Proportional flow control valve, 2-way version

RE 29190/02.07 1/12
Replaces: 02.06

Type 2FRE

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

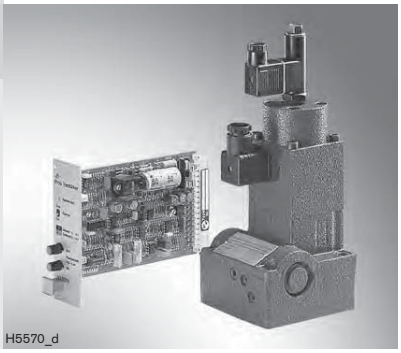

H5570_d

Table of contents

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)

Further details in clear text

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

V = FKM seals

Electrical connection

K4 = **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

B = With pressure compensator stroke limiter

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

Standard types

Size 10

Type	material number
2FRE 10-4X/10LBK4M	R900915817
2FRE 10-4X/16LBK4M	R900915825
2FRE 10-4X/25LBK4M	R900915820
2FRE 10-4X/50LBK4M	R900915815

Size 16

Type	material number
2FRE 16-4X/100LBK4M	R900915819
2FRE 16-4X/160LBK4M	R900915814

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)

Further details in clear text

No code = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

V = FKM seals

Size 10

Type	material number
Z4S 10-2X/	R900413377
Z4S 10-2X/V	R900413379

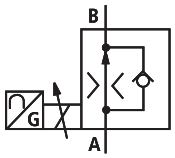
Size 16

Type	material number
Z4S 16-2X/	R900425901
Z4S 16-2X/V	R900427362

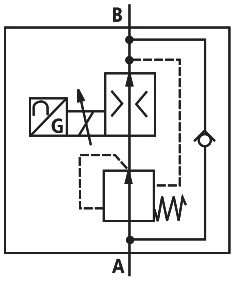
Symbols

Proportional flow control valve

Simplified

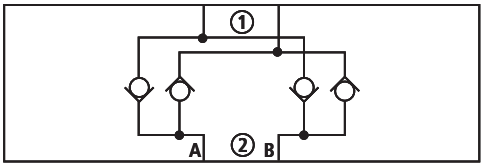


Detailed



Rectifier sandwich plate

① = component side, ② = plate side



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.

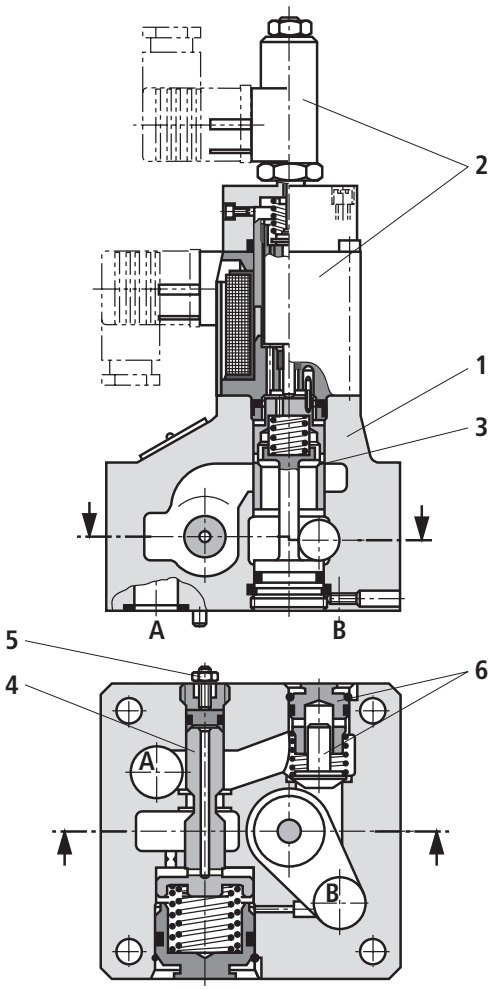
At a command value of 0 % the metering orifice is closed.

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 parametes, please consult us!)

