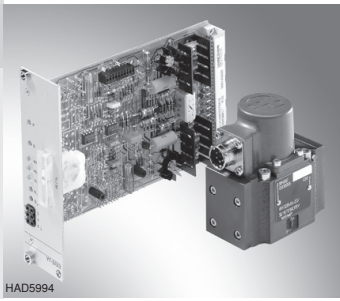
Rexroth
Bosch Group

4-way directional servo-valve

RE 29564/09.10 1/12
Replaces: 01.07

Type 4WS.2E


HAD5994

Size 6
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 48 l/min

Table of contents

Information on available spare parts:
www.boschrexroth.com/spc

Features

- Valve for controlling position, force, direction or velocity
- 2-stage servo-valve with mechanical feedback
- 1st stage as a nozzle-flapper plate amplifier
- For subplate mounting, porting pattern to ISO 4401-03-02-0-05
  Subplates according to data sheet RE 45052 (separate order)
- Dry torque motor, no contamination of the solenoid gaps through the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool return element
- Controlling
  - External control electronics in Euro-card format or of modular design (separate order), see page 6
  - or control electronics integrated in the valve (OBE)
- Valve and integrated control electronics are adjusted and tested
- Pressure chambers on the control bush with gap seal, no seal ring wear
- Filter for 1st stage freely accessible from outside, see pages 9 and 10

Ordering code

	6	2X		B		ET		K17		V	*

Electrically operated 2-stage servo-valve of 4-way design with mechanical feedback

For **external** control electronics **= 4WS2EM**

With **integrated** control electronics (OBE) **= 4WSE2EM**

Size 6 **= 6**

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

Nominal flow [1]

2 l/min	**= 2**
5 l/min	**= 5**
10 l/min	**= 10**
15 l/min	**= 15**
20 l/min	**= 20**
25 l/min	**= 25**

(Observe tolerance field of the flow/signal function, see page 7)

Valves for **external** control electronics [2]

Coil no. 11 (30 mA/85 Ω x per coil) **= 11**

Valves with **integrated** control electronics

Controlling:

Command value ±10 mA **= 8**

Command value ±10 V **= 9**

ET = Internal pilot oil supply and drain [3]

210 = 10 to 210 bar

315 = 10 to 315 bar

Inlet pressure range [4]

K17 = **Without** mating connector, with male connector

Mating connector – separate order, see page 6

Electrical connection

D = 0 to 0.5 % positive

E = 0 to 0.5 % negative

Spool overlap [5]

V = FKM seals, suitable for mineral oil (HL, HLP) to DIN 51524 [6]

Seal material

Further details in clear text

[1] **Nominal flow**
The nominal flow refers to a 100 % command value signal at a 70 bar valve pressure differential (35 bar per control land).
The valve pressure differential must be observed as reference variable. Differing valves cause a change in the flow. It must be noted that the nominal flow tolerance is ±10 % (see flow/signal function on page 7).

[2] **Electrical control data**
Valves for **external** control electronics: The actuating signal must be provided by a current-regulated output stage. For servo amplifiers, see page 6.
Valves with **integrated** control electronics: With integrated control electronics, the command value can be provided as voltage (ordering code "9") or, in the case of large distances of > 25 m between the control and the valve, as current (ordering code "8").

[3] **Pilot oil**
This valve is only available with internal pilot oil supply and drain.

[4] **Inlet pressure range**
The system pressure should be as constant as possible. With regard to dynamics, the frequency relationship must be taken into account within the permissible pressure of 10 to 210 bar or 10 to 315 bar.

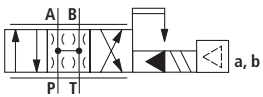
[5] **Spool overlap**
The spool overlap in % is referred to the nominal stroke of the control spool.
Further spool overlaps on request.

[6] **Seal material**
If you require another seal material, please consult us.

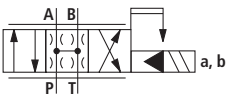
[7] **Details in clear text**
Here, you can specify special requirements. These will be verified in the factory after receipt of your order and the type designation supplemented with an assigned number.

Symbols

Valves with OBE
(Example: 4WS**E**2EM 6-2X…ET…)



Valves without OBE
(Example: 4WS2EM 6-2X…ET…)



Function, section

4WS(E)2EM 6-2X/…

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern to ISO 4401-03-02-0-05. They are mainly used for the closed-loop control of position, force, pressure or velocity.

These valves consist of an electromechanical converter (torque motor) (1), a hydraulic amplifier (nozzle flapper plate principle) (2) and a control spool (3) in a bush (2nd stage), which is connected to the torque motor via a mechanical feedback.

As a result of an electrical input signal applied at coils (4) of the torque motor, a force is generated by a permanent magnet that acts on armature (5), which generates a torque in conjunction with a bending tube (6). This causes flapper plate (7), which is connected by a pin to the bending tube (6), to be moved from the central position between the two control nozzles (8), and a pressure differential occurs across the front faces of the control spool (3). The pressure differential causes a change in the position of the spool, which results in the connection of the pressure port with an actuator port and, at the same time, in the connection of the other actuator port with the return flow port.

The control spool is connected with the flapper plate or the torque motor with the help of a bending spring (mechanical feedback) (9). The position of the spool is changed until the torque fed back by the bending tube and the electromagnetic torque of the torque motor are balanced, and the pressure differential across the nozzle flapper plate system becomes zero.

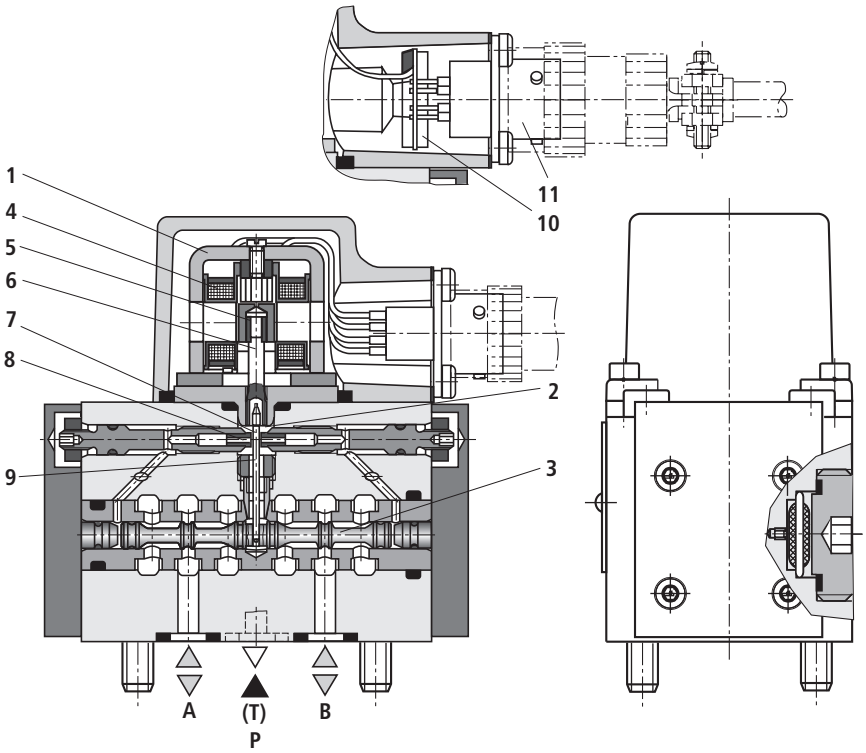
The stroke of the control spool and hence the flow through the servo-valve is therefore controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

Type 4WS2EM 6-2X/… for external control electronics

For controlling the valve, an external control electronic control (servo-amplifier) is used, which amplifies an analogue input signal (command value) to a level required for the output signal to provide a current-regulated control of the servo-valve.

Type 4WSE2EM 6-2X/… with OBE

For the amplification of the analogue input signal, a control electrics (10), which is matched specifically to this valve type, is integrated in the valve. It is mounted to the male connector (11) in the cap of the torque motor.



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

General

Weight	kg	1.1
Porting pattern		ISO 4401-03-02-0-05
Installation orientation		Optional (Make sure that during start-up of the system, the valve is supplied with sufficient pressure ≥ 10 bar!)
Storage temperature range	°C	–20 to +80
Ambient temperature range	°C	–20 to +60, valve with OBE
		–30 to +100, valve without OBE

Hydraulic

Operating pressure	– Ports A, B, P	bar	10 to 210 or 10 to 315
Return flow pressure	– Port T	bar	Pressure peaks < 100, steady-state < 10
Zero flow $q_{V,L}$ [1] with spool overlap E measured without dither signal		l/min	$\sqrt{p_P/70\ bar}$ • (0.4 l/min + 0.02 • q_{Vnom}) [2; 3]
Nominal flows q_{Vnom} ± 10 % at valve pressure differential Δp = 70 bar		l/min	2; 5; 10; 15; 20; 25
Max. possible control spool stroke with mechanical end position (in the event of a failure) referred to nominal stroke		%	120 to 170
Hydraulic fluid			Mineral oil (HL, HLP) to DIN 51524; other hydraulic fluids on request
Hydraulic fluid temperature range preferably +40 to +50 °C		°C	–30 to +80, for valve with OBE
			–30 to +100, for valves without OBE
Viscosity range		mm^2/s	15 to 380, preferably 30 to 45
Permissible max. degree of contamination of the hydraulic fluid - cleanliness class to ISO 4406 (c)			Class 18/16/13 [4]
Feedback system			Mechanical
Hysteresis (dither-optimised)		%	≤ 1.5
Range of inversion (dither-optimised)		%	≤ 0.2
Response sensitivity (dither-optimised)		%	≤ 0.2
Pressure intensification at 1 % spool stroke change (from hydraulic zero point)		% of p_P [3]	≥ 50
Zero balancing current over the entire operating pressure range		%	≤ 3, long term ≤ 5
Zero drift in the case of a change in:			
	Hydraulic fluid temperature	% / 20 °C	≤ 1
	Ambient temperature	% / 20 °C	≤ 1
	Operating temperature 80 to 120 % of p_P [3]	% / 100 bar	≤ 2
	Return flow pressure 80 to 10 % of p_P [3]	% / bar	≤ 1

[1] $q_{V,L}$ = nominal flow in l/min

[2] q_{Vnom} = nominal flow in l/min

[3] p_P = operating pressure in bar

[4] 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 www.boschrexroth.com/filter

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

Electrical

Type of protection to EN 60529			IP 65 with mating connector correctly mounted and locked
Type of signal			Analogue
Nominal current per coil		mA	30
Resistance per coil		Ω	85
Inductivity at 60 Hz and 100 % nominal current	Series connection	H	1.0
	Parallel connection	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

External control electronics

Servo-amplifier (separate order)	Euro-card format	analogue	Type VT-SR2-1X/.-60 according to data sheet RE 29980
	Modular design	analogue	Type VT 11021 according to data sheet RE 29743
The coils of the valve may only be connected to these amplifiers in a parallel connection!			

Note! For details with regard to **environment simulation testing** in the fields of EMC (electromagnetic compatibility), climate and mechanical stress, see RE 29564-U (declaration on environmental compatibility).

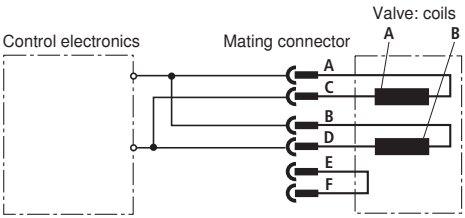
Available accessories

Service case with test unit for servo, proportional and high-response valves with integrated electronics, type VT-VETSY-1 according to data sheet RE 29685.

Service case with test unit for servo-valves for external electronics, type VT-SVTSY-1 according to data sheet RE 29681.

Electrical connection, external control electronics (example of parallel circuit)

Type 4WS2EM 6-2X/…



The coils are connected in parallel in the mating connector or on the amplifier (see figure).

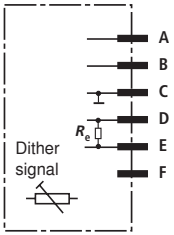
For a serial connection, contacts B and C must be connected.

Bridge E-F can be used for the electrical recognition of the correct connection of the male connector or for cable break detection.

Electrical controlling from A (+) to D (–) results in a direction of flow from P → A and B → T. Reverse electrical controlling results in a direction of flow from P → B and A → T.

Electrical connection, integrated control electronics

Type 4WSE2EM 6-2X/…



	Pin assignment of mating connector	Current control Control "**8**"	Voltage control Control "**9**"
Supply voltage (tolerance ±3 %, residual ripple content < 1 %) Current consumption	A	+15 V, max. 150 mA	+15 V max. 150 mA
	B	–15 V, max. 150 mA	–15 V max. 150 mA
	C	⊥	⊥
Commmand value	D	±10 mA R_i = 1 kΩ	±10 V $R_i \geq 8$ kΩ I_i = 1i2 mA
Commmand value reference	E		
	F	Not assigned	

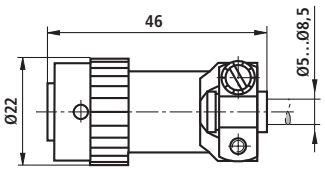
Command value at mating connector connection D = positive against mating connector connection E results in a direction of flow from P → A and B → T.

Command value at mating connector connection D = negative against mating connector connection E results in a direction of flow from P → B and A → T.

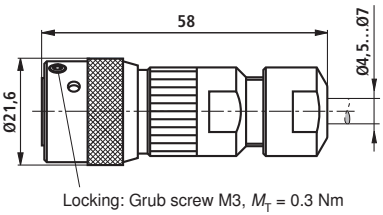
Note: Electrical signals brought out via control electronics must not be used for switching off safety-relevant machine functions!
(See also European standard EN 982, "Safety requirements for fluid power systems and their components – hydraulics").

Electrical connection, mating connector

Plug-in connector,
separate order stating Material no. **R900005414**



Plug-in connector,
separate order stating Material no. **R901043330**



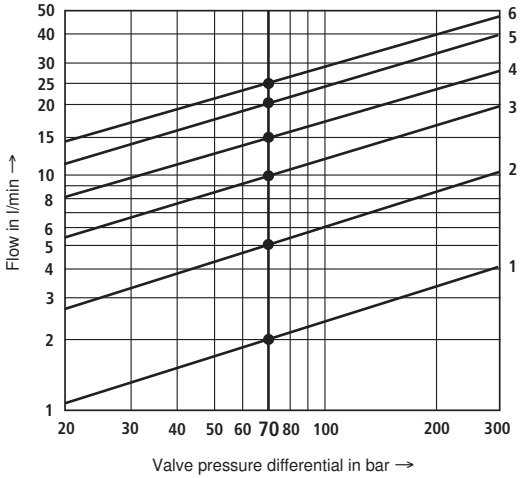
Locking: Grub screw M3, M_T = 0.3 Nm

Connection cable:

4- or 6-wire, 0.75 mm², shielded, with litz wires to DIN VDE 0812 (e.g. cable type LIYCY 4 or 6 x 0.75 mm²)

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

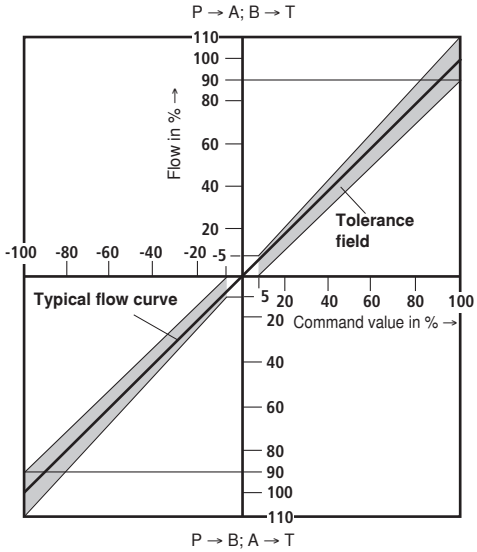
Flow/load function (tolerance ±10 %) at 100 % command value signal



Ordering code	Nominal flow	Curve
2	2 l/min	1
5	5 l/min	2
10	10 l/min	3
15	15 l/min	4
20	20 l/min	5
25	25 l/min	6

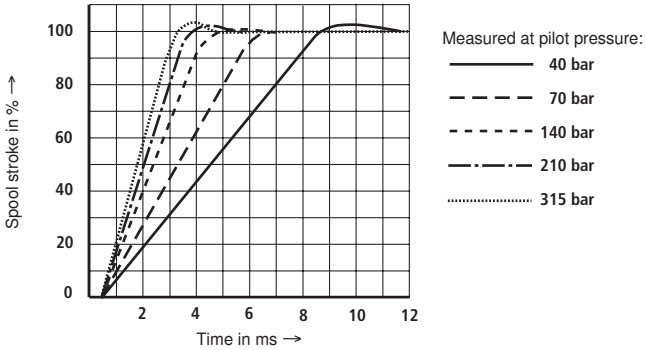
Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of flow/signal function at constant valve pressure differential Δp

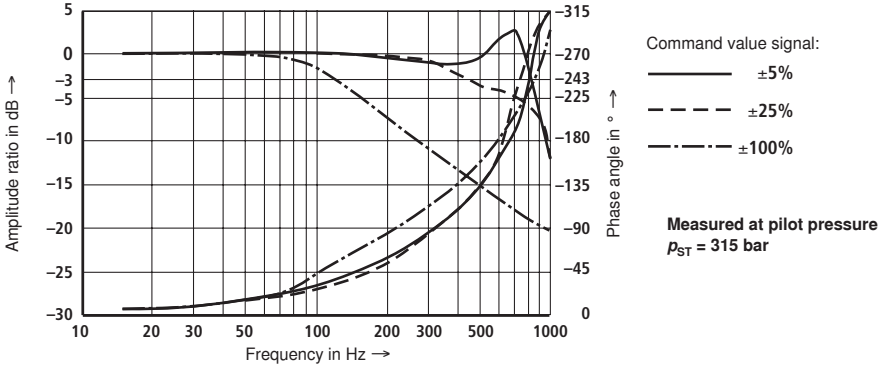


Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

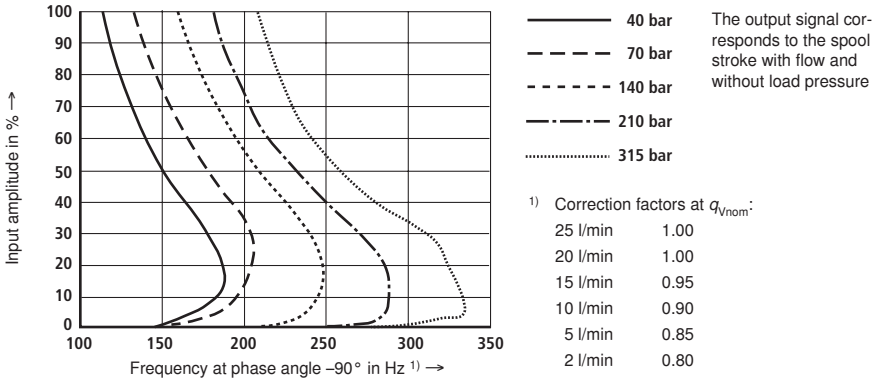
Transient function with pressure stage 315 bar



Frequency response with pressure stage 315 bar



Dependence of frequency at –90° on operating pressure *p* and input amplitude

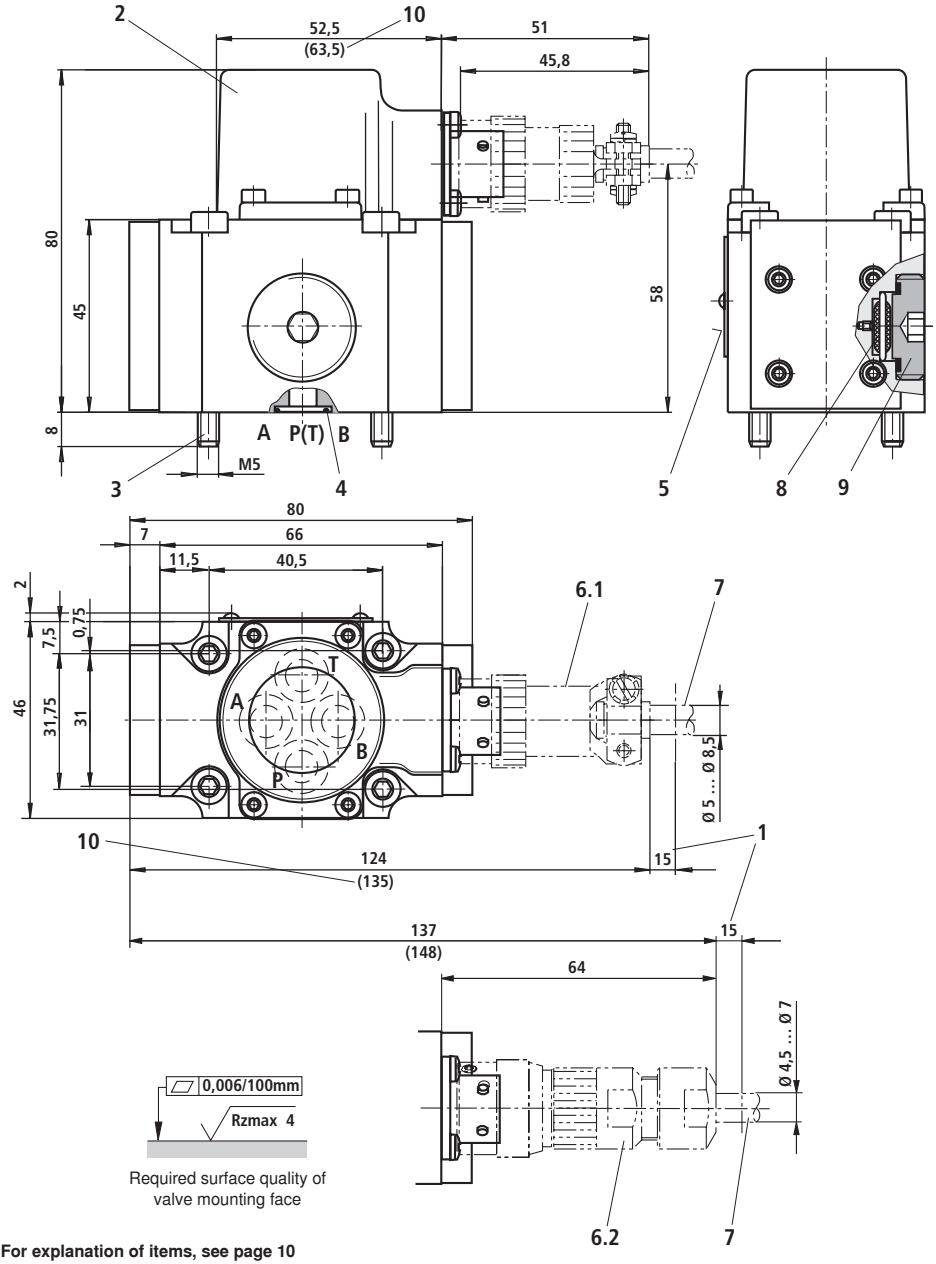


The output signal corresponds to the spool stroke with flow and without load pressure

1) Correction factors at q_{Vnom}:

25 l/min	1.00
20 l/min	1.00
15 l/min	0.95
10 l/min	0.90
5 l/min	0.85
2 l/min	0.80

Unit dimensions: Types 4WS2EM 6 and 4WSE2EM 6 (nominal dimensions in mm)



Required surface quality of valve mounting face

For explanation of items, see page 10

Unit dimensions: Explanation of items

1 Space required to remove mating connector; in addition, take account of the bending radius of the connection cable

2 Cap

3 Valve mounting screws (included in the scope of supply)

For reasons of strength, use exclusively the following valve mounting screws:

4 hexagon socket head cap screws (4 A/F)
ISO 4762-M5 x 50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.4 to VDA 235-101)
M_T = 9.3 Nm

4 Identical seal rings for P, A, B and T

5 Nameplate

6.1 Mating connector, Material no. **R900005414** (separate order, see page 6)

6.2 Mating connector, Material no. **R901043330** (separate order, see page 6)

7 Connection cable; further information on page 6

8 Filter

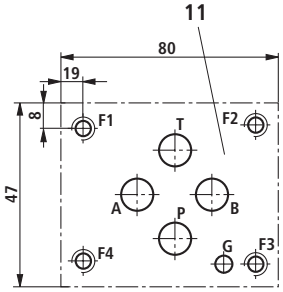
9 Plug screw (6 A/F)
Tighten to M_T = 30 Nm after filter change

10 Dimensions in ( ) for valve with integrated control electronics (OBE)

11 Machined valve mounting face

Porting pattern according to ISO 4401-03-02-0-05

Deviating from standard:
– Locating pin (G) not provided



Subplates according to data sheet RE 45052 (separate order)

G 341/01 (G1/4)
G 342/01 (G3/8)
G 502/01 (G1/2)

Flushing plate with porting pattern to ISO 4401-03-02-0-05 (nominal dimensions in mm)

Symbol

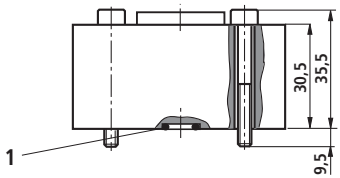
with FKM seals, Material no. **R900936049**, weight: 0.6 kg

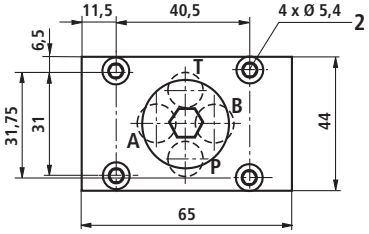
1 4 off R-rings 9.81 x 1.5 x 1.78

2 Mounting screws
(included in the scope of supply)

For strength reasons, use exclusively the following valve mounting screws:

4 hexagon socket head cap screws
ISO 4762-M5 x 40-10.9-flZn-240h-L
(friction coefficient 0.09-0.14 – to VDA 235-101)
M_T = 7 Nm ±10 %





To ensure the proper operation of servo-valves, it is indispensable to flush the system before commissioning.

