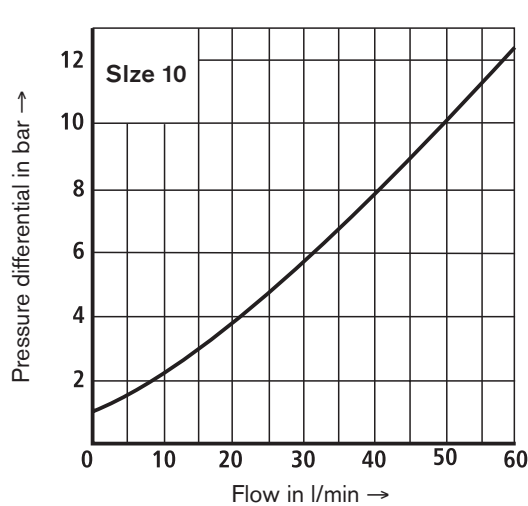


Leakage flow from A → B

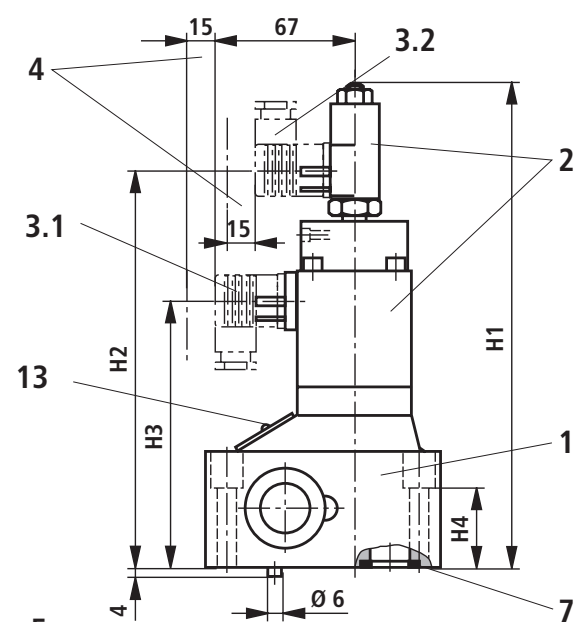


Rectifier sandwich plate

Pressure differential identical in both directions of flow  
Flow from A → B (B → A)

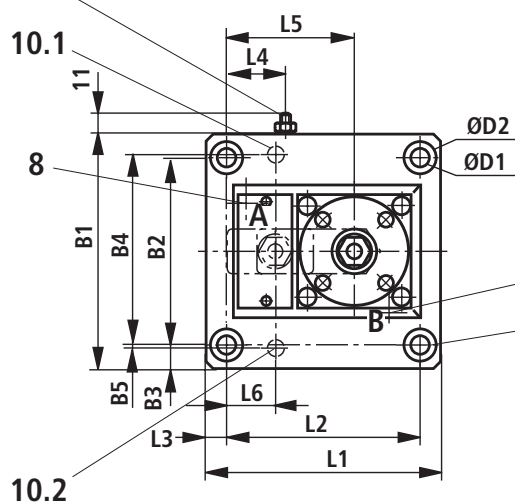


# Unit dimensions: Proportional flow control valve (nominal dimensions in mm)



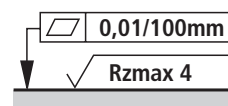
| Size | 10   | 16    |
|------|------|-------|
| B1   | 95   | 123.5 |
| B2   | 76   | 101.5 |
| B3   | 9.5  | 11    |
| B4   | 79.4 | 102.4 |
| B5   | –    | 0.8   |
| B6   | 97   | 126   |
| B7   | 10.5 | 12    |
| ØD1  | 9    | 11    |
| ØD2  | 15   | 18    |
| H1   | 245  | 255.5 |
| H2   | 200  | 210   |
| H3   | 210  | 140   |
| H4   | 48   | 51    |

| Size | 10    | 16    |
|------|-------|-------|
| L1   | 102.5 | 123.5 |
| L2   | 82.5  | 101.5 |
| L3   | 10    | 11    |
| L4   | 24    | 31    |
| L5   | 62.5  | 72.5  |
| L6   | 23.8  | 28.6  |
| L7   | 105   | 126   |
| L8   | 11    | 12    |



- 1 Valve housing
- 2 Proportional solenoid with inductive position transducer
- 3.1 Cable socket for proportional solenoid; separate order, see page 6
- 3.2 Cable socket for position transducer (separate order, see page 6)
- 4 Space required to remove cable socket
- 5 Setscrew of pressure compensator limiter, hexagon socket A/F 3, lock nut A/F 10
- 6 Valve fixing screws (separate order, see page 11)
- 7 Identical seal rings for ports A and B
- 8 Port A
- 9 Port B
- 10.1 Locating pin for sizes 10 and 16
- 10.2 Locating pin for size 16

Required surface quality of the valve contact face



**Tolerances to:** – General tolerances ISO 2768-mK

- 11.1 Locating bore for locating pin for sizes 10 and 16
- 11.2 Locating bore for locating pin for size 16
- 13 Nameplate
- 14 Machined valve mounting face,  
Size 10 - position of ports to ISO 6263-06-05-0-97  
Size 16 - position of ports to ISO 6263-09-05-0-97

Subplates to data sheet RE 45066 and valve fixing screws must be ordered separately.

| Subplates: | Size 10        | Size 16          |
|------------|----------------|------------------|
|            | G279/01 (G1/2) | G281/01 (G1)     |
|            | G280/01 (G3/4) | G282/01 (G1 1/4) |

## Unit dimensions: Valve fixing screws (separate order)

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### Without rectifier sandwich plate

#### Size 10

The following valve fixing screws are recommended:

**4 socket head cap screws to ISO 4762 - M8 x 60 - 10.9-flZn-240h-L**  
(Friction coefficient 0.09 to 0.14 to VDA 235-101);  
tightening torque  $M_T = 30 \text{ Nm} \pm 10\%$ ,  
material no. **R913000217**

or

**4 socket head cap screws to ISO 4762 - M8 x 60 - 10.9**  
(Friction coefficient 0.08 to 0.6 to VDI2230,  
tempering, black);  
tightening torque  $M_T = 34 \text{ Nm} \pm 10\%$

#### Size 16

The following valve fixing screws are recommended:

**4 socket head cap screws to ISO 4762 - M10 x 70 - 10.9-flZn-240h-L**  
(Friction coefficient 0.09 to 0.14 to VDA 235-101);  
tightening torque  $M_T = 64 \text{ Nm} \pm 10\%$ ,  
material no. **R913000126**

or

**4 socket head cap screws to ISO 4762 - M10 x 70 - 10.9**  
(Friction coefficient 0.08 to 0.16 to VDI 2230,  
tempering, black);  
tightening torque  $M_T = 75 \text{ Nm} \pm 10\%$ ,

### With rectifier sandwich plate

#### Size 10

The following valve fixing screws are recommended:

**4 socket head cap screws to ISO 4762 - M8 x 120 - 10.9-flZn-240h-L**  
(Friction coefficient 0.09 to 0.14 to VDA 235-101);  
tightening torque  $M_T = 30 \text{ Nm} \pm 10\%$ ,  
material no. **R913000423**

or

**4 socket head cap screws to ISO 4762 - M8 x 120 - 10.9**  
(Friction coefficient 0.08 to 0.16 to VDI2230,  
tempering, black);  
tightening torque  $M_T = 34 \text{ Nm} \pm 10\%$

#### Size 16

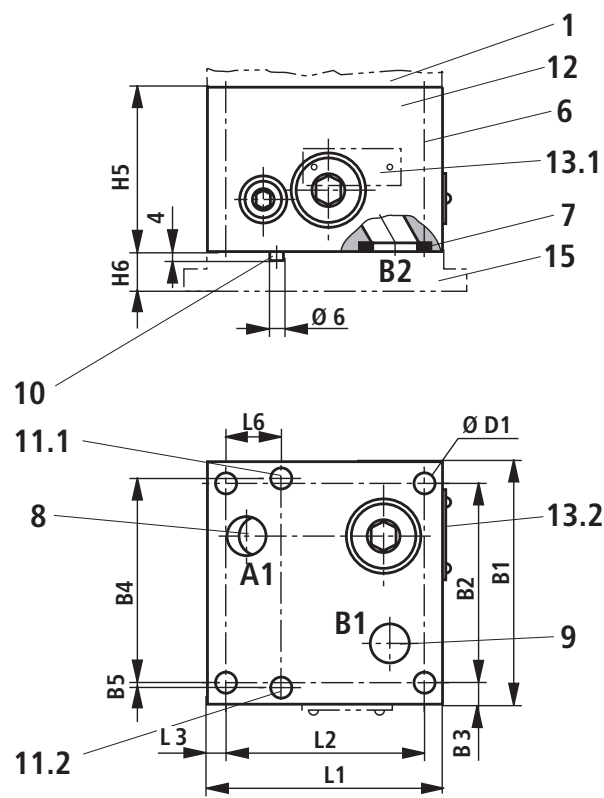
The following valve fixing screws are recommended:

**4 socket head cap screws to ISO 4762 - M10 x 160 - 10.9-flZn-240h-L**  
(Friction coefficient 0.09 to 0.14 to VDA 235-101);  
tightening torque  $M_T = 64 \text{ Nm} \pm 10\%$ ,  
material no. **R913000072**

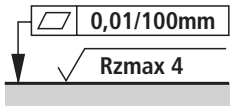
or

**4 socket head cap screws to ISO 4762 - M10 x 160 - 10.9**  
(Friction coefficient 0.08 to 0.6 to VDI 2230,  
tempering, black);  
tightening torque  $M_T = 75 \text{ Nm} \pm 10\%$ ,

Unit dimensions: Rectifier sandwich plate (nominal dimensions in mm)



| Size | 10    | 16    |
|------|-------|-------|
| B1   | 95    | 123.5 |
| B2   | 76    | 101.5 |
| B3   | 9.5   | 11    |
| B4   | 79.4  | 102.4 |
| B5   | –     | 0.8   |
| ØD1  | 9     | 11    |
| H5   | 60    | 85    |
| H6   | 30    | 40    |
| L1   | 102.5 | 123.5 |
| L2   | 82.5  | 101.5 |
| L3   | 10    | 11    |
| L6   | 23.8  | 28.6  |



Required surface quality of valve contact face

Tolerances to:  
– General tolerances ISO 2768-mK

- 1 Valve housing
- 6 Valve fixing screws  
(separate order, see page 11)
- 7 Identical seal rings for A and B
- 8 Port A1 (A2)
- 9 Port B1 (B2)
- 10 Locating pin (position like items 11.1 and 11.2)
- 11.1 Locating bore for locating pin for sizes 10 and 16
- 11.2 Locating bore for locating pin for size 6
- 12 Rectifier sandwich plate
- 13.1 Nameplate (rectifier sandwich plate size 10)
- 13.2 Nameplate (rectifier sandwich plate size 16)
- 15 Subplate (separate order)

Subplates to data sheet RE 45066 and valve fixing screws must be ordered separately.

|            |                |                  |
|------------|----------------|------------------|
| Subplates: | <b>Size 10</b> | <b>Size 16</b>   |
|            | G279/01 (G1/2) | G281/01 (G1)     |
|            | G280/01 (G3/4) | G282/01 (G1 1/4) |