General

Size		Size	**10**					**16**			
Weight	– Proportional flow control valve	kg	6.1					8.5			
	– Rectifier sandwich plate	kg	3.2					9.3			
Installation orientation			Optional								
Storage temperature range		°C	– 20 to + 80								
Ambient temperature range		°C	– 20 to + 70								

Hydraulic – proportional flow control valve (measured with HLP46 and at ϑ_{oil} = 40 °C ± 5 °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			
Δp with free flow B → A		bar	see diagram on page 9								
Flow control											
Temperature drift	– Hydraulic + electrical Δq_V /°C	%	0.1 of q_{Vmax}								
	– Pressure-compensated (up to Δp = 315 bar)	%	± 2 of q_{Vmax}								
Hydraulic fluid			Mineral oil (HL, HLP) to DIN 51524 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 [1]								
Hysteresis		%	< ± 1 of q_{Vmax}								
Repeatability		%	< 1 of q_{Vmax}								
Manufacturing tolerance	Valve	%	≤ ± 2 at 33 % command value ≤ ± 5 at 100 % command value								
	– Amplifier VT-VRPA1-151 (analogue)	%	Amplifier must be matched to valve [2]								
	– Amplifier module VT-MRPA1-151 (analogue)	%	Amplifier must be matched to valve [2]								

Hydraulic – rectifier sandwich plate

Size	Size	**10**	**16**
Operating pressure	bar	Up to 315	
Cracking pressure	bar	1.5	
Nominal flow	l/min	60	160

[1] 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.

[2] 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 parametes, 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 [1]
Type of protection to EN 60529			IP 65 [2], with cable socket mounted and locked

Electrical – inductive position transducer

Coil resistance	Total resistance of coils between		1 and 2	2 and ⏚	⏚ 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) [1]		
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 [2], 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

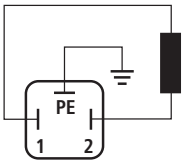
[1] Separate order, see page 6

[2] Due to the surface temperatures of solenoid coils, observe European standards DIN EN563 and DIN EN982!

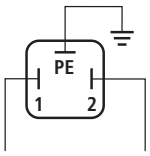
Electrical connection, cable sockets (nominal dimensions in mm)

Proportional solenoid

Connection to component plug

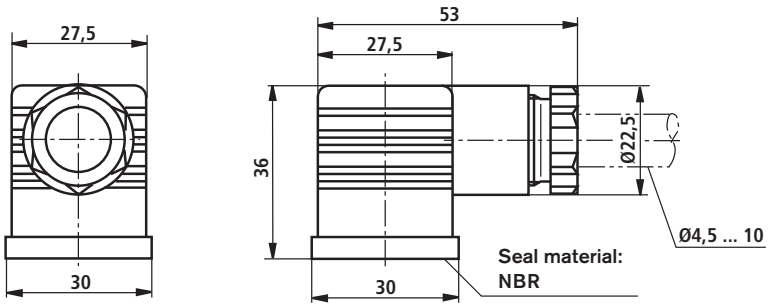


Connection to cable socket

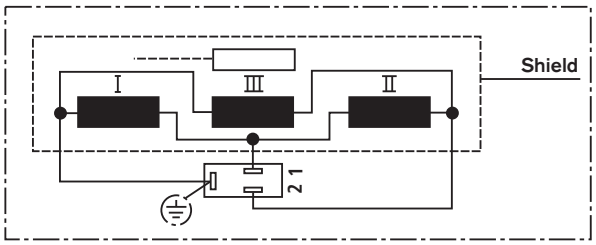


to amplifier

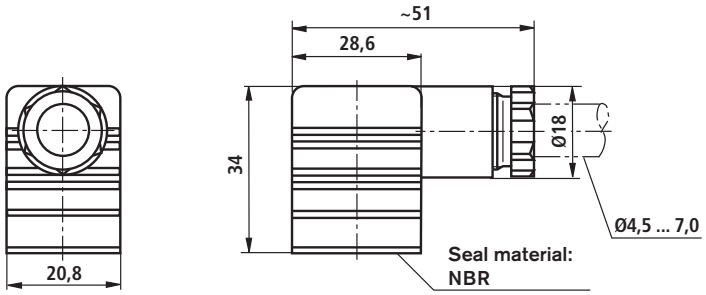
Cable socket to DIN EN 175301-803-A
Separate order stating material no. **R901017011**
(plastic version)