The following equation provides a guideline for the flushing time per system:

$$t \geq \frac{V}{q_V} \cdot 5$$

t = flushing time in h
V = tank capacity in l
q_V = pump flow in l/min

When topping up more than 10 % of the tank capacity, repeat the flushing process.

Better than the use of a flushing plate is a directional valve with connection to ISO 4401-03-02-0-05. This valve can also be used for flushing the actuator ports. See also data sheet RE 07700.

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

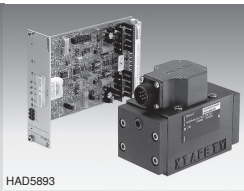
Rexroth
Bosch Group

Directional servo-valve in 4-way design

RE 29583/05.11 1/20
Replaces: 07.03

Type 4WS.2E...

Type 4WSE2ED 10-5X/...B...K31EV



Type 4WS2EM 10-5X/...B...K31EV

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

Table of contents

Information on available spare parts:
www.boschrexroth.com/spc

Features

- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical or mechanical and electric return
- 1st stage as nozzle flapper plate amplifier
- Subplate mounting:
  Porting pattern according to ISO 4401
- Dry control motor, no pollution of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free control spool return element
- Control
  • External control electronics in Eurocard format or in modular design (separate order), see page 8
  • Or control electronics integrated in the valve (OBE)
- Valve and integrated control electronics are adjusted and tested
- Control spool with flow force compensation
- Control sleeve centrically fixed; thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, no wear of the seal ring
- Filter for 1st stage externally accessible, see pages 16, 17 and 18

Ordering code

		10	5X	B				K31	E	V	*

Directional servo-valve in 4-way design for **external** control electronics **= 4WS2E**
with **integrated** control electronics **= 4WSE2E**

Mechanical return **= M**

Mechanical and electric return **= D**
(only available with integrated electronics)

Size 10 **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: Unchanged installation and connection dimensions)

Rated flow [1]
with valve pressure differential Δp = 70 bar

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Further details in the plain text [7]

V = FKM seals [6] suitable for mineral oil (HL, HLP) according to DIN 51524

Spool overlap [5]

E = 0 to 0.5 % negative

Electrical connection

K31 = **Without** mating connector with connector according to EN 175201-804
Mating connector - separate order see page 7

Inlet pressure range [4]

210 = 10 to 210 bar

315 = 10 to 315 bar

Pilot oil supply and return [3]

– = Supply external, return external

E = Supply internal, return external

T = Supply external, return internal

ET = Supply internal, return internal

Valves for **external** control electronics: [2]

11 = Coil no. 11 (30 mA / 85 Ω per coil)

Valves with **integrated** control electronics:

	Command value	Actual value (only available with 4WSE2ED…)
9 =	±10 V	±10 V
13 =	±10 mA	±10 mA

Rated flow [1]

The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed.

A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 9).

Electrical control data [2]

Valves for **external** control electronics:
The actuating signal must be formed by a current-controlled output stage. Servo amplifier see page 7.

Valves with **integrated** control electronics:
With the integrated electronics, the command value can be fed in as voltage (ordering code "9") or - with larger distances (> 25 m between control and valve) as current (ordering code "13").

Pilot oil [3]

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous. The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

The ports X and Y are also pressurized in case of "Internal" pilot oil supply.

Inlet pressure range [4]

Care should be taken that the system pressure is as constant as possible.

Pilot pressure range: 10 to 210 bar or 10 to 315 bar

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

Spool overlap [5]

The spool overlap in % refers to the nominal stroke of the control spool.

Other control spool overlaps upon request!

Seal material [6]

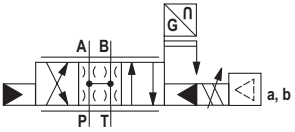
If you need any other sealing material, please contact us!

Details in the plain text [7]

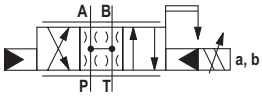
Here, special requests are to be specified in the plain text. After receipt of the order, they are checked by the plant and the type designation is amended with a related number.

Symbols

Valves with electric and mechanical return, with OBE
(example: 4WS**E**2ED 10-5X…ET…)



Valves with mechanical return, without OBE
(example: 4WS2EM 10-5X…ET…)



Function, section

4WS(E)2EM10-5X/...

Valves of type 4WS(E)2EM10-5X/... are electrically operated, 2-stage directional servo-valves. They are mainly used to control position, force and velocity.

These valves consist of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (nozzle flapper plate principle) (2) and a control spool (3) in a sleeve (2nd stage), which is connected to the torque motor via a mechanical return.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool. This pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical return) (9). The position of the control spool is changed until the feedback torque across the bending spring and the electromagnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics, type 4WS2EM10-5X/... (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Integrated control electronics, type 4WSE2EM10-5X/... and 4WSE2ED10-5X/...

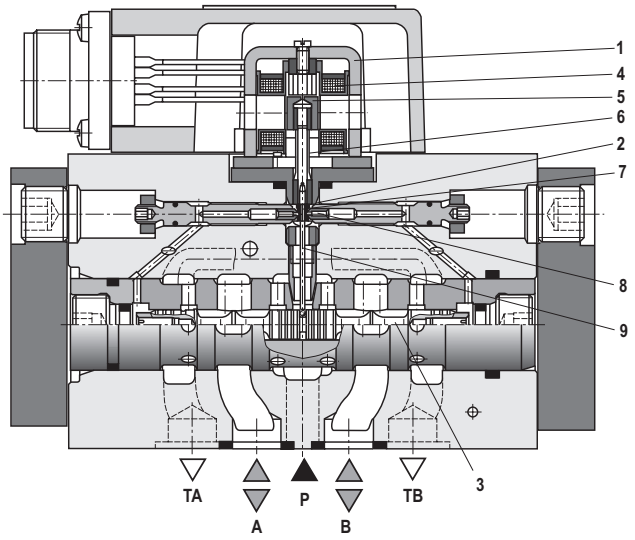
To amplify the analog input signal, control electronics (10) especially adjusted to this valve type are integrated. They are located in the torque motor cover cap. The valve zero point can be adjusted by means of an externally accessible potentiometer.

4WSE2ED10-5X/...

In addition to the mechanical control by the return spring, valves of this types are equipped with the electric spool position detection and control. The control spool position is determined by an inductive position transducer (11). The position transducer signal is compared to the command value by integrated control electronics (10). Any possible control deviation is amplified electrically and fed to the torque motor as control signal. With the additional electric return, higher dynamical values can be achieved by the electric controller gain in the small signal range than with the purely mechanical version. The additionally available mechanical return ensures that in case the electric voltage supply fails, the valve spool is positioned in the zero range.

The valve is only available with integrated control electronics. The valve zero point can be adjusted by means of an externally accessible potentiometer.

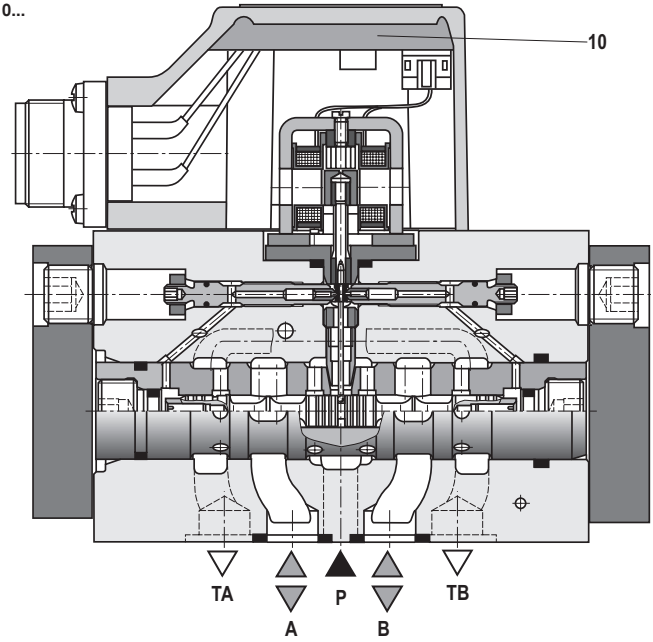
Note:
Changes in the zero point may result in damage to the system and may only be implemented by instructed specialists.



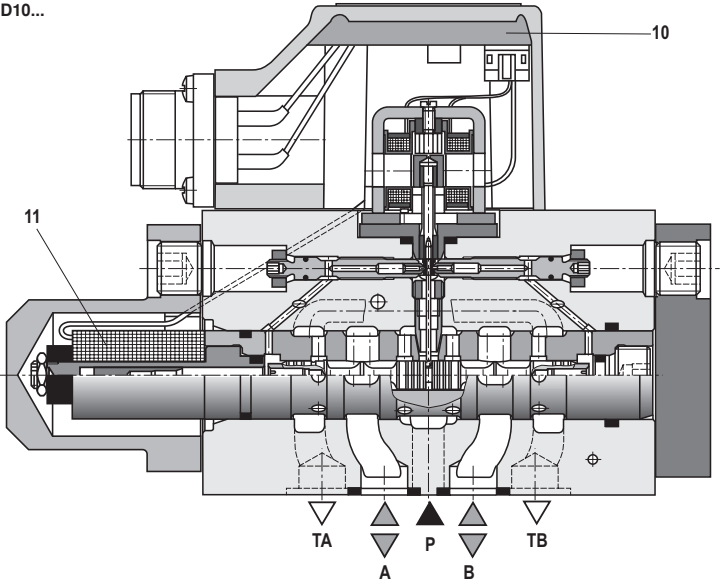
Type 4WS2EM10...

Section

Type 4WSE2EM10...



Type 4WSE2ED10...



Technical data (For applications outside these parameters, please consult us!)

general

Weight	with mechanical return	kg	3.56
	with mechanical and electric return and integrated control electronics	kg	3.65
Installation position			Optional, if it is ensured that during start-up of the system the pilot control is supplied with sufficient pressure (≥ 10 bar).
Storage temperature range		°C	–20 to +80
Ambient temperature range		°C	–20 to +60 valve with OBE
			–30 to +100 valve without OBE

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 to 210 or 10 to 315							
	Main valve, port P, A, B	bar	Up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted, static < 10							
	Pilot oil return external	bar	Up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			See table page 7							
Hydraulic fluid temperature range		°C	–15 to +80, preferably +40 to +50							
Viscosity range		mm²/s	15 to 380, preferably 30 to 45							
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $Q_{V,L}$ [2] measured without dither signal		l/min	$\sqrt{\frac{p_P}{70\ bar}}$ [4] •0.7 l/min	$\sqrt{\frac{p_P}{70\ bar}}$ [4] •0.9 l/min	$\sqrt{\frac{p_P}{70\ bar}}$ [4] •1.2 l/min			$\sqrt{\frac{p_P}{70\ bar}}$ [4] •1.5 l/min		$\sqrt{\frac{p_P}{70\ bar}}$ [4] •1.7 l/min
Rated flow $Q_{v\ rated}$ [3], tolerance ±10 % with valve differential pressure Δp = 70 bar		l/min	5	10	20	30	45	60	75	90
Maximum control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 to 170				120 to 150			
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Return system			Mechanical "M"					Mechanical and electric "D"		
Hysteresis (dither-optimized)		%	≤ 1.5					≤ 0.8		
Range of inversion (dither-optimized)		%	≤ 0.3					≤ 0.2		
Response sensitivity (dither-optimized)		%	≤ 0.2					≤ 0.1		
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5					≤ 2		
Zero shift upon change of:										
	Hydraulic fluid temperature	% / 20 °C	≤ 1					≤ 2		
	Ambient temperature	% / 20 °C	≤ 1					≤ 2		
	Operating pressure 80 to 120 % of p_P [4]	% / 100 bar	≤ 2					≤ 2		
	Return flow pressure 0 to 10 % p_P [4]	% / bar	≤ 1					≤ 1		

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of the filters see www.boschrexroth.com/filter

[2] $Q_{V,L}$ = Zero flow in l/min

[3] $Q_{V\ rated}$ = Rated flow (complete valve) in l/min

[4] p_P = Operating pressure in bar

Technical Data (For applications outside these parameters, please consult us!)

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons	HL, HLP	NBR, FKM	DIN 51524
Flame-resistant – Water-containing	HFC	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, service life, maintenance intervals, etc.)!
- The flash point of the process and operating medium used must be 40 K higher than the maximum solenoid surface temperature.
- **Flame-resistant – water-containing**: Maximum pressure difference per control edge 175 bar, otherwise, increased cavitation erosion!
  Tank pre-loading < 1 bar or > 20 % of the pressure difference. The pressure peaks should not exceed the maximum operating pressures!

electric

Return system			Mechanical "M"	Mechanical and electric "D"
Protection class of the valve according to EN 60529			IP 65 with mating connector mounted and locked	
Type of signal			Analog	
Rated current per coil		mA	30	
Resistance per coil		Ω	85	
Inductivity with 60 Hz and 100 % rated current	Connection in series	H	1.0	
	Connection in parallel	H	0.25	
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal				

electric, external control electronics (only version "M")

Amplifier (separate order)	Eurocard format	Analog	Type VT-SR2-1X/... according to data sheet 29980
	Modular design	Analog	Type VT 11021 according to data sheet 29743

Important: Information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load see data sheet 29583-U (declaration on environmental compatibility).

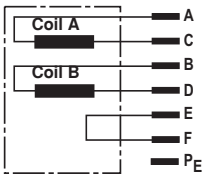
Available accessories

Service case with test device for continuous valves with integrated electronics type VT-VETSY-1 according to data sheet 29685.

Service case with test device for servo valves for external electronics type VT-SVTSY-1 according to data sheet 29681.

Electrical connection, external control electronics

Type 4WS2EM 10-5X...



The electrical connection can be designed as parallel or serial connection. For reasons of operational safety and the resulting lower coil inductivity, we recommend the connection in parallel.

The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

Connection in parallel:
In the mating connector, connect contact A with B and C with D.

Connection in series:
In the mating connector, connect contact B with C.

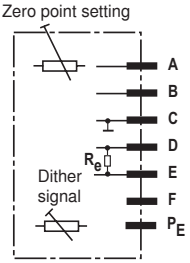
Electrical control from A (+) to D (–) results in the flow direction P to A and B to T. Inverted electrical control results in the flow direction P to B and A to T.

E → F = bridge

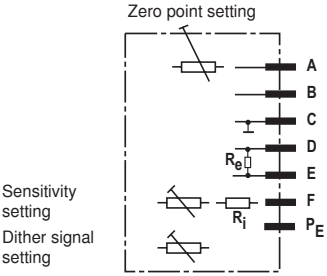
6

Electrical connection, integrated control electronics

Type 4WSE2EM 10-5X...



Type 4WSE2ED 10-5X...



	Mating connector assignment	Current control	Voltage control
		Control "**13**"	Control "**9**"
Supply voltage	A	+15 V	+15 V
	B	–15 V	–15 V
	C	⊥	⊥
Command value	D	±10 mA	±10 V
	E	R_e = 100 Ω	R_e ≥ 50 kΩ
Measuring output for control spool	F [1]	±10 mA [2] Load max. 1 kΩ	+10 V against ⊥ [2] R_i ≈ 4.7 kΩ

[1] In valves with mechanical return, part F is not used.
[2] With nominal spool stroke

Current consumption at the mating connector port	A	Max. 150 mA	Max. 150 mA
	B		
	D	0 to ±10 mA	≤ 0.2 mA
	E		

Supply voltage: ±15 V ±3 %, residual ripple < 1 %

Command value: Command value at the mating connector port D = positive against mating connector port E results in flow from P to A and B to T.
Measuring output F has positive signal against ⊥.

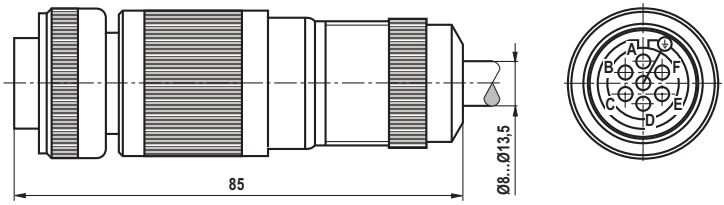
Command value at the mating connector port D = negative against mating connector port E results in flow from P to B and A to T.
Measuring output F has negative signal against ⊥.

Measuring output: The voltage or current signal is proportional to the control spool stroke.

Important: Electric signals taken out via control electronics (e.g. actual value) must not be used for switching off safety-relevant machine functions!