Inductive position transducer

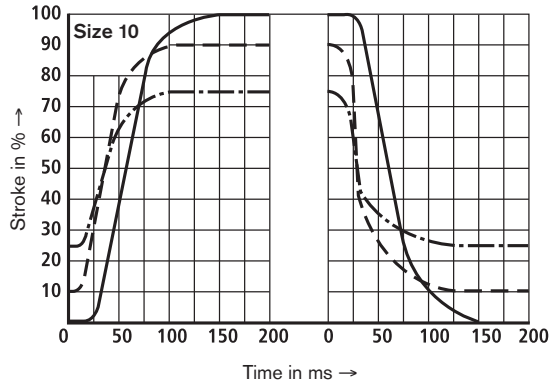


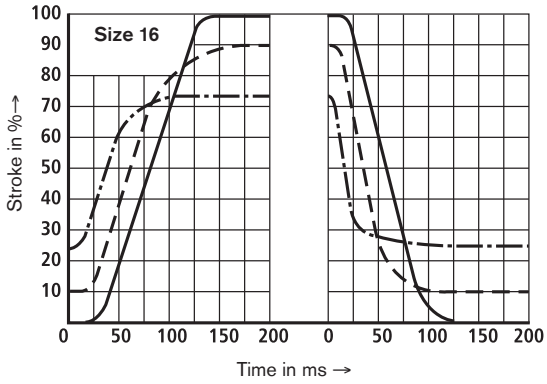
Cable socket Pg 9
Separate order stating material no. **R900013674**
(plastic version)



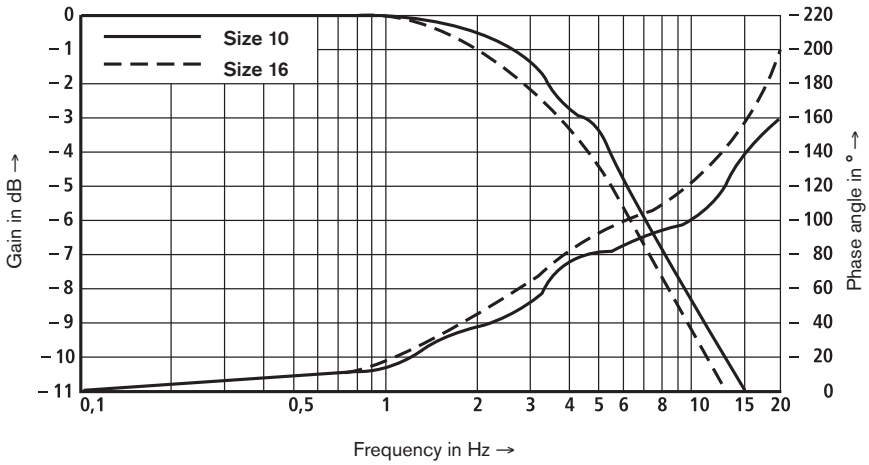
Characteristic curves (measured at $\nu = 41$ mm²/s and $\vartheta = 50$ °C; $p_{nom} = 50$ bar; Amplitude 0 → 100 %; size 10 type 60L / size 16 type 160L)

Transient function at stepped command value change



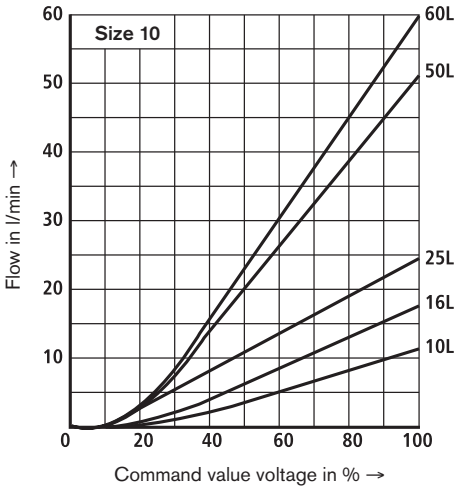


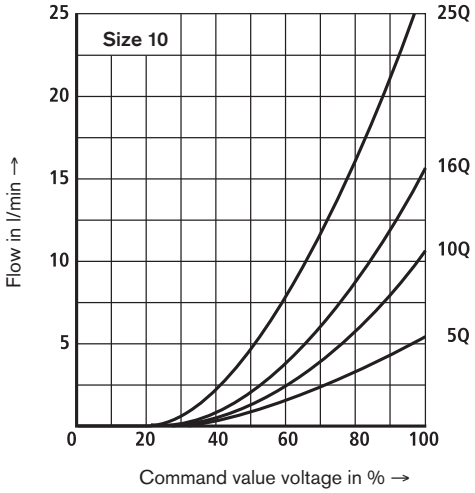
Frequency response characteristic curves