Electrical connection, mating connector

Mating connector according to DIN EN 175.201-804
separate order under Material no. **R900223890**
(metal version)

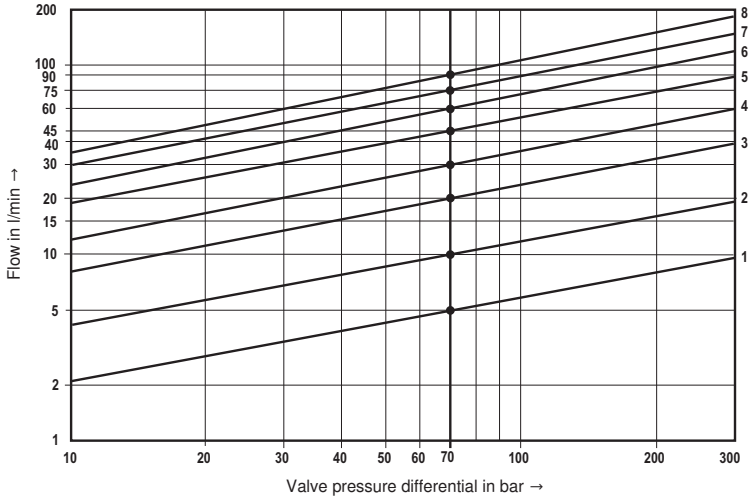


Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %)
with 100 % command value signal

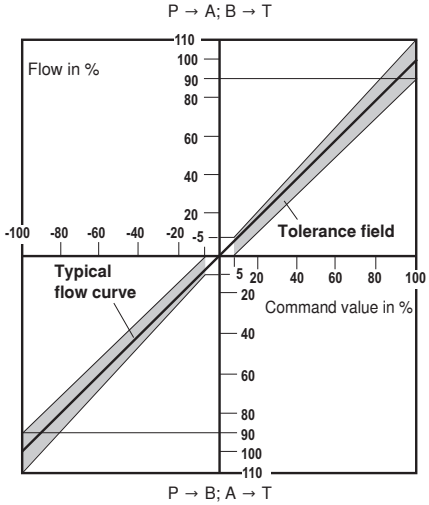
Rated flow

5 l/min	=	Curve **1**	45 l/min	=	Curve **5**
10 l/min	=	Curve **2**	60 l/min	=	Curve **6**
20 l/min	=	Curve **3**	75 l/min	=	Curve **7**
30 l/min	=	Curve **4**	90 l/min	=	Curve **8**



Δ***p*** = Valve pressure differential (inlet pressure p_P minus load pressure p_L and minus return flow pressure p_T)

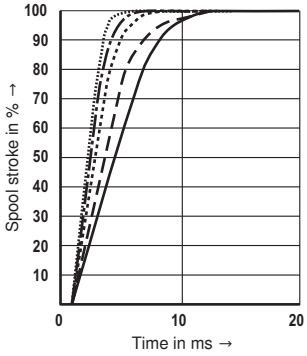
Tolerance field of the flow command value function
at constant valve pressure differential



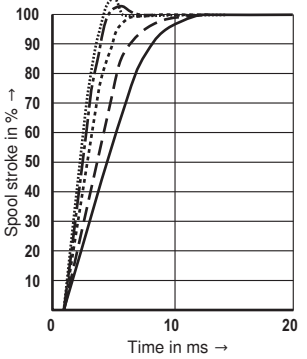
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **5, 10, 20 l/min**



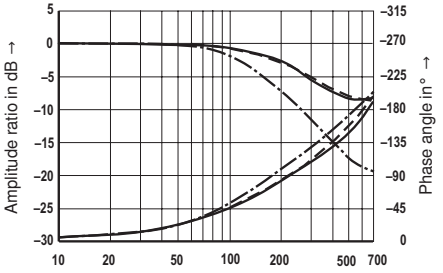
4WSE2ED 10
Rated flow **5, 10, 20 l/min**



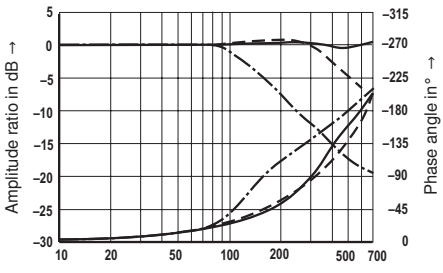
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **5, 10, 20 l/min**



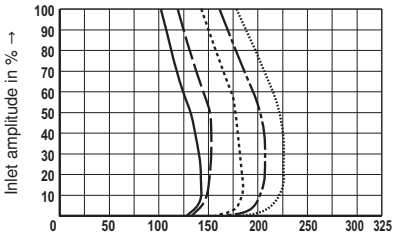
4WSE2ED 10
Rated flow **5, 10, 20 l/min**



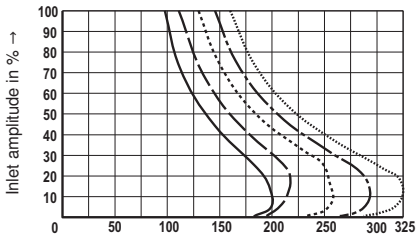
5 % — — — 25 % —·—·— 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **5, 10, 20 l/min**



4WSE2ED 10
Rated flow **5, 10, 20 l/min**

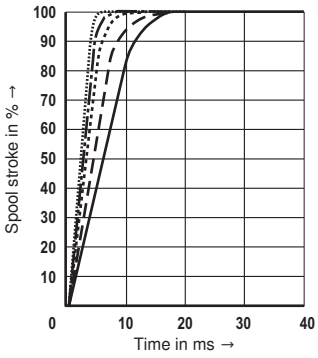


40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

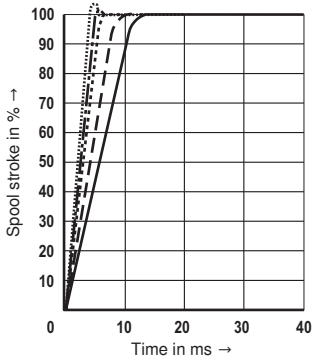
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **30 l/min**



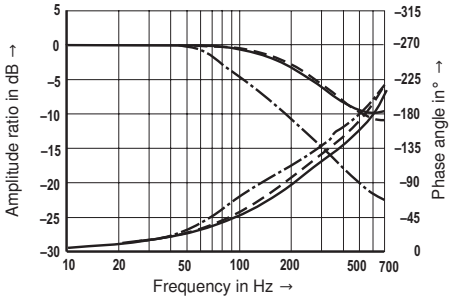
4WSE2ED 10
Rated flow **30 l/min**



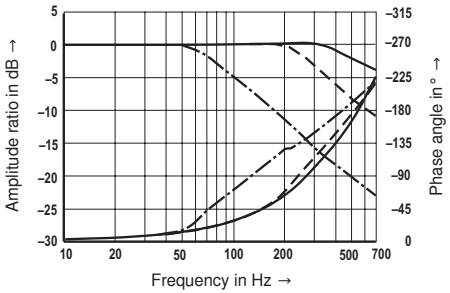
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **30 l/min**



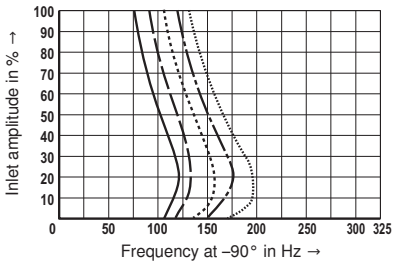
4WSE2ED 10
Rated flow **30 l/min**



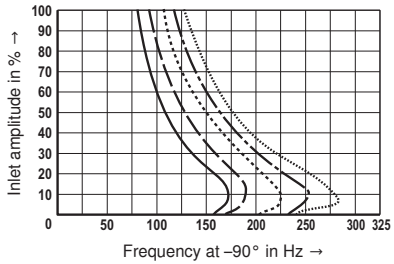
5 % — — — 25 % —·—·— 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **30 l/min**



4WSE2ED 10
Rated flow **30 l/min**



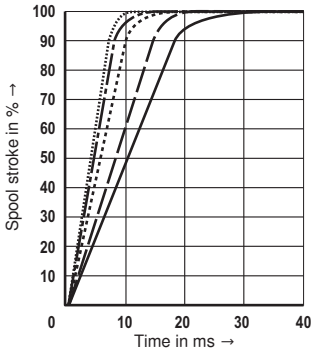
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

6

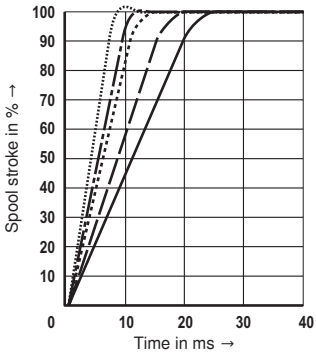
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **45 l/min**



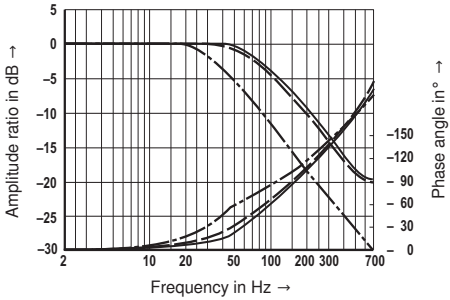
4WSE2ED 10
Rated flow **45 l/min**



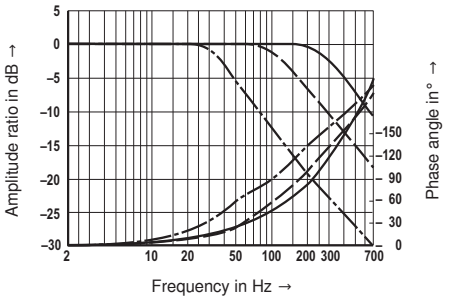
40 bar — 70 bar ---- 140 bar -·- 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **45 l/min**



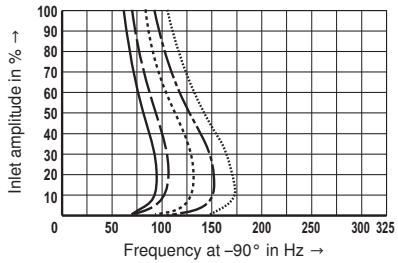
4WSE2ED 10
Rated flow **45 l/min**



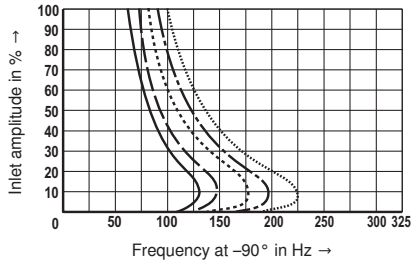
5 % — 25 % -·- 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **45 l/min**



4WSE2ED 10
Rated flow **45 l/min**

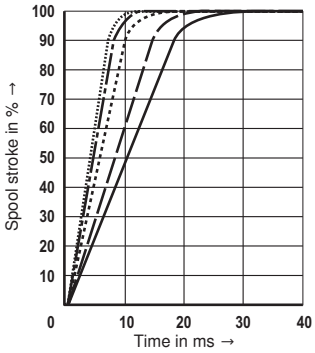


40 bar — 70 bar ---- 140 bar -·- 210 bar ····· 315 bar

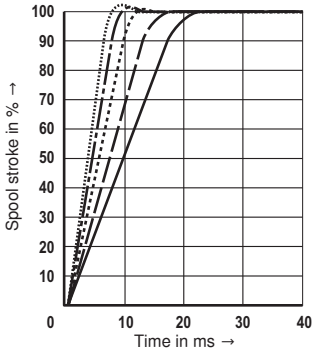
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **60 l/min**



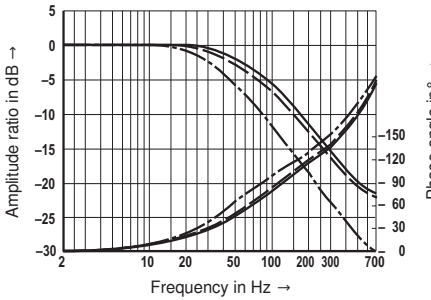
4WSE2ED 10
Rated flow **60 l/min**



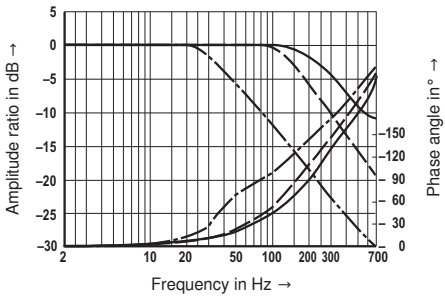
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **60 l/min**



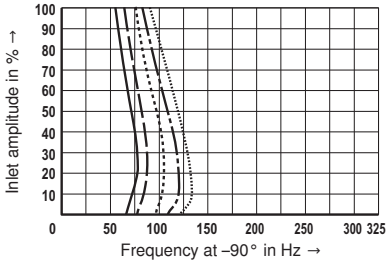
4WSE2ED 10
Rated flow **60 l/min**



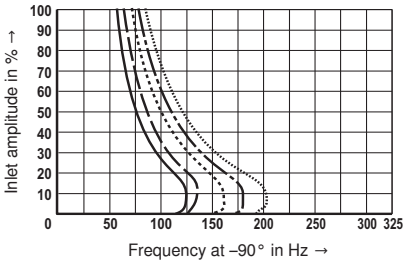
5 % — 25 % —·— 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **60 l/min**



4WSE2ED 10
Rated flow **60 l/min**



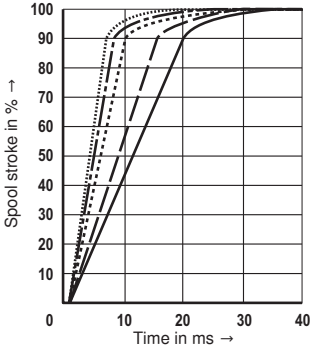
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

6

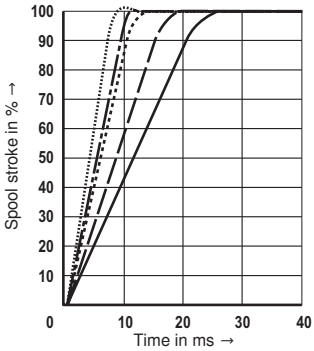
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **75 l/min**



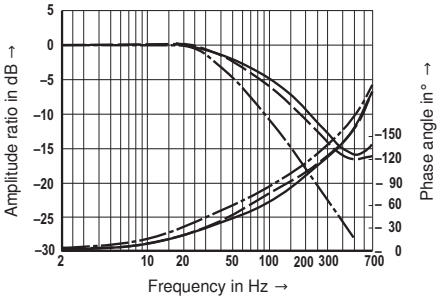
4WSE2ED 10
Rated flow **75 l/min**



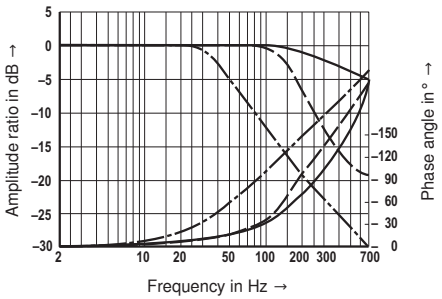
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **75 l/min**



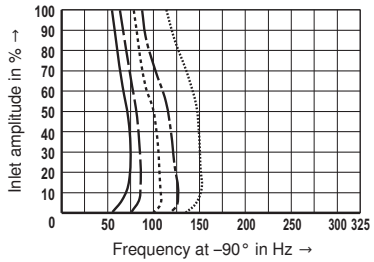
4WSE2ED 10
Rated flow **75 l/min**



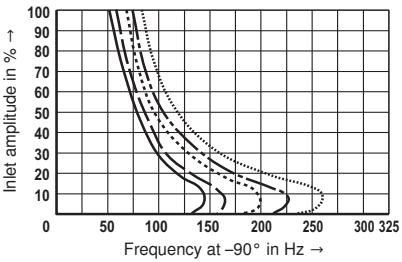
5 % — — — 25 % —·— 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **75 l/min**



4WSE2ED 10
Rated flow **75 l/min**

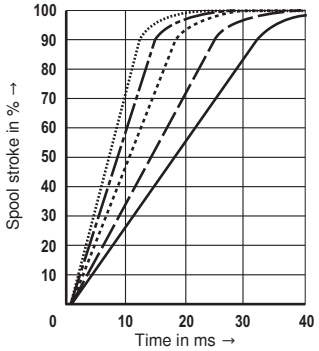


40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

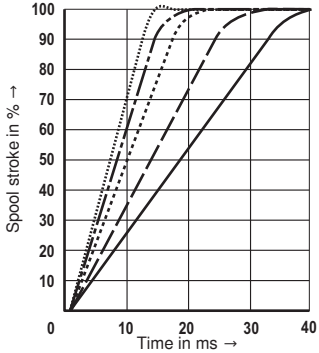
Characteristic curves: Type 4WS.2EM 10 and 4WSE2ED 10 (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

4WS.2EM 10
Rated flow **90 l/min**



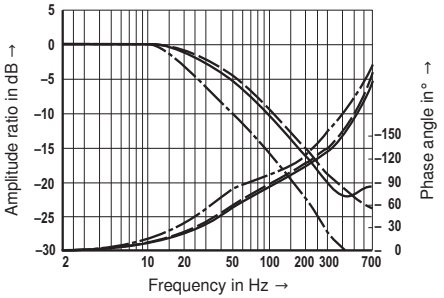
4WSE2ED 10
Rated flow **90 l/min**



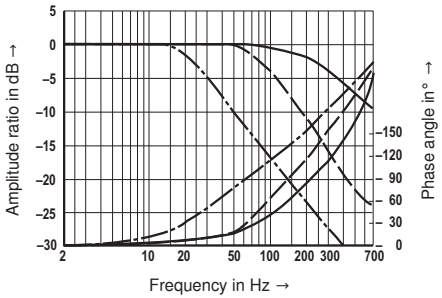
40 bar — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

4WS.2EM 10
Rated flow **90 l/min**



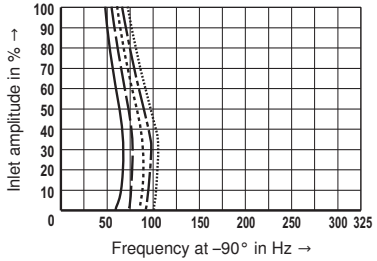
4WSE2ED 10
Rated flow **90 l/min**



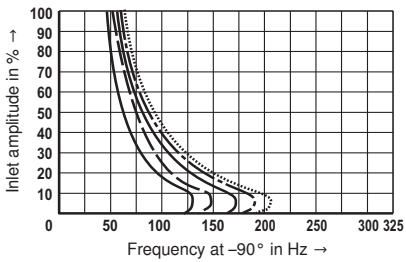
5 % — — — 25 % —·— 100 %

Dependency of the frequency *f* at –90° on the operating pressure *p* and the inlet amplitude

4WS.2EM 10
Rated flow **90 l/min**



4WSE2ED 10
Rated flow **90 l/min**

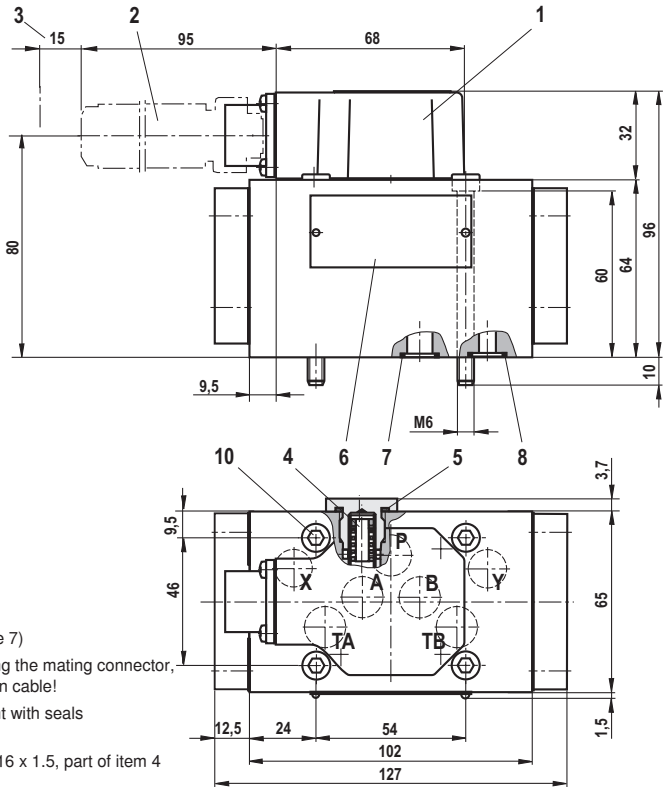


40 bar — — — 70 bar ····· 140 bar —·— 210 bar ····· 315 bar

6

Unit dimensions: Type 4WS2EM 10 (dimensions in mm)

Mechanical return / external control electronics, type 4WS2EM 10-5X/…



1 Cap

2 Mating connector
(order separately, see page 7)

3 Space required for removing the mating connector, also take care of connection cable!

4 Exchangeable filter element with seals
Material no.: **R961001950**

5 Profile seal for filter screw 16 x 1.5, part of item 4

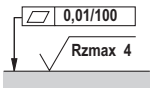
6 Name plate

7 Identical seal rings for ports A, B, P, TA and TB

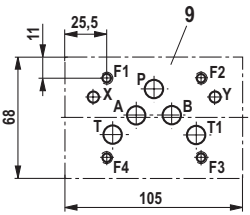
8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply.

9 Processed valve mounting faces, porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M6x70-10.9-flZn-240h-L (friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)



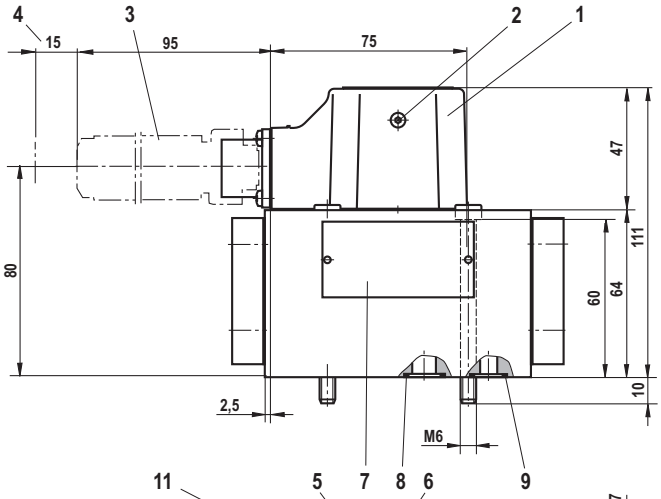
Required surface quality of the counterpart

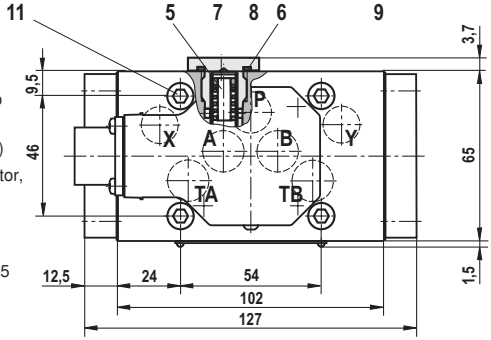


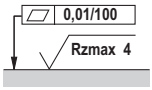
Subplates according to data sheet 45054 must be ordered separately.

Unit dimensions: Type 4WSE2EM 10 (dimensions in mm)

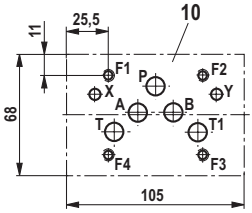
Mechanical return / integrated control electronics, type 4WSE2EM 10-5X/…







Required surface quality of the counterpart



1 Cap **with** integrated control electronics

2 Electric zero point setting:
After removal of the SW2.5 plug screw, the zero point can be corrected using a potentiometer

3 Mating connector (order separately, see page 7)

4 Space required for removing the mating connector, also take care of connection cable!

5 Exchangeable filter element with seals
Material no.: **R961001950**

6 Profile seal for filter screw 16 x 1.5, part of item 5

7 Name plate

8 Identical seal rings for ports A, B, P, TA and TB

9 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply.

10 Processed valve mounting faces, porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

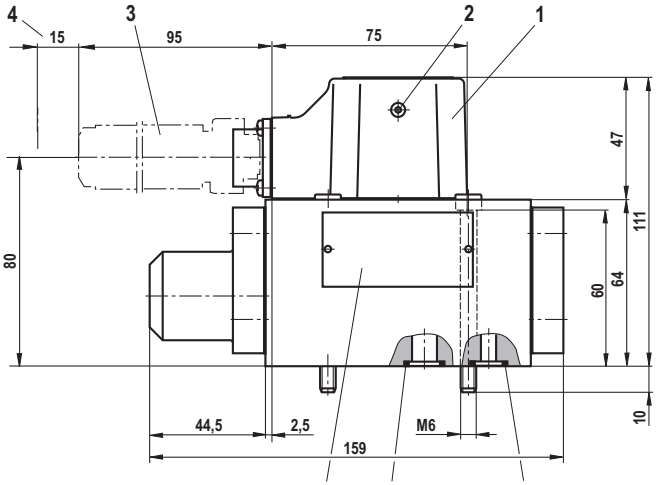
11 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M6x70-10.9-flZn-240h-L (friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

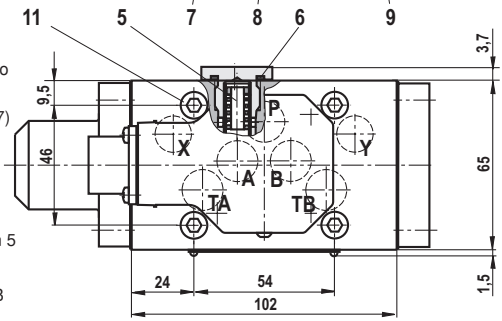
Subplates according to data sheet 45054 must be ordered separately.

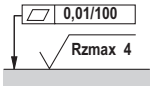
6

Unit dimensions: Type 4WSE2ED 10 (dimensions in mm)

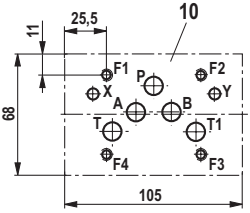
Electric and mechanical return / integrated control electronics, type 4WSE2ED 10-5X/…







Required surface quality of the counterpart



1 Cap **with** integrated control electronics

2 Electric zero point setting:
After removal of the SW2.5 plug screw, the zero point can be corrected using a potentiometer

3 Mating connector (order separately, see page 7)

4 Space required for removing the mating connector, also take care of connection cable!

5 Exchangeable filter element with seals
Material no.: **R961001950**

6 Profile seal for filter screw 16 x 1.5, part of item 5

7 Name plate

8 Identical seal rings for ports A, B, P, TA and TB

9 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply.

10 Processed valve mounting faces, porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

11 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M6x70-10.9-flZn-240h-L (friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

Subplates according to data sheet 45054 must be ordered separately.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol

with FKM seals,
Material no. **R900912450**, weight: 2 kg

1 R-ring 13 x 1.6 x 2 (A, B, P, TA and TB)

2 R-ring 11.18 x 1.6 x 1.78 (X, Y)

3 Mounting screws
For reasons of stability, exclusively the following mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M6x50-10.9-flZn-240h-L (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

To ensure proper operation of the servo-valves, it is necessary to flush the system before commissioning.

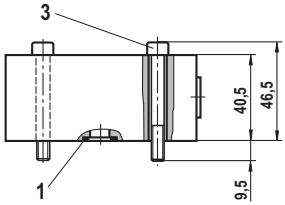
The following values are guidelines for the flushing time per system:

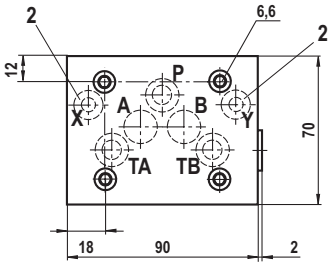
$$t \geq \frac{V}{Q_V} \cdot 5$$

t = Flushing time in h
V = Tank capacity in l
Q_V = Pump flow in l/min

When topping up more than 10 % of the tank capacity, flushing must be repeated.

The use of a directional valve with port in accordance with ISO 4401-05-05-0-05 is suited better than a flushing plate. This valve can also be used for flushing the actuator ports. Also refer to catalog sheet RE 07700.





Notes

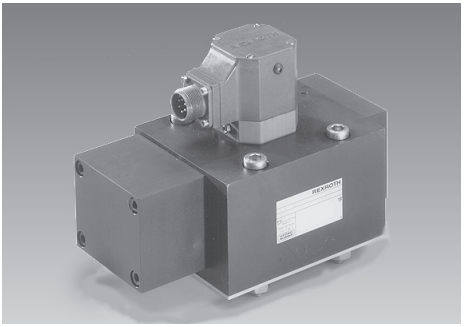
Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

RE 29 591/06.02

Replaces: 03.93

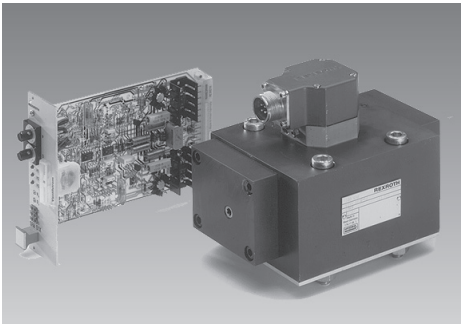
4-way directional servo valve Type 4WS.2E…

Nominal size 16
Series 2X
Maximum operating pressure 210/315 bar
Maximum flow 320 L/min



H/A 3013

Type 4WSE2ED 16-2X/…B… with mechanical and electrical feedback and integrated control electronics



H/A/3012

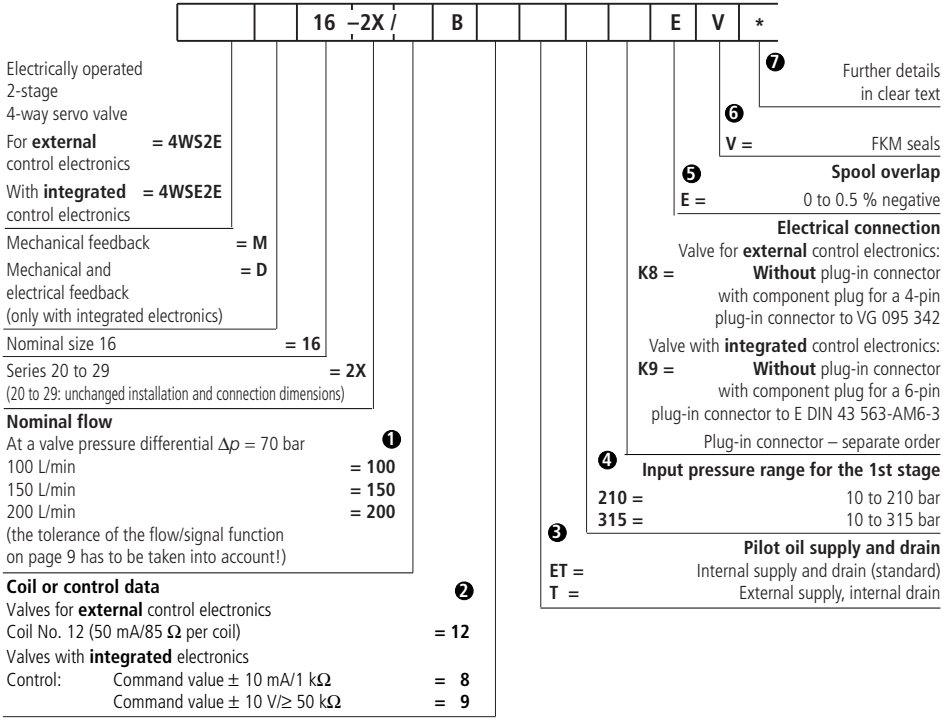
Type 4WS2EM 16-2X/…B… with mechanical feedback and associated external control electronics (separate order)

Overview of contents

Features

- Valve for closed loop position, force and speed control
- Two stage servo valve with mechanical or mechanical and electrical feedback
- 1st stage as an orifice-flapper plate amplifier
- For subplate mounting, porting pattern to DIN 24 340 form A16 with port X, subplates to catalogue sheet RE 45 054 (separate order)
- Dry torque motor, no contamination of the solenoid gap by the pressure fluid
- Can also be used as a 3-way version
- Wear-free spool return element
- Three control variations
- Control:
  - External control electronics in eurocard format (separate order), see page 7
  - Or with the control electronics integrated into the valve
- The valves with integrated control electronics are calibrated and tested
- The pilot oil supply, internal/external, can be changed without dismantling the valve
- The control sleeve can be replaced
- Filter for the 1st stage is accessible from the outside by means of a plug

Ordering details



❶ Nominal flow

The nominal flow refers to a 100 % command value signal at a 70 bar valve pressure differential (35 bar per control land). This valve pressure differential is to be considered as a reference value. Other values cause a change in the flow.

Please take into account a possible nominal flow tolerance of ± 10 % (see flow/load function on page 9).

❷ Electrical control data

Valves for **external** control electronics: The positioning signal must be generated by a current regulated output stage. See page 7 for servo amplifiers.

Valves with **integrated** control electronics: The command value can be applied as a voltage (ordering detail „9“) or for longer distances (> 25 m between the control and the valve) as a current (ordering detail „8“).

❸ Input pressure for the pilot control

The pilot pressure must be maintained as constant as possible. Therefore an external pilot control via port X is often advantageous.

The dynamic response of the valve may be influenced using a higher pressure at X than at P.

❹ Input pressure range

The system pressure must be maintained as constant as possible.

Pilot pressure range: 10 to 210 bar or 10 to 315 bar

With referance to the dynamics, within the permissible pressure range the frequency relationship must be taken into account.

❺ Spool overlap

The spool overlap in % refers to the control spool nominal stroke.

Other spool overlaps on request!

❻ Seal material

If other seal materials are required please consult us!

❼ Details in clear text

Special requirments are to be specified in clear text. After receipt of the order they will be checked by the factory and the type code will be completed with an associated number.

Test unit

Test unit (battery operated, optionally with a power supply) to catalogue sheet RE 29 681
Attention:
– Only for valves with external control electronics

Test unit for proportional and servo valves with integrated control electronics
Type VT-VET-1, series 1X to catalogue sheet RE 29 685.

The test unit is used for the control and functional testing of proportional and servo valves with integrated electronics. It is suitable for testing valves with an operating voltage of ± 15 V or 24 V.
The following operating modes are possible:
– External operation → Linking the operating voltage and the command value from the control cabinet to the valve
– Internal/external operation → Command value is applied by the test unit; the operating voltage via the control cabinet
– Internal operation → Operating voltage via a seperate power supply; the command value is applied by the test unit
– Command value is applied via a BNC socket → Optional operating voltage

Preferred types (readily available)

Valves for external control electronics, mechanical feedback

Material No.	Type 4WS2EM
00769978	4WS2EM 16-2X/100B12ET315K8EV
00716550	4WS2EM 16-2X/150B12ET315K8EV
00960575	4WS2EM 16-2X/200B12ET315K8EV

Valves with integrated control electronics, mechanical feedback

Material No	Type 4WSE2EM
00769976	4WSE2EM 16-2X/100B9ET315K9EV
00769980	4WSE2EM 16-2X/150B9ET315K9EV
00769981	4WSE2EM 16-2X/200B9ET315K9EV

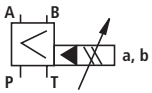
Valves with integrated control electronics, mechanical and electrical feedback

Material No.	Type 4WSE2ED
00769983	4WSE2ED 16-2X/100B9ET315K9EV
00769982	4WSE2ED 16-2X/150B9ET315K9EV
00769984	4WSE2ED 16-2X/200B9ET315K9EV

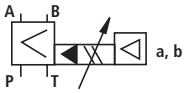
Symbols

Simplified

Valves for external control electronics

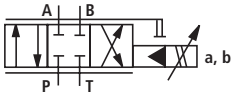


Valves with integrated control electronics

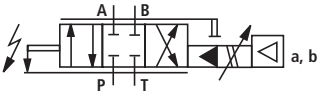


Detailed

Mechanical feedback



Electrical and mechanical feedback



Function, section

4WS(E)2EM 16-2X/...

The valve types 4WS(E)2EM... are electrically actuated, 2-stage servo directional valves with a porting pattern to DIN 24 340 form A16. They are primarily used for the closed loop control of position, force and velocity.

These valves comprise of an electro-mechanical convertor (torque motor) (1), a hydraulic amplifier (flapper jet principle) (2) and a control spool (3) in a sleeve (2nd stage), that is connected to the torque motor via a mechanical feedback.

Via an electrical input signal at the coils (4) of the torque motor, a force is generated via a permanent magnet at the armature (5) that, in conjunction with a torque tube, (6) generates a torque. Due to this the flapper plate (7), which is connected with the torque tube (6) via a rod, is moved out of the central position between the control orifices (8) a pressure differential now results which acts on the front face of the control spool. This pressure differential causes the spool to move, whereby the pressure connection is connected to an actuator connection and at the same time the other actuator connection is connected to the return connection.

The control spool is connected via a feedback spring (mechanical feedback) (9) to the flapper plate and torque motor. The control spool continues to change position until the torque feedback, via the feedback spring and the electro-magnetic torque of the torque motor are balanced, and the pressure differential at the flapper jet system becomes zero.

The stroke of the control spool and thus the flow through the pilot control valve is closed loop controlled in proportion to the electrical input signal. It has, however to be taken into account that the flow is dependent on the valve pressure differential.

External control electronics, type 4WS2EM 16-2X/...
(separate order)

External control electronics, (servo amplifier), are used to control the valve, they so amplifiy the analogue input signal (command value) that the controlled current output signal is capable of driving the valve.

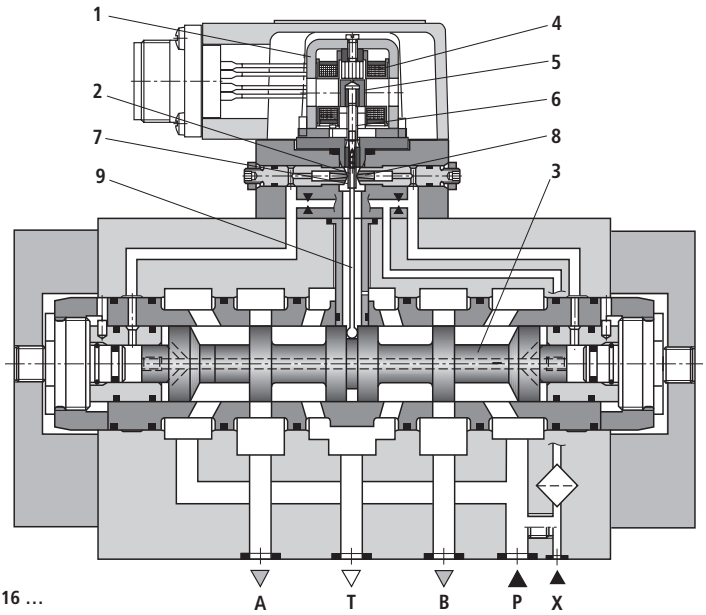
Integrated control electronics, types 4WSE2EM16-2X/... and 4WSE2ED 16-2X/...

For the amplification of the analogue input signal control electronics (10), which are specially matched to the valve, are integrated into the valve. They are built into the torque motor cover plate. The valve zero point can be adjusted by a potentiometer which is externally accessible.

4WSE2ED 16-2X/...

This type of valve is fitted with, in addition to the mechanical closed loop control via a feedback spring, an electrical spool position acquisition and control system. The spool position is obtained via an inductive position transducer (11). The position transducer signal is compared with the command value via the integrated control electronics (10). Any possible control deviation is electrically amplified and then passed onto the torque motor as a control signal. With the additional electrical feedback it is possible to obtain higher dynamic values in the small signal range than the purely mechanical version due to the electrical closed loop amplification. The mechanical feedback ensures that, in the case of failure of the electrical power supply, the spool is positioned in the zero range.

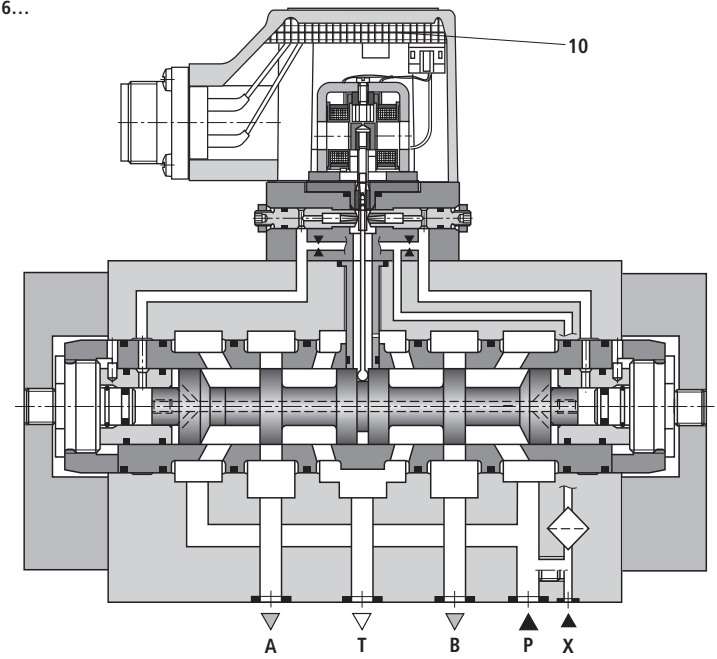
The valve is only available with integrated control electronics. The valve zero point can be adjusted by an externally accessible potentiometer.



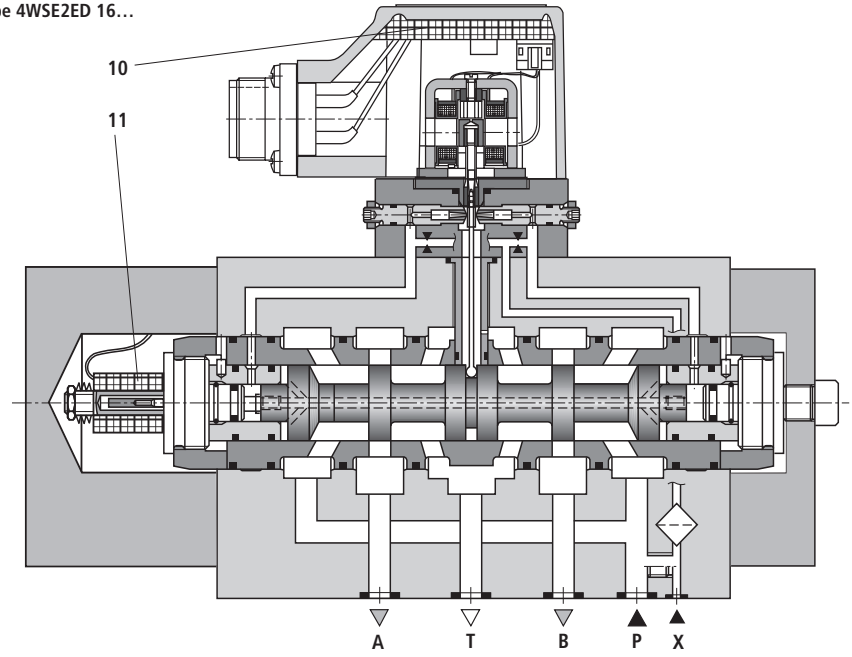
Type 4WS2EM 16 …

Section

Type 4WSE2EM 16…



Type 4WSE2ED 16…



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

General

Porting pattern			DIN 24 340 form A16
Installation			Optional, it has however to be ensured that, when the system is started, the pilot control is supplied with an adequate pressure (≥ 10 bar)!
Storage temperature range		°C	–20 to +80
Ambient temperature range		°C	–30 to +70, valve for external control electronics
			–20 to +60, valve with integrated control electronics
Weight	With mechanical feedback	kg	10.0
	With mechanical and electrical feedback and integrated control electronics	kg	11.0

Hydraulic (measured with a viscosity of $\nu = 32$ mm²/s and $\vartheta = 40$ °C)

Operating pressure (ports A, B, P, X)		bar	10 to 210 or 10 to 315	
Return pressure, port T		bar	Pressure peaks < 100, static < 10	
Pressure fluid			Mineral oil (HL, HLP) to DIN 51 524, other pressure fluids on request!	
Pressure fluid temperature range		°C	–20 to +80; preferably +40 to +50	
Viscosity range		mm²/s	15 to 380; preferably 30 to 45	
Degree of contamination			Maximum permissible degree of contamination of the pressure fluid	A filter with a minimum retention rate of $\beta_x \geq 75$ is recommended without bypass valve and fitted as close as possible in front of the servo valve
			Class 7	x = 5
Zero flow $q_{V,L}$ [1] (spool overlap "E") measured without a dither signal		L/min	$\leq \sqrt{\frac{p}{70}} \bullet 3.5$ L/min [2]	
Nominal flow $q_{V\,nom} \pm 10$ % [3] at a valve pressure differential $\Delta p = 70$ bar [4]		L/min	100	150 / 200
Pressure gain (spool overlap „E") at 1% change in stroke (starting from the hyd. zero point)		% von p	≥ 65	≥ 80 / ≥ 90
Control spool stroke		mm	0.6	0.9 / 1.2
Control spool area		mm²	78	
Feedback system			Mechanical (M)	Mechanical and electrical (D)
Hysteresis (dither optimised)		%	≤ 1.5	≤ 0.5
Reversal range (dither optimised)		%	≤ 0.3	≤ 0.2
Response sensitivity (dither optimised)		%	≤ 0.2	≤ 0.1
Zero balance		in % von I_{nom}	≤ 3	≤ 2
Zero offset at change in:				
	Pressure fluid temperature	%/20 °K	≤ 1.5	≤ 1.2
	Ambient temperature	%/20 °K	≤ 1	≤ 0.5
	Operating pressure	%/100 bar	≤ 2	≤ 1
	Return pressure 0 to 10 % of p	%	≤ 1	≤ 0.5

[1] $q_{V,L}$ = Zero flow in L/min
[2] p = Operating pressure in bar
[3] $q_{V\,nom}$ = Nominal flow (complete valve) in L/min
[4] Δp = Valve pressure differential in bar

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

Electrical

Feedback system		Mechanical (M)	Mechanical and electrical (D)
Valve protection to EN 60 529		IP65	
Signal type		Analogue	
Nominal current per coil	mA	50	–
Resistance per coil	Ω	85	–
Inductivity at 60 Hz and 100% nominal current:			
Series circuit	H	0.96	–
Parallel circuit	H	0.24	–
Recommended dither signal: f = 400 Hz		The amplitude value is dependent on the hydraulic system: a max. 5 % vom of the nominal current	

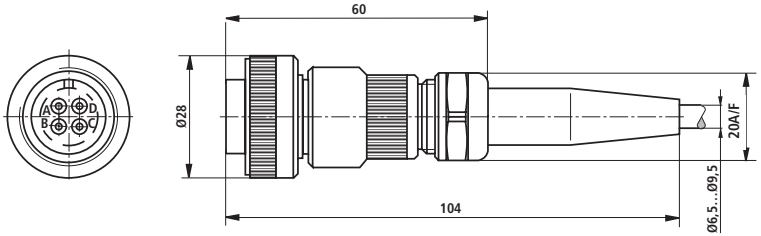
Electrical, external control electronics

Amplifier in (separate order) eurocard format	Type VT-SR2, to catalogue sheet RE 29 980

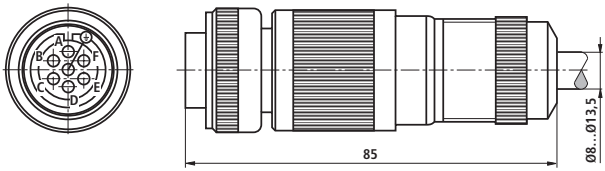
Note: For details regarding the **environmental simulation test** covering EMC (electro-magnetic compatibility), climate and mechanical loading see RE 29 591-U (declaration regarding environmental compatibility).

Plug-in connector

Plug-in connector version **K8** (external control electronics) to
VG 095 342 – separate order under Material No. **00002460**



Plug-in connector version **K9** to E DIN 43 563-BF6-3/Pg11
separate order under Material No. **00223890**
(metal version)



Coil electrical connections in the component plug (for valves with external control electronics)

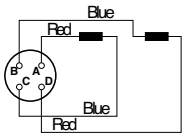
The electrical connections can be either in parallel or series. Due to operational safety considerations and the low spool inductivity, we recommend a parallel circuit.