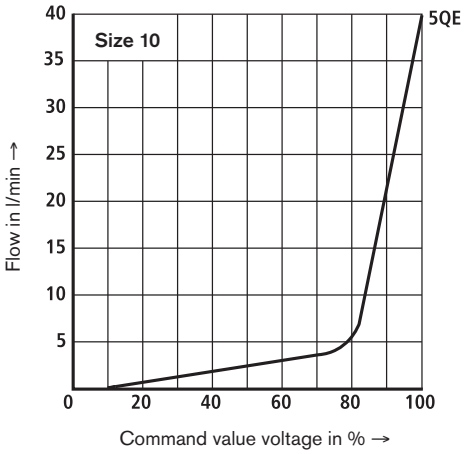


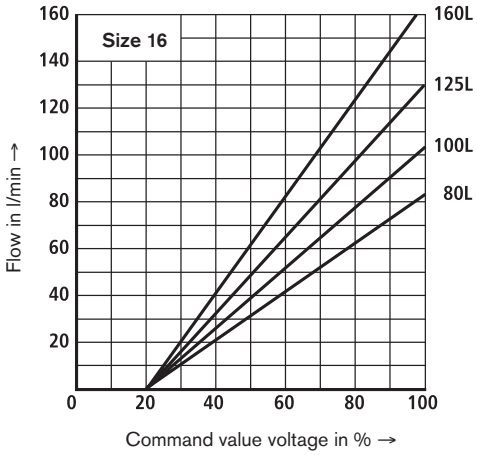
Characteristic curves (measured at $\nu = 41$ mm²/s and $\vartheta = 50$ °C)

Dependence of flow on command value voltage (flow control from A → B)



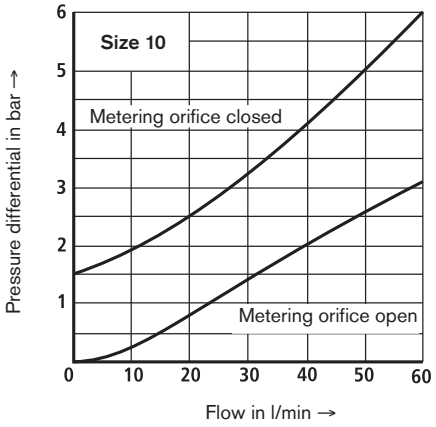


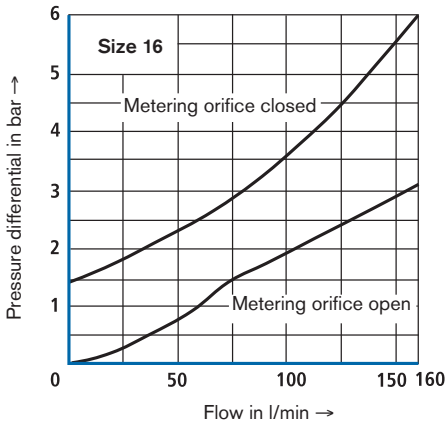




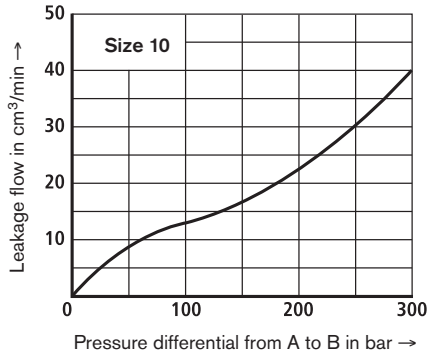
Characteristic curves (measured at $\nu = 41$ mm²/s and $\vartheta = 50$ °C)

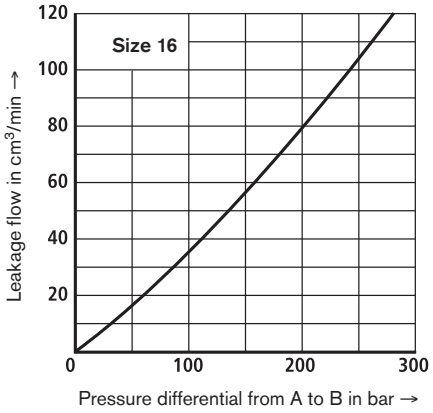
Pressure differential across check valve B → A