Parallel circuit: In the plug connect contacts A with B and C with D.

Series circuit: In the plug connect contacts B with C.

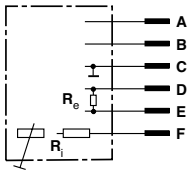
Electrical control from A (+) to D (–) results in a flow direction from P to A and B to T. Reversed electrical control results in a flow direction of P to B and A to T.

4 WS 2 EM 16-2X/...



Connection cable:
4-core, 0.75 mm², screened (e.g. cable type LiYCY 4x0.75mm²)
Outside diameter 6.5 to 9.5 mm
Only connect the screen to the supply side.

Terminal connections 4 WSE2E .16. (valves with integrated control electronics)



	Terminal connections	Current input signal	Voltage input signal
		Control "**8**"	Control "**9**"
Supply voltage (± 3 %)	A	+ 15 V	+ 15 V
	B	– 15 V	– 15 V
	C	⊥	⊥
Command value	D	± 10 mA;	± 10 V
	E	R_e = 1 kΩ	R_e ≥ 50 kΩ
Measuring output for the control spool	F [1]	Nom. stroke corresponds to approx. ± 10 V with respect to ⊥ ; R_i = 1 kΩ	
Current consumption at plug terminal	A	Max. 150 mA	Max. 150 mA
	B		
	D	± 10 mA	≤ 0.2 mA
	F		

[1] For valves without electrical feedback terminal F is not connected.

Supply voltage: ± 15 V ± 3 %, residual ripple < 1 %

Command value: A command value at plug connection D = negative with respect to the plug connection E results in a flow from P to B and A to T.

Measurement output F has a negative signal with respect to ⊥ .

A command value at plug connection D = positive with respect to the plug connection E results in a flow from P to A and B to T.

Measurement output F has a positive signal with respect to ⊥ .

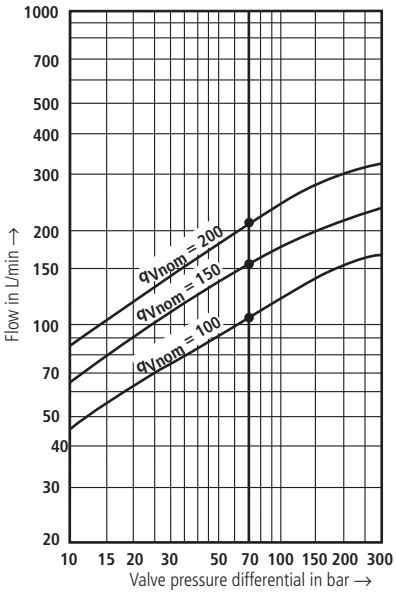
Measurement output: The voltage signal U_F is proportional to the spool stroke.

Note: Electrical signals (e. g. actual value) taken via valve electronics must not be used to switch off the machine safety functions!

(Also see European standard "Safety requirements of fluid technology systems and components – hydraulics", prEN 982 !)

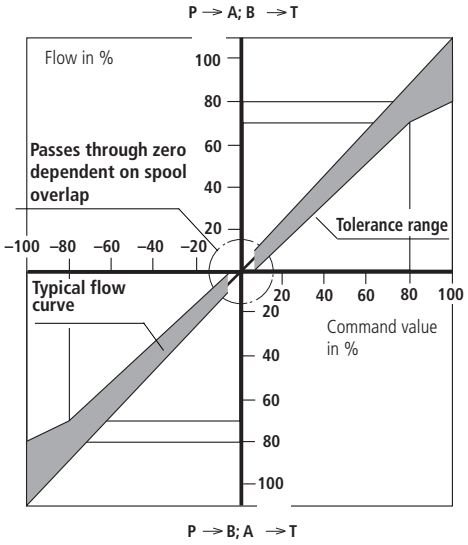
Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ± 10 %)
at 100 % command value signal



Δp = Valve pressure differential (input pressure minus the return pressure and minus the load pressure)

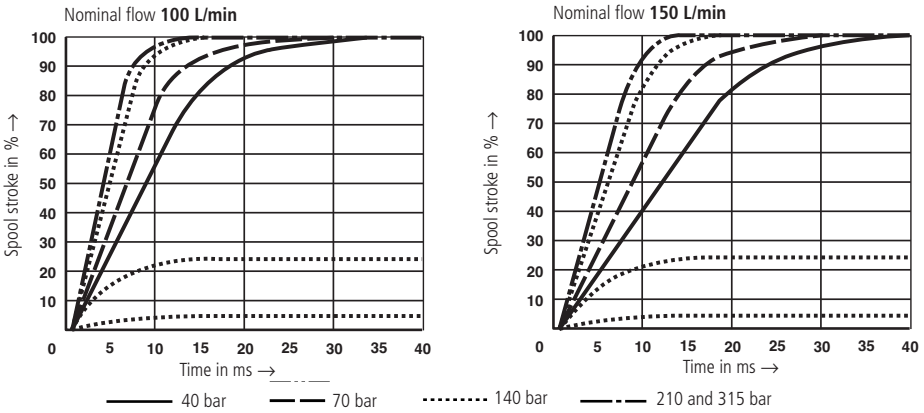
Tolerance range of flow/signal function
at constant valve pressue differential



Characteristic curves: type 4WS.2EM 16 (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

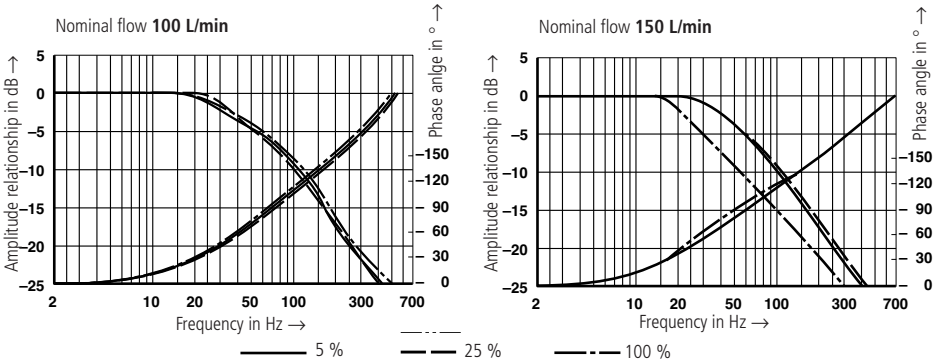
Transient function with a 315 bar pressure stage

Stop response without flow

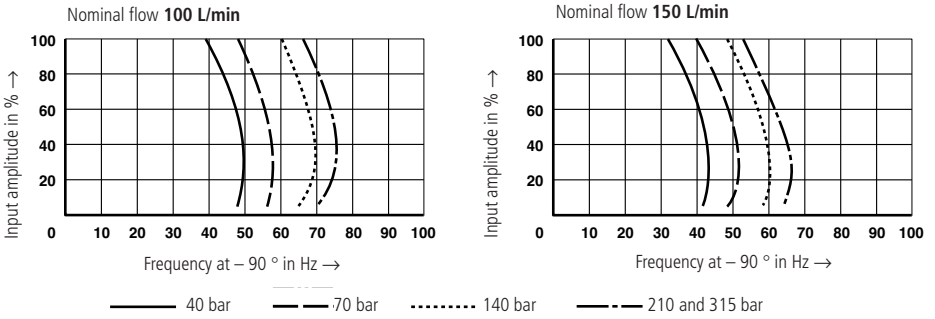


Frequency response with a 315 bar pressure stage, p = 315 bar

Stroke frequency response without flow



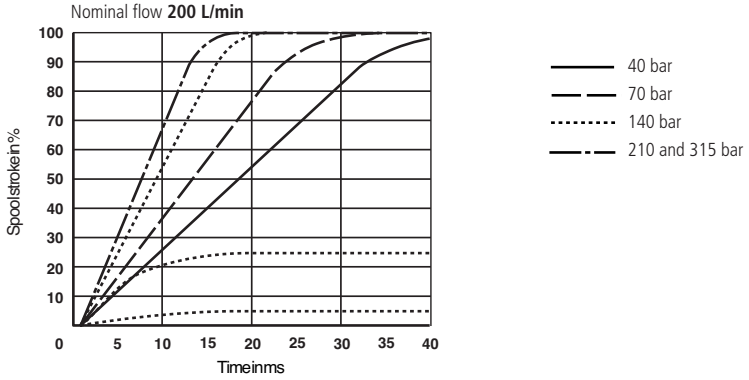
Relationship of the corner frequency to the operating pressure p



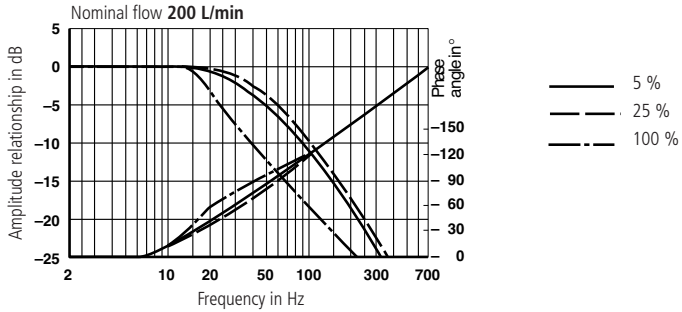
Output signal ≙ spool stroke without flow

Characteristic curves: type 4WS.2EM 16 (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

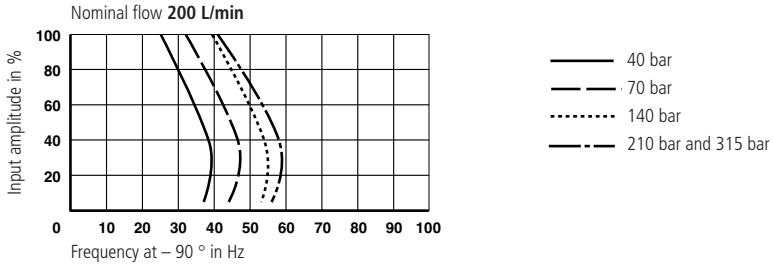
Transient function with a 315 bar pressure stage Step response without flow



Frequency response with a 315 bar pressure stage, p = 315 bar Stroke requency response without flow



Relationship of the corner frequency to the operating pressure p

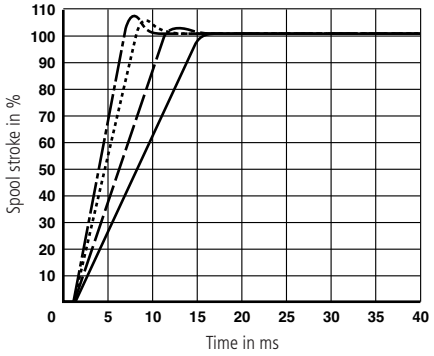


Output signal ≙ spool stroke without flow

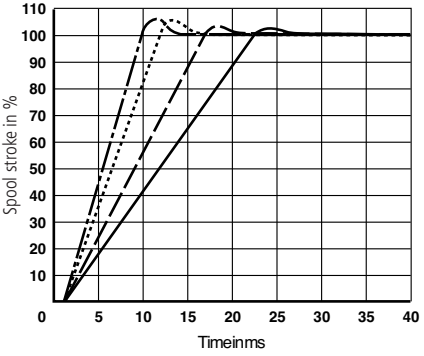
Characteristic curves: type 4WSE2ED 16 (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Transient function with a 315 bar pressure stage Step response without flow

Nominal flow **100 L/min**



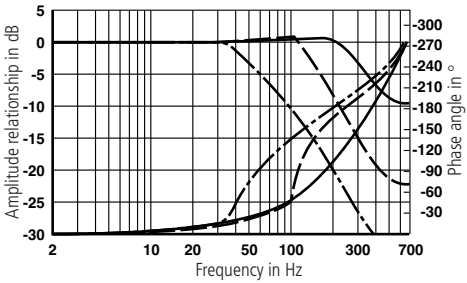
Nominal flow **150 L/min**



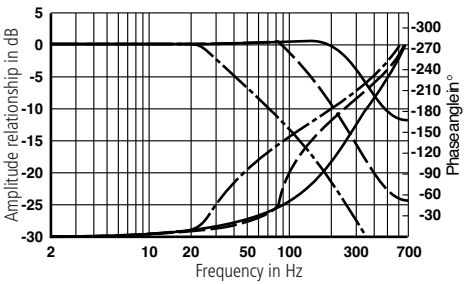
40 bar — 70 bar ····· 140 bar —·— 210 bar and 315 bar

Frequency response with a 315 bar pressure stage, p = 315 bar Stroke requency response without flow

Nominal flow **100 L/min**



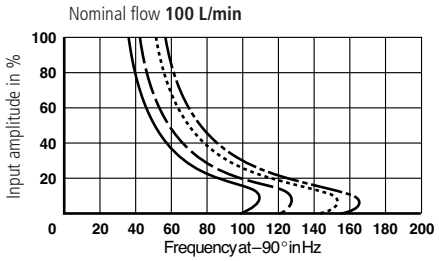
Nominal flow **150 L/min**



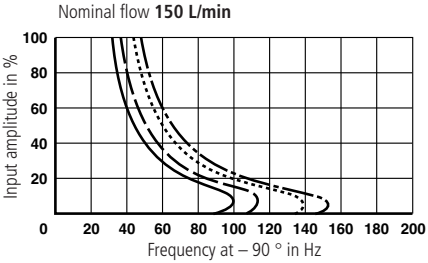
5 % — 25 % —·— 100 %

Relationship of the corner frequency to the operating pressure p

Nominal flow **100 L/min**



Nominal flow **150 L/min**

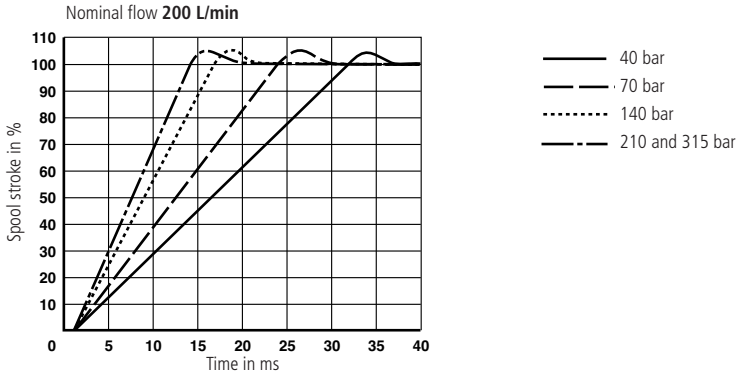


40 bar — 70 bar ····· 140 bar —·— 210 bar and 315 bar

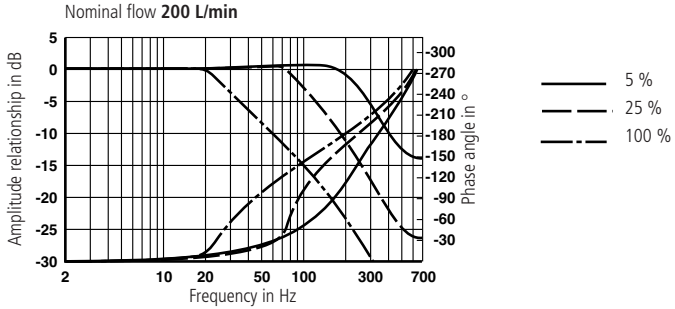
Output signal ≙ spool stroke without flow

Characteristic curves: type 4WSE2ED 16 (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

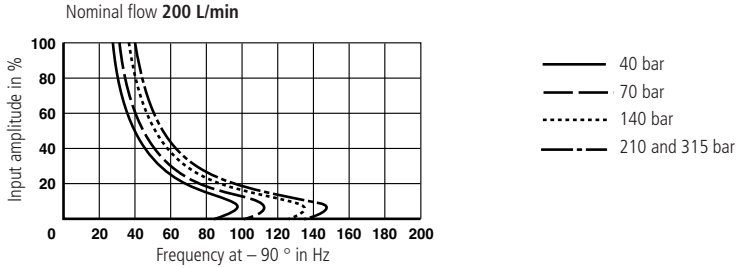
Transient function with a 315 bar pressure stage Step response without flow



Frequency response with a 315 bar pressure stage, p = 315 bar Stroke frequency response without flow

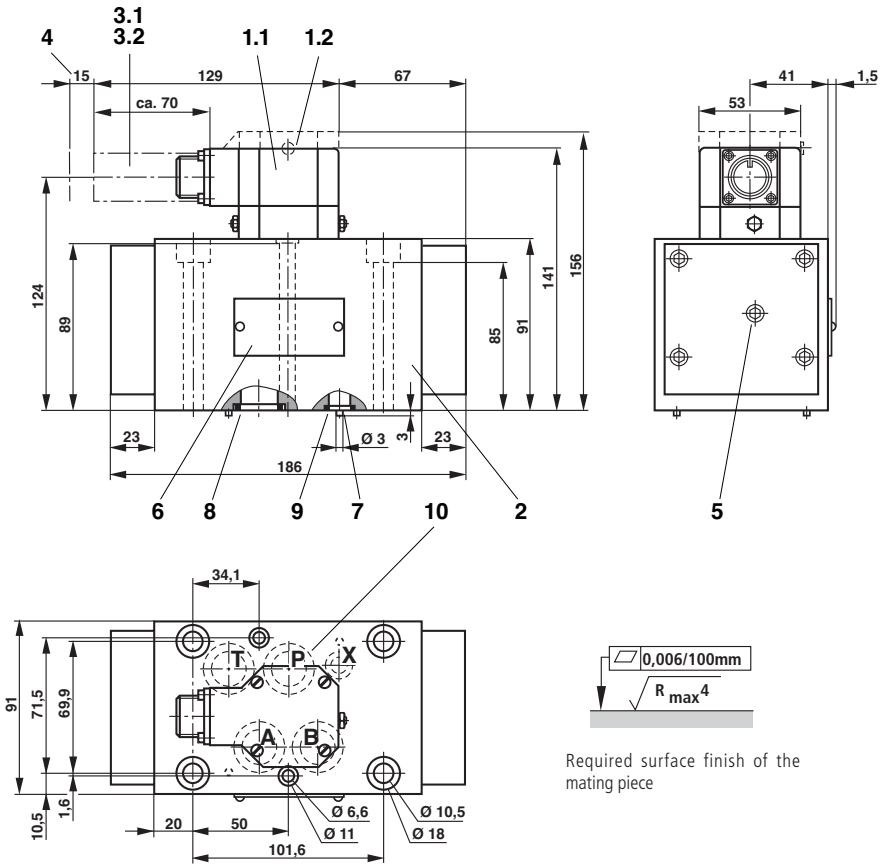


Relationship of the corner frequency to the operating pressure p



Output signal ≙ spool stroke without flow

Unit dimensions: type 4WS.2EM 16 (dimensions in mm)



Required surface finish of the mating piece

1.1 Pilot control (1st stage) **without** integrated control electronics (4 WS 2 EM 16)

1.2 Pilot control (1st stage) **with** integrated control electronics (4 WSE 2 EM 16)
Electrical zero point setting:
Having removed the plug (2.5A/F) the zero point may be corrected via the potentiometer.

2 2nd stage

3.1 **Without integrated electronics:**
4-pin plug-in connector compatible with VG 095 342

3.2 **With integrated electronics:**
6-pin plug-in connector compatible with VG 095 342

4 Space required to remove the plug-in connector, take the connection cable into account!

5 For setting the hydraulic zero point on both sides 5A/F internal hexagon

6 Name plate

7 Locating pin (2 off)

8 Identical seal rings for ports A, B, P and T

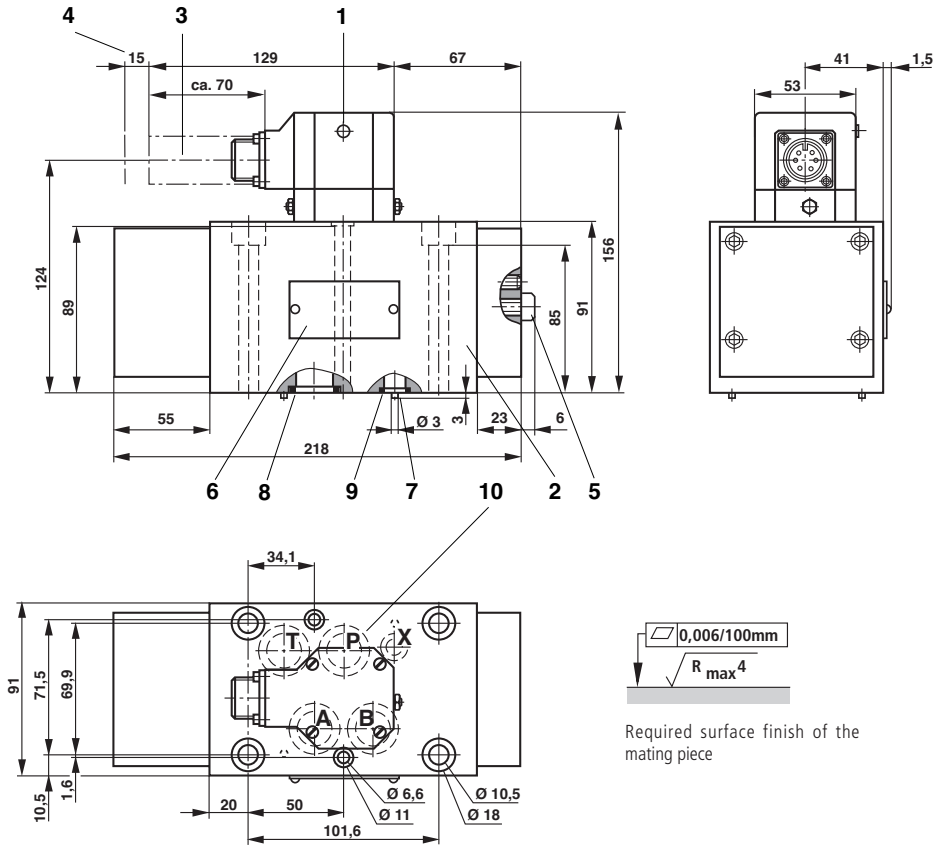
9 Seal ring for port X

10 Porting pattern to DIN 24 340, form A 16

Subplates G 172/01 (G 3/4)
G 174/01 (G 1); G 174/08 (flange)
to catalogue sheet RE 45 056 must be ordered separately.

Valve fixing screws are included within the scope of supply.
4 off M10 x 100 DIN 912-10.9; M_A = 75 Nm
2 off M6 x 100 DIN 912-10.9; M_A = 15.5 Nm

Unit dimensions: type 4WSE2ED 16 (dimensions in mm)



Required surface finish of the mating piece

1 Pilot control (1st stage) with integrated control electronics
Electrical zero point setting:
Having removed the plug (2.5A/F) the zero pont may be corrected via the potentiometer.