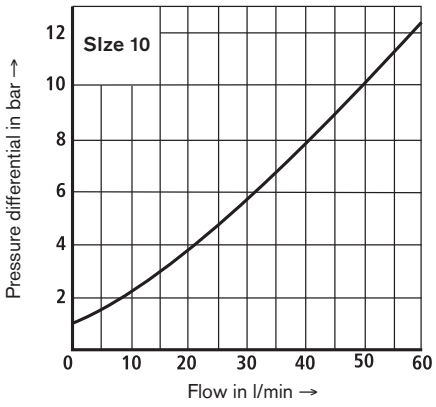
Leakage flow from A → B

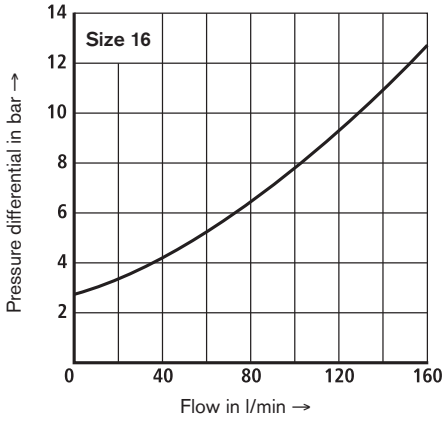




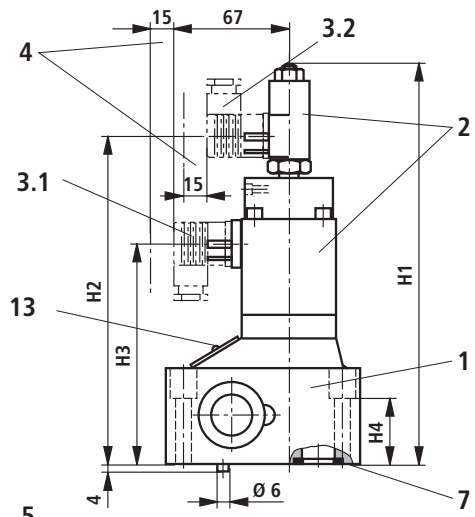
Rectifier sandwich plate

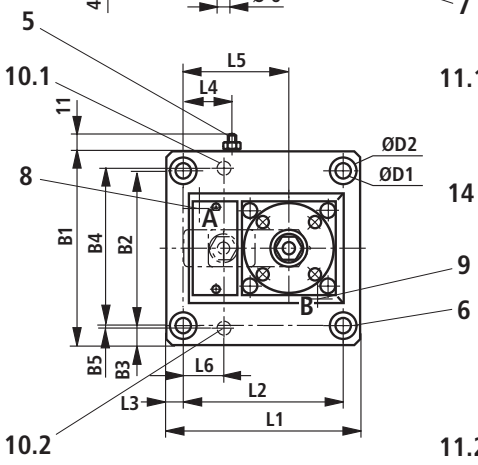
Pressure differential identical in both directions of flow
Flow from A → B (B → A)

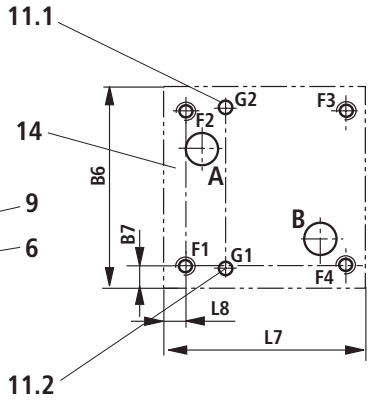




Unit dimensions: Proportional flow control valve (nominal dimensions in mm)



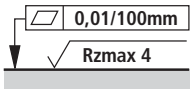




Size	10	16
B1	95	123.5
B2	76	101.5
B3	9.5	11
B4	79.4	102.4
B5	–	0.8
B6	97	126
B7	10.5	12
ØD1	9	11
ØD2	15	18
H1	245	255.5
H2	200	210
H3	210	140
H4	48	51

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)

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 Nm ± 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 Nm ± 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 Nm ± 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 Nm ± 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 Nm ± 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 Nm ± 10%

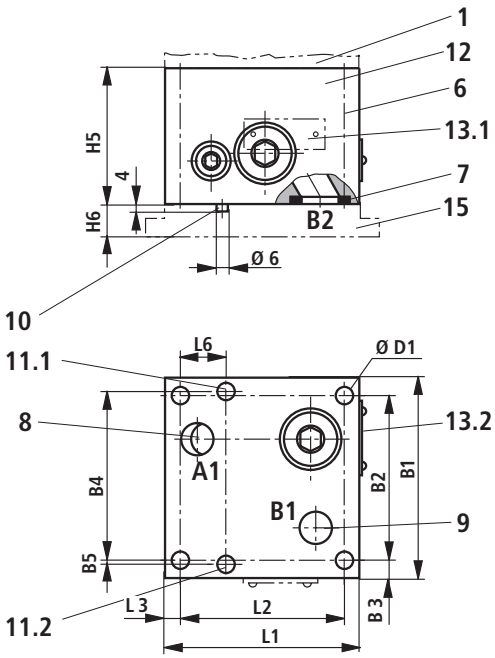
Size 16
The following valve fixing screws are recommended:

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 Nm ± 10%,
material no. **R913000072**

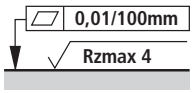
or

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 Nm ± 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:	**Size 10**	**Size 16**
	G279/01 (G1/2)	G281/01 (G1)
	G280/01 (G3/4)	G282/01 (G1 1/4)