2 2nd stage

3 6-pin plug-in connector compatible to VG 095 342

4 Space required to remove the plug-in connector, take the connection cable into account!

5 Setting of hydraulic zero point via two screws 5A/F and 3A/F internal hexagon

6 Name plate

7 Locating pin (2 off)

8 Identical seal rings for ports A, B, P and T

9 Seal ring for port X

10 Porting pattern to DIN 24 340, form A 16

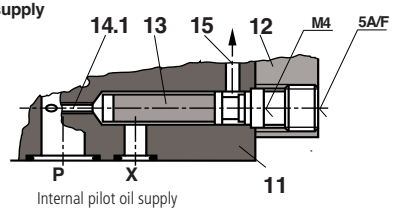
Subplates G 172/01 (G 3/4)
G 174/01 (G 1); G 174/08 (flange)
to catalogue sheet RE 45 056 must be ordered separately.

Valve fixing screws are included within the scope of supply.
4 off M10 x 100 DIN 912-10.9; M_A = 75 Nm
2 off M6 x 100 DIN 912-10.9; M_A = 15.5 Nm

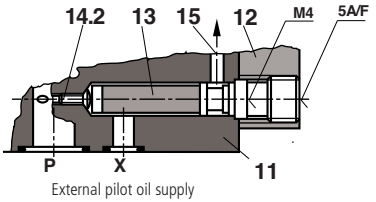
6

Pilot oil supply (pilot oil drain usually internal)

Pilot oil supply



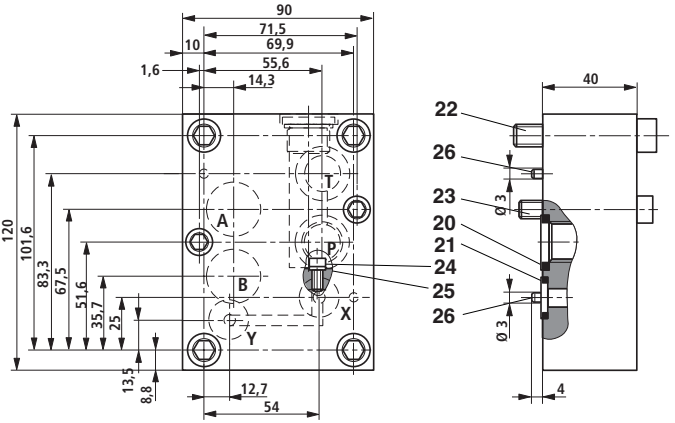
Internal pilot oil supply
(version **"ET"**)



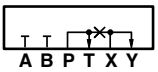
External pilot oil supply
(version **"T"**)

11 Main valve
12 Cover
13 Filter
Material No. **00649157**
14.1 Open
14.2 Closed
plug M6 x 10 DIN 906
15 For 1st stage

Flushing plate (dimensions in mm)



Symbol



With NBR seals
Material No. 00308493

20 Identical seal rings for ports A, B, P, T
21 Identical seal rings for ports X, Y
22 4 off S.H.C.S. M10 x 50 DIN 912–8.8
(are included within the scope supply); M_A = 51 Nm
23 2 off S.H.C.S. M6 x 50 DIN 912–8.8
(are included within the scope supply); M_A = 10,4 Nm
24 1 off S.H.C.S. M6 x 10 DIN 912–8.8
(are included within the scope supply)
25 Seal ring
26 Locating pin (2 off)

In order to ensure that the servo valves functions correctly it is always necessary to flush the system before commissioning As a guideline for the flushing time per system the following may be used:

$$t \geq \frac{V}{q_V} \cdot 5$$

t = Flushing time in hours
V = Tank contents in litres
q_V = Pump flow in litres per minute

If the tank is subsequently filled with more than 10 % of the tank contents then the flushing process must be repeated.

A directional valve with a porting pattern to DIN 24 340 form A 16 is more suitable than a flushing plate. The actuator lines can also be flushed using this valve.

Bosch Rexroth AG
Industrial Hydraulics
D-97813 Lohr am Main
Zum Eisengießer 1 • D-97816 Lohr am Main
Telefon 0 93 52 / 18-0
Telefax 0 93 52 / 18-23 58 • Telex 6 89 418-0
eMail documentation@boschrexroth.de
Internet www.boschrexroth.de

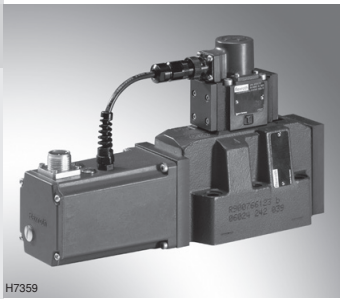
Bosch Rexroth Limited
Cromwell Road, St Neots,
Cambs, PE19 2ES
Tel: 0 14 80/22 32 56
Fax: 0 14 80/21 90 52
E-mail: info@boschrexroth.co.uk

Rexroth
Bosch Group

Directional servo-valve in 4-way version

RE 29620/03.12 1/14
Replaces: 04.08

Type 4WSE3E 16


H7359

Size 16
Component series 2X
Maximum operating pressure 350 bar
Maximum flow 570 l/min

Table of contents

Information on available spare parts:
www.boschrexroth.com/spc

Features

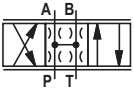
- Valve for position, force, pressure or velocity control
- 3-stage servo-valve with electrical position control of the control spool of the 3rd stage, position sensing of the control spool by means of an inductive position transducer
- High dynamics 2-stage pilot control valve of size 6
- 1st stage as nozzle flapper plate amplifier
- Filter for 1st stage externally accessible and replaceable
- Subplate mounting:
  Porting pattern according to ISO 4401
- Can also be used as 3-way version
- Valve and integrated control electronics are adjusted and tested in the factory
- Optimized valve control loop
- High response sensitivity, very low hysteresis and zero point drift
- Internal or external pilot oil supply and return
- Gap seals at pressure chambers of the control sleeve, no wear of O-ring

Ordering code

4WSE3E 16 | | | | −2X/ | | / K31 | | *

3-stage servo-valve

Size
Size 16 **= 16**

Control spool symbol [1]


= V
= V1

Control spool position in de-energized state
Not defined **= no code**
100 % P → A / B → T **= P**

Rated flow [2]
105 l/min **= 100**
150 l/min **= 150**
200 l/min **= 200**
260 l/min **= 300**

Control spool overlap [3]
0 to 0.5 % positive **= D**
0 to 0.5 % negative **= E**

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

Seal material [4]
FKM seals **= V**
NBR seals **= M**

Further details in the plain text

Electronics interface command/actual value
A1 = 0 to 10 V
C1 = 0 to 10 mA
F1* = 4 to 20 mA

Electrical connection
K31 = 6+PE
Without mating connector

Supply voltage
15 = ±15 V
24 = +24 V
See page 6

Pressure rating [6]
7 = 210 bar
9 = 315 bar

Pilot flow [5]
XY = Pilot oil supply external, return external
XT = Pilot oil supply external, return internal
PY = Pilot oil supply internal, return external
PT = Pilot oil supply internal, return internal

* Only with +24 V supply voltage

[1] **Control spool symbols**
with control spool symbol V
P → A: $q_{V\,max}$ B → T: $q_{V\,max}$
P → B: $q_{V\,max}$ A → T: $q_{V\,max}$
with control spool symbol V1
P → A: $q_{V\,max}$ B → T: q_V / 2
P → B: q_V / 2 A → T: $q_{V\,max}$

[2] **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed.
A possible rated flow tolerance of ±10 % and a saturation influence must be taken into account (see flow/signal function page 8).

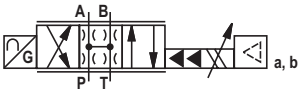
[3] **Control spool overlap**
The control spool overlap in % is referred to the nominal stroke of the control spool.
(Other control spool overlaps upon request.)

[4] **Seal material**
See notices on page 5

[5] **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

[6] **Inlet pressure range**
Care should be taken that the inlet pressure is as constant as possible. Minimum control pressure ≥ 10 bar.
Up to a pilot pressure of 210 bar, pressure rating 7 is to be selected. From a pilot pressure greater than 210 bar, pressure rating 9 is to be selected.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.
At an inlet pressure > 40 bar, the control pressure must not be less than 60 % of the inlet pressure as otherwise the current forces at the control spool of the 3rd stage will impair the controllability.
At an inlet pressure ≤ 40 bar working with a control pressure above port X (external supply) is in any case advantageous.

Symbol



Function, section

The valves of type 4WSE3E 16 are electrically operated, 3-stage directional servo-valves. They are mainly used for position, force or pressure and velocity controls.

These valves consist of a 2-stage pilot control valve of type 4WS2EM 6 (1), a main stage with a main control spool in a sleeve (2), an inductive position transducer (3), and the integrated control electronics (4).

The pilot control valve (1) consists of an electro-mechanical transformer (torque motor), a hydraulic amplifier (nozzle flapper plate principle) and a pilot control spool in a sleeve, which is connected to the torque motor via a mechanical feedback.

Electric currents in the coils of the torque motor generate a force by means of a permanent magnet which acts on the armature, and in connection with a torque tube results in a torque. This causes the flapper plate which is connected to the torque tube via a pin to move from the central position between the two control nozzles, and a pressure differential is created across the front sides of the pilot control spool. The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

The pilot control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback).

The position of the control spool is changed until the flapper plate position and hence the pressure differential across the nozzle flapper plate system becomes zero due to the feedback torque, which acts via the bending spring against the electro-magnetic torque of the torque motor.

In doing so, the stroke of the pilot control spool and hence the flow of the pilot control valve is controlled proportionally to the electrical input signal (see data sheet 29564).

In the main stage, the main control spool (2) is operated by the pilot control valve and its position is sensed by an inductive position transducer (3). The position transducer signal is compared to the command value by integrated control electronics (4). Any possible control deviation is amplified electrically and fed to the pilot control valve as control signal. The pilot control valve starts to move and the main control spool is re-positioned.

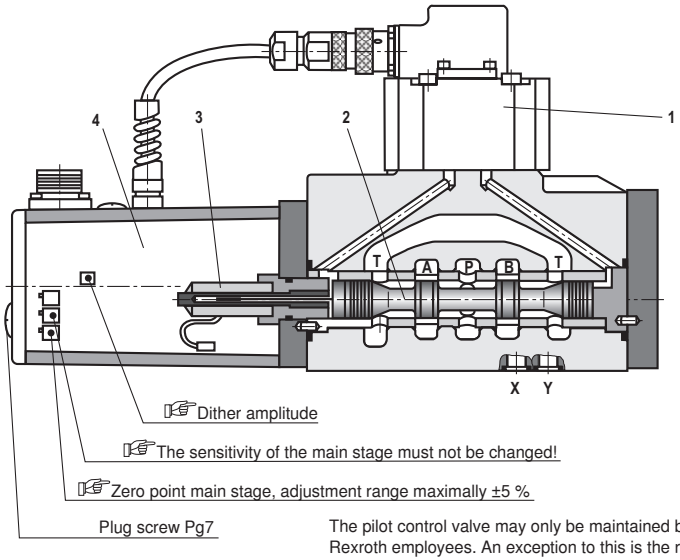
The stroke of the main control spool and consequently the flow of the servo-valve are controlled in proportion to the command value. It must be noted that the flow depends on the valve pressure differential.

The valve zero point can be adjusted by means of an externally accessible potentiometer.

The valves are factory-set with a dither default setting with the constant frequency of 400 Hz.

☞ **Notice!**

Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.



The pilot control valve may only be maintained by Bosch Rexroth employees. An exception to this is the replacement of the filter element – see data sheet 29564.

6

Technical data (For applications outside these parameters, please consult us!)

general

Weight		kg	9.5
Installation position			Any, if it is ensured that the pilot control is supplied with sufficient pressure (> 10 bar) during start-up of the system. In case of insufficient pressure supply, the control spool of the servo-valve can take any position. This may result in channel P being connected to the actuator and the build-up of pressure being delayed. This may be prevented by providing an external pressure supply at port X.
Storage temperature range		°C	–20 to +80
Ambient temperature range		°C	–20 to +60

hydraulic (measured with HLP 32, ϑ_{Oil} = 40 °C ± 5 °C)

Maximum operating pressure	Pilot control stage, pilot oil supply X		bar	10 to 210 and/or 10 to 315 (see page 2, pressure rating)
	Main valve, port P, A, B	Pilot oil supply internal	bar	315
	Main valve, port P, A, B	Pilot oil supply external	bar	350
Maximum return flow pressure	Pilot control stage, port Y		bar	Pressure peaks < 100 admissible, static < 10
	Main valve, port T	Pilot oil return internal	bar	Pressure peaks < 100 admissible, static < 10
		Pilot oil return external	bar	250
Zero flow				See page 9 (characteristic curves)
Rated flow q_{Vnom} ±10 % with Δp = 70 bar			l/min	105, 150, 200, 260
Hydraulic fluid				See table page 5
Hydraulic fluid temperature range			°C	–20 to +80; preferably +40 to +50
Viscosity range			mm^2/s	15 to 380; preferably 30 to 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Pilot control valve	Class 18/16/13 [1]
			Main stage	Class 20/18/15 [1]
Hysteresis			%	≤ 0.10
Range of inversion			%	≤ 0.05
Response sensitivity			%	≤ 0.05
Pressure gain				≥ 90 % of p_P [2] with 1 % change in the control spool stroke (from hydraulic zero point)
Zero shift upon change of:	Hydraulic fluid temperature		% / 10 K	≤ 0.3
	Ambient temperature		% / 10 K	≤ 0.3
	Operating pressure		% / 100 bar	≤ 0.3
	Return flow pressure 0 to 10 % of p_P		% / 100 bar	≤ 0.3

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.
For the selection of the filters see www.boschrexroth.com/filter

[2] p_P = Inlet pressure/operating pressure

Notice!
For information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 29620-U.

Technical data (For applications outside these parameters, please consult us!)

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons	HL, HLP	NBR, FKM	DIN 51524
Flame-resistant – containing water	HFC Fuchs Hydrotherm 46M Petrofer Ultra Safe 620	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, service life, maintenance intervals, etc.)!
- **Flame-resistant – containing water**:

  Maximum pressure differential per control edge 210 bar, otherwise, increased cavitation erosion!
  Tank pre-loading < 1 bar or > 20 % of the pressure differential of the tank edge. The pressure peaks should not exceed the maximum operating pressures!

  Maximum fluid temperature 60 °C

Technical data (For applications outside these parameters, please consult us!)

electric

Protection class according to EN 60529	IP 65 with mating connector mounted and locked
Type of signal	Analog

Electronics interface		**A1**	**C1**	**F1**
Current consumption at the mating connector	Pin			
	A	< ±150 mA with ±15 V < 200 mA with 24 V		< 200 mA with 24 V
	B			
	D	0 to ±0.05 mA	0 to ±10 mA	4 to 20 mA
	E			

Device connector allocation	**Pin**	**Supply voltage 15**		**Supply voltage 24**		
Interface		A1	C1	A1	C1	F1
Supply voltage	A	+15 VDC		+24 VDC		
	B	–15 VDC		0 VDC		
M0	C	0 VDC / reference to pins A, B		Not used		
Differential command value input	D	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	4 to 20 mA R_e = 100 Ω
	E					
Actual value Reference with +24 V is pin B Reference with ±15 V is pin C	F	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	4 to 20 mA Load max. 500 Ω
Protective earth	PE	Connected to valve housing				

☞**One end of the shield must be connected to the control!**

Supply voltage: ±15 V ±3 %, residual ripple < 1 %
+24 VDC / 18 V to 35 V; full bridge rectification with smoothing capacitor
2200 µF = I_{max} = 230 mA

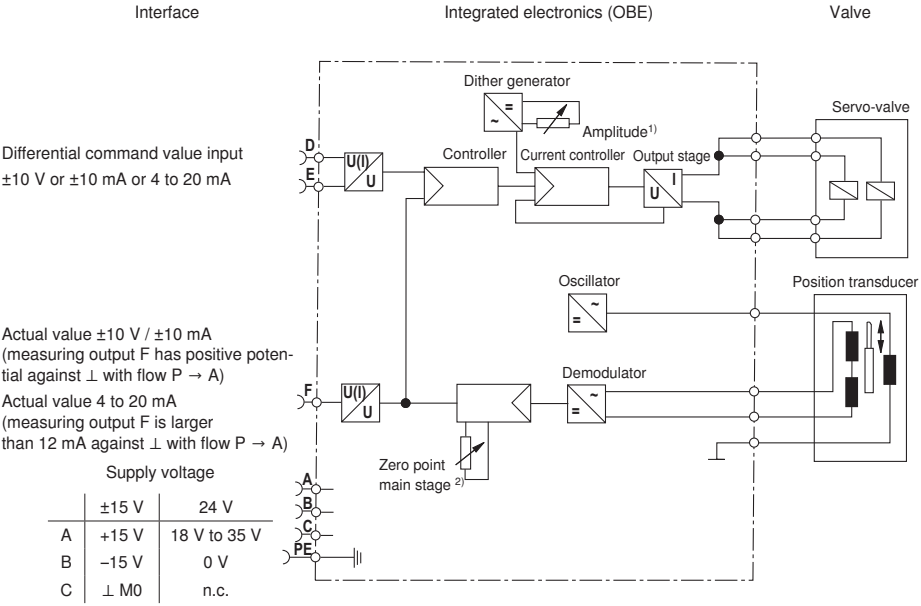
Command value: **A1, C1:**
Reference potential at E and positive command value at D result in flow from P → A and B → T.
Reference potential at E and negative command value at D result in flow from P → B and A → T.
F1:
Reference potential at E and signal 12 to 20 mA at D result in flow from P → A and B → T.
Reference potential at E and signal 12 to 4 mA at D result in flow from P → B and A → T.

Actual value / measuring output: The voltage / current signal is proportional to the control spool stroke and has the same sign as the command value.

Connection cable: Recommendation: – up to 25 m line length: Type LiYCY 7 x 0.75 mm²
– up to 50 m line length: Type LiYCY 7 x 1.0 mm²
Only connect the shield to ⊥ on the supply side.

Notice: **Electric signals taken out via valve electronics (e.g. actual value) must not be used for switching off safety-relevant machine functions!**

Block diagram of the integrated electronics (OBE)



	±15 V	24 V
A	+15 V	18 V to 35 V
B	−15 V	0 V
C	⊥ M0	n.c.

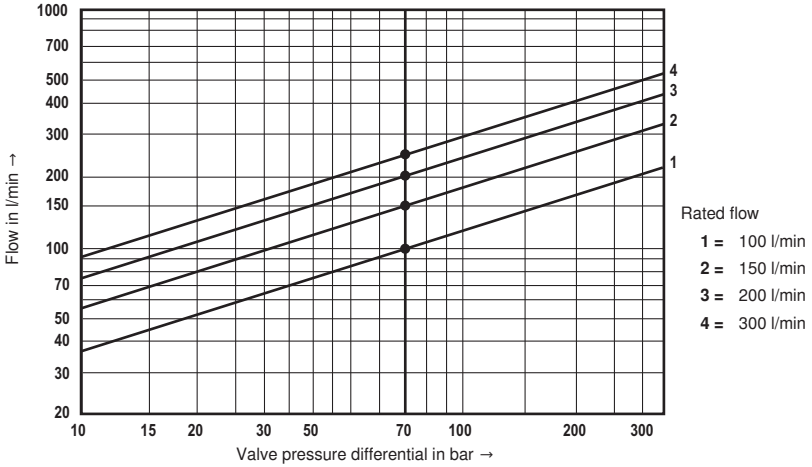
1) 2)

☞ **Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.**

6

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

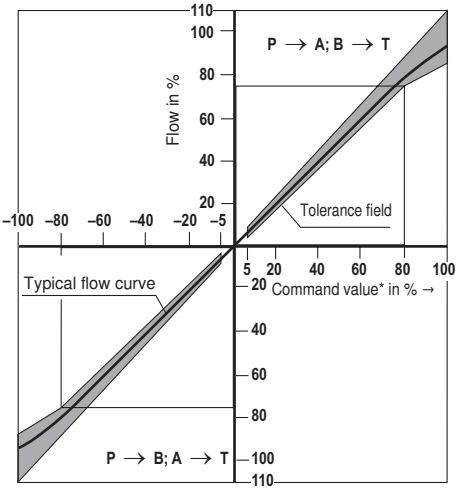
Flow/load function (tolerance ±10 %) with 100 % command value signal



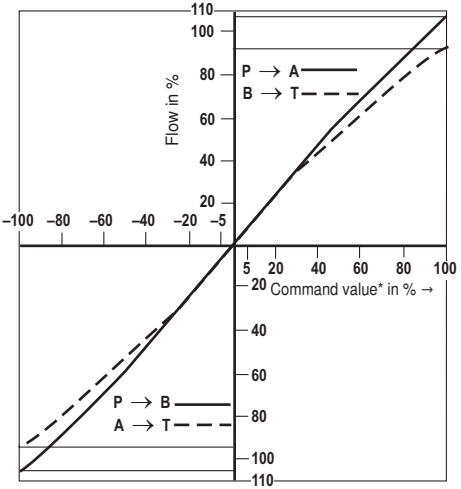
Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function at constant valve pressure differential

Summated edge Δp_V = 70 bar



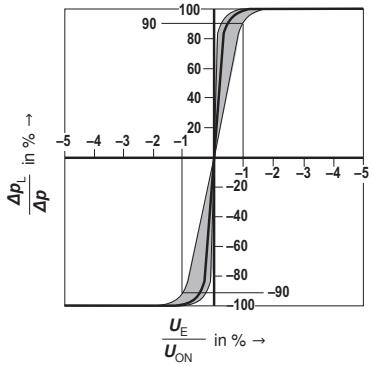
Single edge Δp_V = 35 bar (tolerance ±5 %)



* With interface F1, the negative command value axis corresponds to 4 to 12 mA, the positive command value axis to 12 to 20 mA

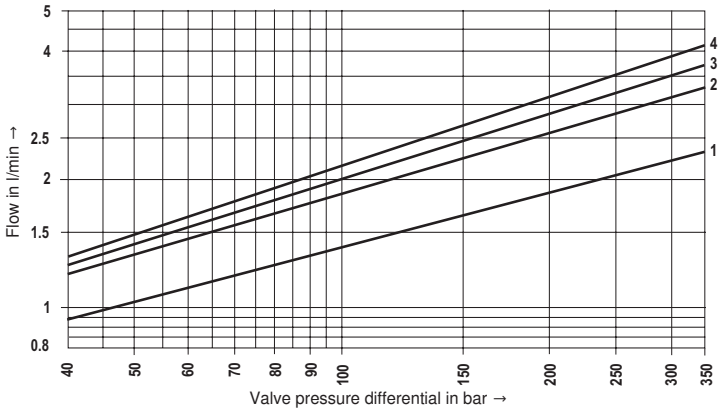
Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Pressure signal characteristic curve



Measured at
280 bar operating pressure

Zero flow total with "D" overlap (pilot control valve and main stage)
Tolerance ±20 %



1 = 100 l/min
2 = 150 l/min
3 = 200 l/min
4 = 300 l/min

Zero flow Data valid for overlap "E"	Pilot control valve L1	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.5$
	Overall valve q_V	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.015 \cdot q_{Vnom}$

q_{Vnom} Rated flow (overall valve) in l/min
105, 150, 200, 260

p_P Operating pressure in bar

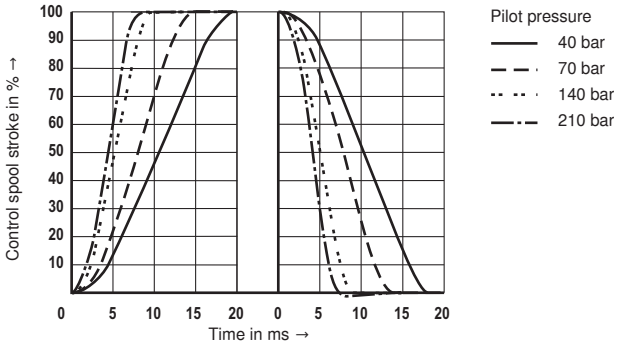
Δp Valve pressure differential in bar

q_V 100, 150, 200, 300 l/min

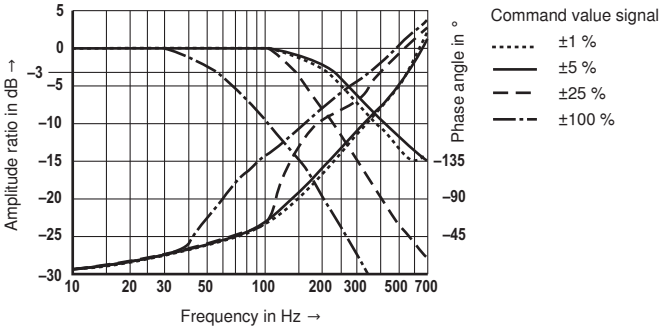
6

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

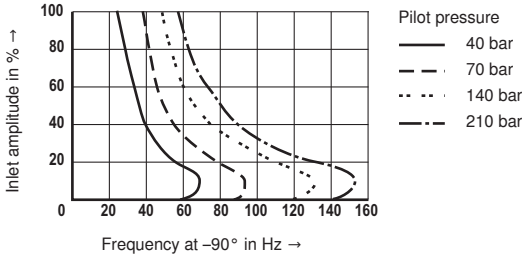
Transition function – measured with 210 bar pressure rating



Frequency response at p_P = 210 bar – measured with 210 bar pressure rating

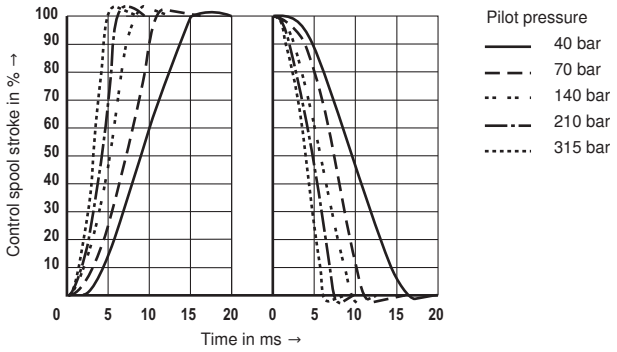


Dependence of the –90° frequency on the pilot pressure – measured with 210 bar pressure rating

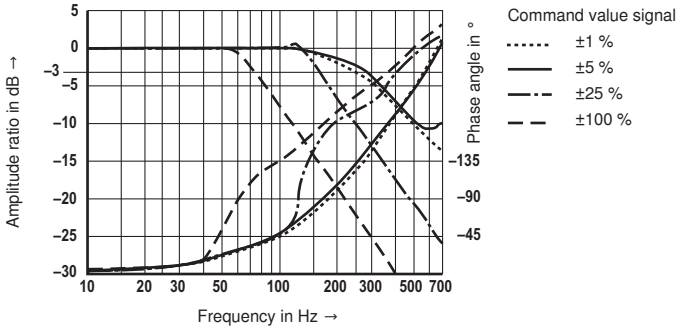


Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

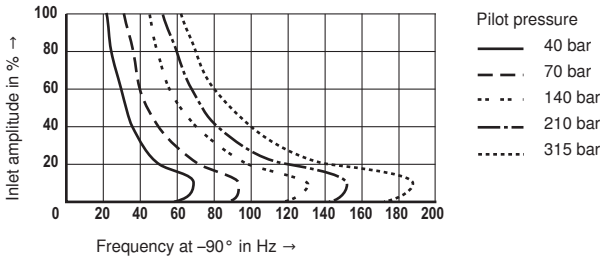
Transition function – measured with 315 bar pressure rating



Frequency response at p_P = 315 bar – measured with 315 bar pressure rating

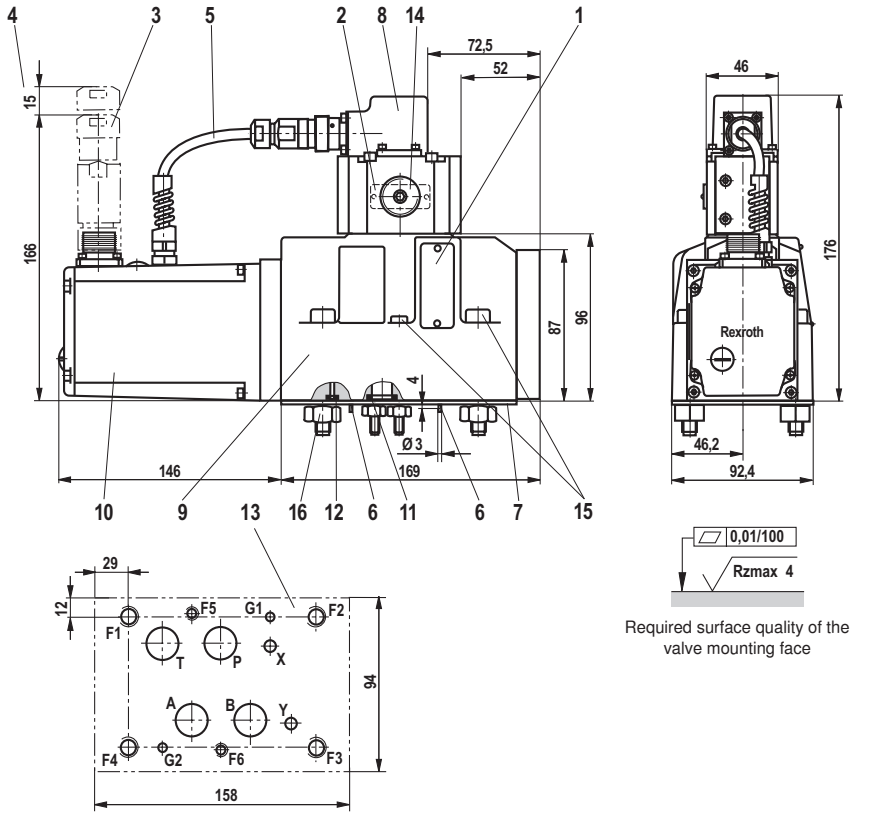


Dependence of the –90° frequency on the pilot pressure – measured with 315 bar pressure rating



Output signal corresponds to control spool stroke without flow

Unit dimensions: Type 4WSE3E 16 (dimensions in mm)



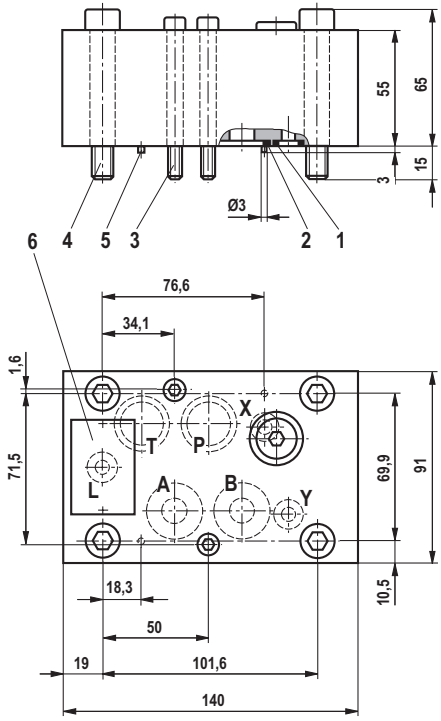
Required surface quality of the valve mounting face

1 Name plate – overall valve
2 Name plate – pilot control valve
3 Mating connector according to EN 175201-804, separate order, see page 13
4 Space required to remove the mating connector, take connection cable into account!
5 PVC cable not resistant when in contact with HFD-R fluid
6 Locating pin (2 units) G1 and G2
7 Cover plate (for transport only)
8 Pilot control valve (2-stage)
9 Main stage (3rd stage)
10 Integrated control electronics
11 Identical seal rings for ports A, B, P, and T
12 Identical seal rings for ports X and Y
The ports X and Y are also pressurized in the case of "internal" pilot oil supply
13 Machined valve mounting face, porting pattern according to ISO 4401-07-07-0-05
14 Exchangeable filter element with seal, material no. **R961000194**
15 Valve mounting screws
16 Hexagon nuts (for transport only)

Hexagon socket head cap screws (included in the delivery)		**Material number**
Size 16	2x ISO 4762 - M6 x 60 - 10.9-flZn-240h-L Tightening torque M_A = 12.5 Nm ±10 % 4x ISO 4762 - M10 x 60 - 10.9-flZn-240h-L Tightening torque M_A = 58 Nm ±10 %	R913000115 R913000116

Notice: The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Flushing plate with porting pattern according to ISO 4401-07-07-0-05 (dimensions in mm)



1 R-ring 10 x 2 x 2 (L, X, Y) included in scope of delivery

2 R-ring 22.53 x 2.30 x 2.62 (P, T, A, B) included in scope of delivery

3 2 hexagon socket head cap screws (included in the scope of delivery)
ISO4762-M6x70-10.9flZn-240h-L
(friction coefficient 0.09 to 0.14 according to VDA 235-101)
M_A = 15.5 Nm ±20 %
Material no. **R913000282**

4 4 hexagon socket head cap screws (included in the scope of delivery)
ISO4762-M10x70-10.9flZn-240h-L
(friction coefficient 0.09 to 0.14 according to VDA 235-101)
M_A = 75 Nm ±20 %
Material no. **R913000126**

5 2 locating pins 3 x 8 - A2C DIN EN 28741

6 Name plate

To ensure proper functioning of the servo-valves, it is necessary to flush the system before commissioning.

The following values are guidelines for the flushing time per system:

$$t \geq \frac{V}{q_V} \cdot 5$$

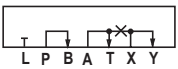
t = Flushing time in hours
V = Tank capacity in liters
q_V = Pump flow in liters per minute

When topping up more than 10 % of the tank capacity, the flushing procedure must be repeated.

The use of a directional valve with port in accordance with ISO 4401-07-07-0-05 is better suited than a flushing plate. With this valve, you can also flush the actuator ports.

Symbols

with FKM seals,
material no. **R900904218**
Weight: 4.75 kg



with FKM seals,
material no. **R900959376**
(without fig.)
Weight: 4.5 kg

6

Accessories (not included in the scope of delivery)

Mating connectors		Material number
Mating connector for servo-valve	DIN EN 175201-804, see data sheet 08006	R900223890 (metal)

Subplates	Data sheet
Size 16	45056

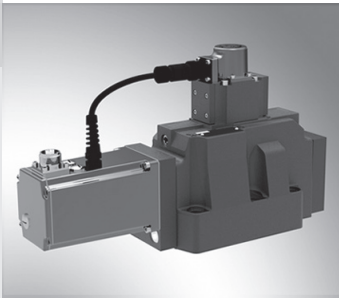
Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Directional servo-valve in 4-way version

RE 29621/03.12 1/14
Replaces: 05.09

Type 4WSE3E 25



Size 25
Component series 3X
Maximum operating pressure 350 bar
Maximum flow 1020 l/min

Table of contents

Information on available spare parts:
www.boschrexroth.com/spc

Features

- Valve for position, force, pressure or velocity control
- 3-stage servo-valve with electrical position control of the control spool of the 3rd stage, position sensing of the control spool by means of an inductive position transducer
- High dynamics 2-stage pilot control valve of size 6
- 1st stage as nozzle flapper plate amplifier
- Filter for 1st stage externally accessible and replaceable
- Subplate mounting:
  Porting pattern according to ISO 4401
- Can also be used as 3-way version
- Valve and integrated control electronics are adjusted and tested in the factory
- Optimized valve control loop
- High response sensitivity, very low hysteresis and zero point drift
- Internal or external pilot oil supply and return
- Gap seals at pressure chambers of the control sleeve, no wear of O-ring

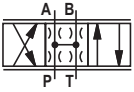
Ordering code

4WSE3E	25					3X	/		/	K31		*

3-stage servo-valve

Size
Size 25 **= 25**

Control spool symbol [1]



= V
= V1

Control spool position in de-energized state
Not defined **= no code**
100 % P → A / B → T **= P**

Rated flow [2]
210 l/min **= 200**
300 l/min **= 300**
380 l/min **= 400**
450 l/min **= 500**

Control spool overlap [3]
0 to 0.5 % positive **= D**
0 to 0.5 % negative **= E**

Component series 30 to 39 **= 3X**
(30 to 39: Unchanged installation and connection dimensions)

Seal material [4]
FKM seals **= V**
NBR seals **= M**

Further details in the plain text

Electronics interface command/actual value
A1 = 0 to 10 V
C1 = 0 to 10 mA
F1* = 4 to 20 mA

Electrical connection
K31 = 6+PE
Without mating connector

Supply voltage
15 = ±15 V
24 = +24 V
See page 6

Pressure rating [6]
7 = 210 bar
9 = 315 bar

Pilot flow [5]
XY = Pilot oil supply external, return external
XT = Pilot oil supply external, return internal
PY = Pilot oil supply internal, return external
PT = Pilot oil supply internal, return internal

* Only with +24 V supply voltage

[1] **Control spool symbols**
with control spool symbol V
P → A; $q_{V\,max}$ B → T; $q_{V\,max}$
P → B; $q_{V\,max}$ A → T; $q_{V\,max}$
with control spool symbol V1
P → A; $q_{V\,max}$ B → T; q_V / 2
P → B; q_V / 2 A → T; $q_{V\,max}$

[2] **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed.
A possible rated flow tolerance of ±10 % and a saturation influence must be taken into account (see flow/signal function page 8).

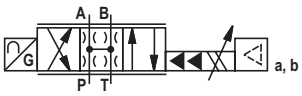
[3] **Control spool overlap**
The control spool overlap in % is referred to the nominal stroke of the control spool.
(Other control spool overlaps upon request.)

[4] **Seal material**
See notice on page 5

[5] **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

[6] **Inlet pressure range**
Care should be taken that the inlet pressure is as constant as possible. Minimum pilot pressure ≥ 10 bar.
Up to a pilot pressure of 210 bar, pressure rating 7 is to be selected. From a pilot pressure greater than 210 bar, pressure rating 9 is to be selected.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.
At an inlet pressure > 40 bar, the pilot pressure must not be less than 60 % of the inlet pressure as otherwise the current forces at the control spool of the 3rd stage will impair the controllability.
At an inlet pressure ≤ 40 bar, working with a pilot pressure above port X (external supply) is in any case advantageous.

Symbol



Function, section

Valves of type 4WSE3E 25 are electrically operated, 3-stage directional servo-valves. They are mainly used for position, force or pressure and velocity controls.

These valves consist of a 2-stage pilot control valve of type 4WS2EM 6 (1), a main stage with a main control spool in a sleeve (2), an inductive position transducer (3), and integrated control electronics (4).

The pilot control valve (1) consists of an electro-mechanical transformer (torque motor), a hydraulic amplifier (nozzle flapper plate principle) and a pilot control spool in a sleeve, which is connected to the torque motor via a mechanical feedback.

Electric currents in the coils of the torque motor generate a force by means of a permanent magnet which acts on the armature, and in connection with a torque tube results in a torque. This causes the flapper plate which is connected to the torque tube via a pin to move from the central position between the two control nozzles, and a pressure differential is created across the front sides of the pilot control spool. The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

The pilot control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback).

The position of the control spool is changed until the flapper plate position and hence the pressure differential across the nozzle flapper plate system becomes zero due to the feedback torque, which acts via the bending spring against the electro-magnetic torque of the torque motor.

In doing so, the stroke of the pilot control spool and hence the flow of the pilot control valve is controlled proportionally to the electrical input signal (see data sheet 29564).

In the main stage, the main control spool (2) is operated by the pilot control valve and its position is sensed by an inductive position transducer (3). The position transducer signal is compared to the command value by integrated control electronics (4). Any possible control deviation is amplified electrically and fed to the pilot control valve as control signal. The pilot control valve starts to move and the main control spool is re-positioned.

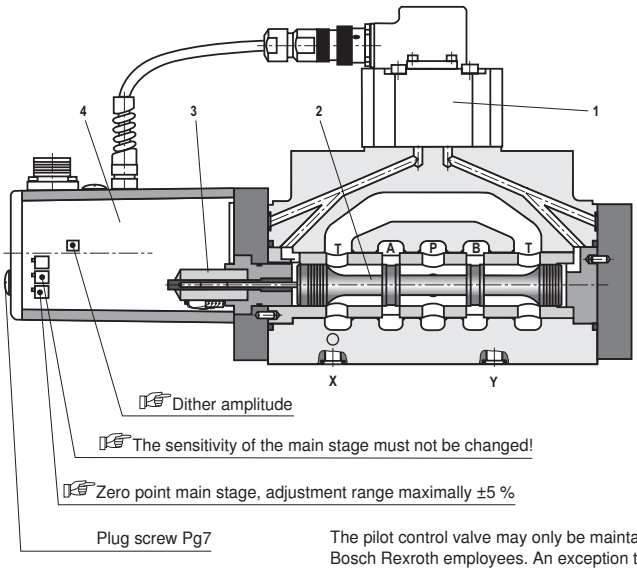
The stroke of the main control spool and consequently the flow of the servo-valve are controlled in proportion to the command value. It must be noted that the flow depends on the valve pressure differential.

The valve zero point can be adjusted by means of an externally accessible potentiometer.

The valves are factory-set with a dither default setting with the constant frequency of 400 Hz.

☞ **Notice!**

Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.



The pilot control valve may only be maintained by Bosch Rexroth employees. An exception to this is the replacement of the filter element – see data sheet 29564.

6

Technical data (For applications outside these parameters, please consult us!)

general

Weight	kg	16
Installation position		Any, if it is ensured that the pilot control is supplied with sufficient pressure (> 10 bar) during start-up of the system. In case of insufficient pressure supply, the control spool of the servo-valve can take any position. This may result in channel P being connected to the actuator and the build-up of pressure being delayed. This may be prevented by providing an external pressure supply at port X.
Storage temperature range	°C	–20 to +80
Ambient temperature range	°C	–20 to +60

hydraulic (measured with HLP 32, ϑ_{Oil} = 40 °C ± 5 °C)

Maximum operating pressure	Pilot control stage, pilot oil supply X		bar	10 to 210 and/or 10 to 315 (see page 2, pressure rating)
	Main valve, port P, A, B	Pilot oil supply internal	bar	315
	Main valve, port P, A, B	Pilot oil supply external	bar	350
Maximum return flow pressure	Pilot control stage, port Y		bar	Pressure peaks < 100 admissible, static < 10
	Main valve, port T	Pilot oil return internal	bar	Pressure peaks < 100 admissible, static < 10
		Pilot oil return external	bar	250
Leakage flow				See page 9 (characteristic curves)
Rated flow q_{Vnom} ±10 % with Δp = 70 bar			l/min	210, 300, 380, 450
Hydraulic fluid				See table page 5
Hydraulic fluid temperature range			°C	–20 to +80; preferably +40 to +50
Viscosity range			mm^2/s	15 to 380; preferably 30 to 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Pilot control valve	Class 18/16/13 [1]
			Main stage	Class 20/18/15 [1]
Hysteresis			%	≤ 0.10
Range of inversion			%	≤ 0.05
Response sensitivity			%	≤ 0.05
Pressure gain				≥ 90 % of p_P [2] with 1 % change in the control spool stroke (from hydraulic zero point)
Zero shift upon change of:	Hydraulic fluid temperature		% / 10 K	≤ 0.3
	Ambient temperature		% / 10 K	≤ 0.3
	Operating pressure		% / 100 bar	≤ 0.3
	Return flow pressure 0 to 10 % of p_P		% / 100 bar	≤ 0.3

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.
For the selection of the filters see www.boschrexroth.com/filter

[2] p_P = Inlet pressure/operating pressure

☞ **Notice!**
For information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 29620-U.

Technical data (For applications outside these parameters, please consult us!)

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons	HL, HLP	NBR, FKM	DIN 51524
Flame-resistant – containing water	HFC Fuchs Hydrotherm 46M Petrofer Ultra Safe 620	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, service life, maintenance intervals, etc.)!
- **Flame-resistant – containing water**:

  Maximum pressure differential per control edge 210 bar, otherwise, increased cavitation erosion!
  Tank pre-loading < 1 bar or > 20 % of the pressure differential of the tank edge. The pressure peaks should not exceed the maximum operating pressures!

  Maximum fluid temperature 60 °C

Technical data (For applications outside these parameters, please consult us!)

electric

Protection class according to EN 60529	IP 65 with mating connector mounted and locked
Type of signal	Analog

Electronics interface		**A1**	**C1**	**F1**
Current consumption at the mating connector	Pin			
	A	< ±150 mA with ±15 V < 200 mA with 24 V		< 200 mA with 24 V
	B			
	D	0 to ±0.05 mA	0 to ±10 mA	4 to 20 mA
	E			

Device connector allocation	**Pin**	**Supply voltage 15**		**Supply voltage 24**		
Interface		A1	C1	A1	C1	F1
Supply voltage	A	+15 VDC		+24 VDC		
	B	–15 VDC		0 VDC		
M0	C	0 VDC / reference to pins A, B		Not used		
Differential command value input	D	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	4 to 20 mA R_e = 100 Ω
	E					
Actual value Reference with +24 V is pin B Reference with ±15 V is pin C	F	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	4 to 20 mA Load max. 500 Ω
Protective earth	PE	Connected to valve housing				

☞**One end of the shield must be connected to the control!**

Supply voltage: ±15 V ±3 %, residual ripple < 1 %
+24 VDC / 18 V to 35 V; full bridge rectification with smoothing capacitor
2200 µF = I_{max} = 230 mA

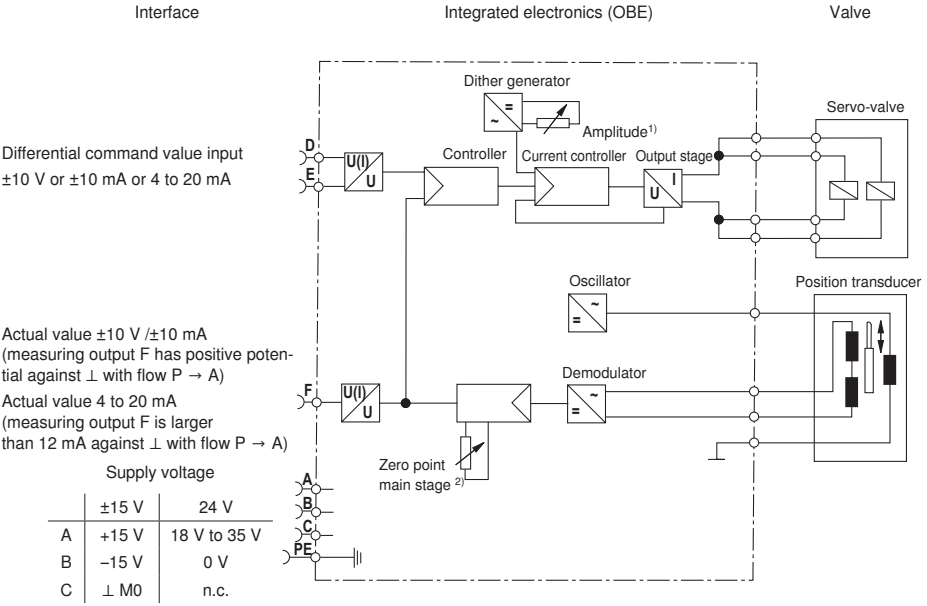
Command value: **A1, C1:**
Reference potential at E and positive command value at D result in flow from P → A and B → T.
Reference potential at E and negative command value at D result in flow from P → B and A → T.
F1:
Reference potential at E and signal 12 to 20 mA at D result in flow from P → A and B → T.
Reference potential at E and signal 12 to 4 mA at D result in flow from P → B and A → T.

Actual value / measuring output: The voltage / current signal is proportional to the control spool stroke and has the same sign as the command value.

Connection cable: Recommendation: – up to 25 m line length: Type LiYCY 7 x 0.75 mm²
– up to 50 m line length: Type LiYCY 7 x 1.0 mm²
Only connect the shield to ⊥ on the supply side.

Notice: **Electric signals taken out via valve electronics (e.g. actual value) must not be used for switching off safety-relevant machine functions!**

Block diagram of the integrated electronics (OBE)



	±15 V	24 V
A	+15 V	18 V to 35 V
B	−15 V	0 V
C	⊥ M0	n.c.

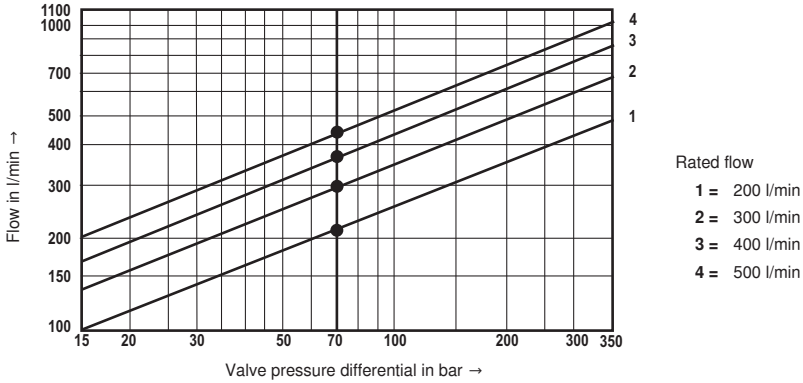
1) 2)

☞ **Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.**

6

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

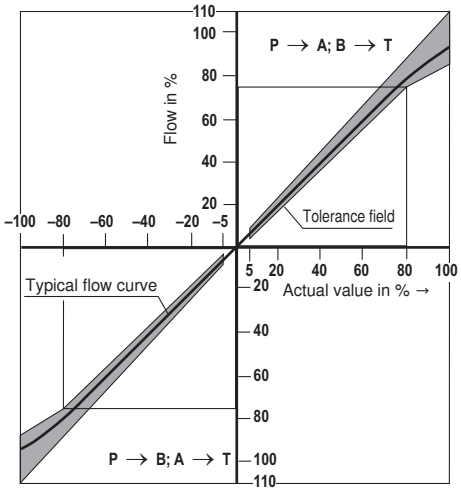
Flow/load function (tolerance ±10 %) with 100 % command value signal



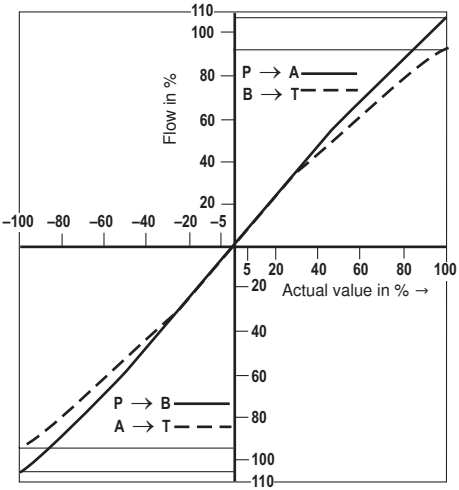
Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function at constant valve pressure differential

Summated edge Δp_V = 70 bar



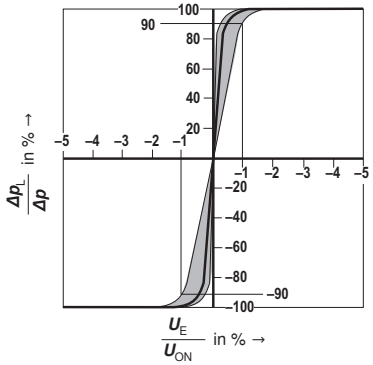
Single edge Δp_V = 35 bar (tolerance ±5 %)



* With interface F1, the negative command value axis corresponds to 4 to 12 mA, the positive command value axis to 12 to 20 mA

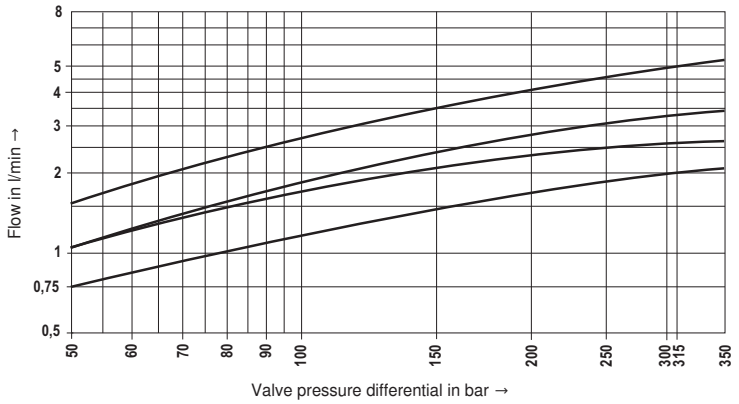
Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Pressure signal characteristic curve



Measured at
280 bar operating pressure

Zero flow total with "D" overlap (pilot control valve and main stage)
Tolerance ±20 %



1 = 200 l/min
2 = 300 l/min
3 = 400 l/min
4 = 500 l/min

Zero flow Data valid for overlap "E"	Pilot control valve L1	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.55$
	Overall valve q_V	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.015 \cdot q_{Vnom}$

q_{Vnom} Rated flow (overall valve) in l/min
210, 300, 380, 450

p_P Operating pressure in bar

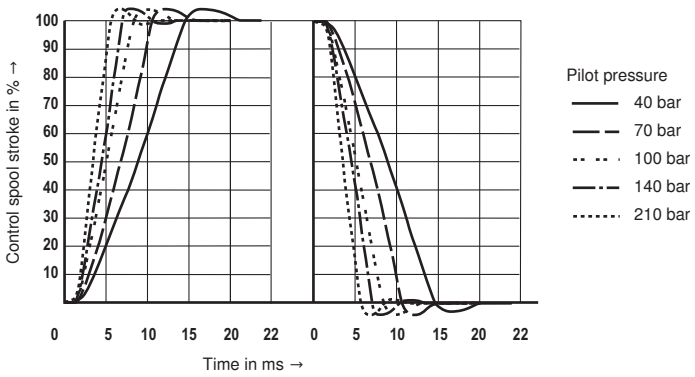
Δp Valve pressure differential in bar

q_V 200, 300, 400, 500 l/min

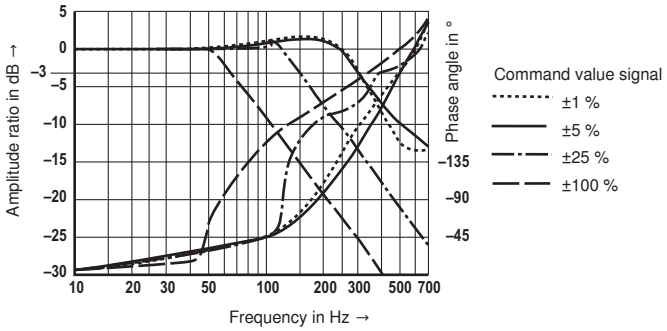
6

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

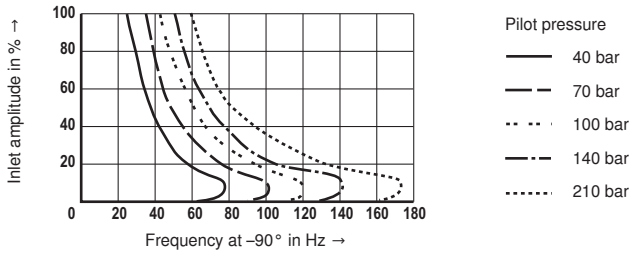
Transition function – measured with 210 bar pressure rating



Frequency response at p_P = 210 bar – measured with 210 bar pressure rating

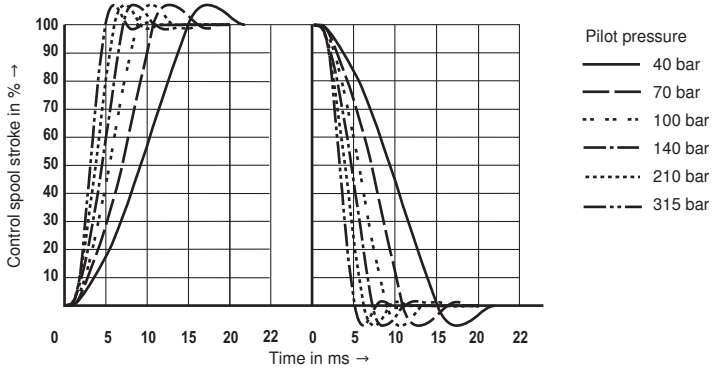


Dependence of the –90° frequency on the pilot pressure – measured with 210 bar pressure rating

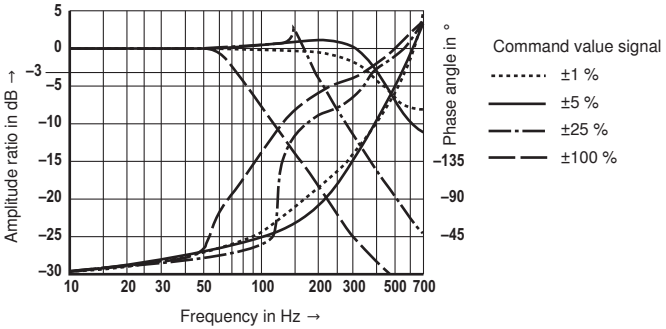


Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

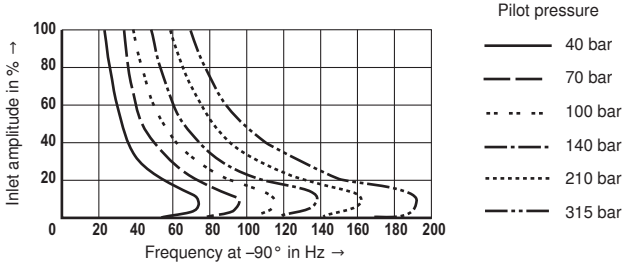
Transition function – measured with 315 bar pressure rating



Frequency response at p_P = 315 bar – measured with 315 bar pressure rating

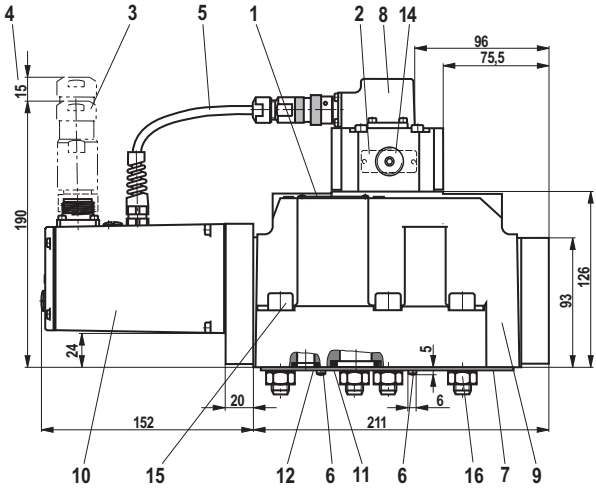


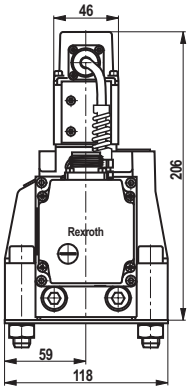
Dependence of the –90° frequency on the pilot pressure – measured with 315 bar pressure rating

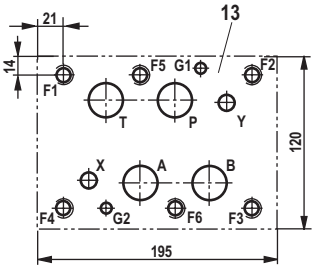


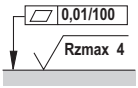
6

Unit dimensions: Type 4WSE3E 25 (dimensions in mm)









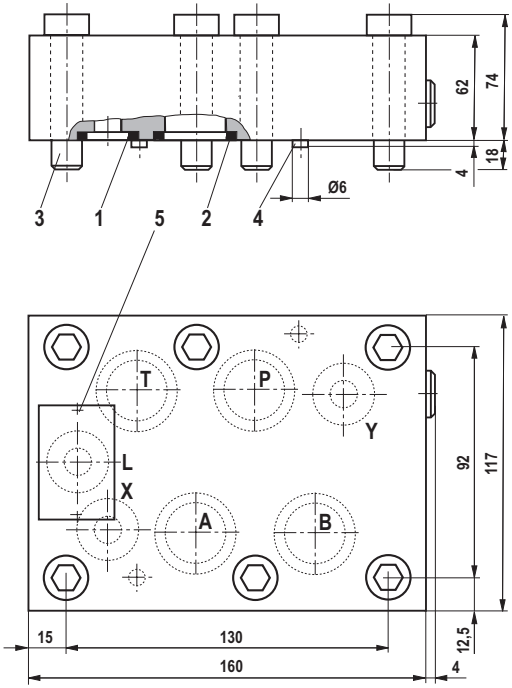
Required surface quality of the valve mounting face

1 Name plate – overall valve
2 Name plate – pilot control valve
3 Mating connector according to EN 175201-804, separate order, see page 13
4 Space required to remove the mating connector, take connection cable into account!
5 PVC cable not resistant when in contact with HFD-R fluid
6 Locating pin (2 units) G1 and G2
7 Cover plate (for transport only)
8 Pilot control valve (2-stage)
9 Main stage (3rd stage)
10 Integrated control electronics
11 Identical seal rings for ports A, B, P, and T
12 Identical seal rings for ports X and Y
The ports X and Y are also pressurized in the case of "internal" pilot oil supply
13 Machined valve mounting face, porting pattern according to ISO 4401-08-08-0-05
14 Exchangeable filter element with seal, material no. **R961000194**
15 Valve mounting screws
16 Hexagon nuts (for transport only)

Hexagon socket head cap screws (included in the scope of delivery)		**Material number**
Size 25	6x ISO 4762 - M12 x 60 - 10.9-flZn-240h-L Tightening torque M_A = 100 Nm ±10 %	R913000121

Notice: The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Flushing plate with porting pattern according to ISO 4401-08-08-0-05 (dimensions in mm)



1 R-ring 19x3x3 (X, Y) included in scope of delivery

2 R-ring 27.8x2.6x3 (P, T, A, B) included in scope of delivery

3 6 hexagon socket head cap screws (included in scope of delivery)
ISO4762-M12x80-10.9
(friction coefficient 0.09 to 0.14 according to VDA 235-101)
M_A = 100 Nm
Material no. **R913000413**

4 2 locating pins ISO8741 - 6X12-ST

5 Name plate

To ensure proper functioning of the servo-valves, it is necessary to flush the system before commissioning.

The following values are guidelines for the flushing time per system:

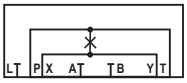
$$t \geq \frac{V}{q_V} \cdot 5$$

t = Flushing time in hours
V = Tank capacity in liters
q_V = Pump flow in liters per minute

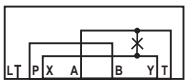
When topping up more than 10 % of the tank capacity, the flushing procedure must be repeated.

The use of a directional valve with port in accordance with ISO 4401-08-08-0-05 is better suited than a flushing plate. With this valve, you can also flush the actuator ports.

Symbols



with FKM seals,
Material no. **R900959384**
Weight: 8.4 kg



with FKM seals,
Material no. **R900959377**
(without fig.)
Weight: 8.4 kg

6

Accessories (not included in the scope of delivery)

Mating connectors		Material number
Mating connector for servo-valve	DIN EN 175201-804, see data sheet 08006	R900223890 (metal)

Subplates	Data sheet
Size 25	45058

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Rexroth
Bosch Group

Directional servo-valve in 4-way version

RE 29622/03.12 1/14
Replaces: 05.09

Type 4WSE3E 32

Size 32
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 1800 l/min

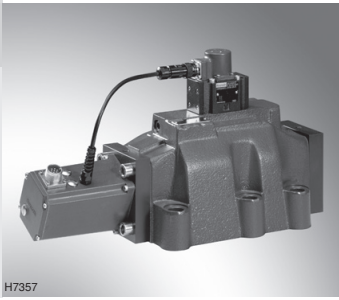

H7357

Table of contents

Information on available spare parts:
www.boschrexroth.com/spc

Features

- Valve for position, force, pressure or velocity control
- 3-stage servo-valve with electrical position control of the control spool of the 3rd stage, position sensing of the control spool by means of an inductive position transducer
- High dynamics 2-stage pilot control valve of size 6
- 1st stage as nozzle flapper plate amplifier
- Filter for 1st stage externally accessible and replaceable
- Subplate mounting:
  Porting pattern according to ISO 4401
- Can also be used as 3-way version
- Valve and integrated control electronics are adjusted and tested in the factory
- Optimized valve control loop
- High response sensitivity, very low hysteresis and zero point drift
- Internal or external pilot oil supply and return
- Gap seals at pressure chambers of the control sleeve, no O-ring wear

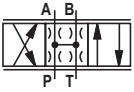
Ordering code

4WSE3E	32					5X	/		/	K31		*

3-stage servo-valve

Size
Size 32 **= 32**

Control spool symbol [1]



= V
= V1

Control spool position in de-energized state
Not defined **= no code**
100 % P → A / B → T **= P**

Rated flow [2]
500 l/min **= 500**
670 l/min **= 700**
890 l/min **= 1000**

Control spool overlap [3]
0 to 0.5 % positive **= D**
0 to 0.5 % negative **= E**

Component series 50 to 59 **= 5X**
(50 to 59: Unchanged installation and connection dimensions)

Seal material [4]
FKM seals **= V**
NBR seals **= M**

Further details in the plain text

Electronics interface command/actual value
A1 = 0 to 10 V
C1 = 0 to 10 mA
F1* = 4 to 20 mA

Electrical connection
K31 = 6+PE
Without mating connector

Supply voltage
15 = ±15 V
24 = +24 V
See page 6

Pressure rating [6]
7 = 210 bar
9 = 315 bar

Pilot flow [5]
XY = Pilot oil supply external, return external
XT = Pilot oil supply external, return internal
PY = Pilot oil supply internal, return external
PT = Pilot oil supply internal, return internal

* Only with +24 V supply voltage

[1] **Control spool symbols**
with control spool symbol V
P → A; $q_{V\,max}$ B → T; $q_{V\,max}$
P → B; $q_{V\,max}$ A → T; $q_{V\,max}$
with control spool symbol V1
P → A; $q_{V\,max}$ B → T; $q_V / 2$
P → B; $q_V / 2$ A → T; $q_{V\,max}$

[2] **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % and saturation influence must be taken into account (see flow/signal function page 8).

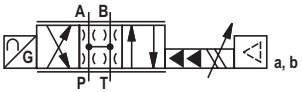
[3] **Control spool overlap**
The control spool overlap in % is referred to the nominal stroke of the control spool.
(Other control spool overlaps upon request.)

[4] **Seal material**
See notices on page 5

[5] **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

[6] **Inlet pressure range**
Care should be taken that the inlet pressure is as constant as possible. Minimum control pressure ≥ 10 bar.
Up to a pilot pressure of 210 bar, pressure rating 7 is to be selected. From a pilot pressure greater than 210 bar, pressure rating 9 is to be selected.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.
At an inlet pressure > 40 bar, the pilot pressure must not be less than 60 % of the inlet pressure as otherwise the current forces at the control spool of the 3rd stage will impair the controllability.
At an inlet pressure ≤ 40 bar, working with a pilot pressure above port X (external supply) is in any case advantageous.

Symbol



Function, section

Valves of type 4WSE3E 32 are electrically operated, 3-stage directional servo-valves. They are mainly used for position, force or pressure and velocity controls.

These valves consist of a 2-stage pilot control valve of type 4WS2EM 6 (1), a main stage with a main control spool in a sleeve (2), an inductive position transducer (3), and integrated control electronics (4).

The pilot control valve (1) consists of an electro-mechanical converter (torque motor), a hydraulic amplifier (nozzle flapper plate principle) and a pilot control spool in a sleeve, which is connected to the torque motor via a mechanical feedback.

Electric currents in the coils of the torque motor generate a force by means of a permanent magnet which acts on the armature, and in connection with a torque tube results in a torque. This causes the flapper plate which is connected to the torque tube via a pin to move from the central position between the two control nozzles, and a pressure differential is created across the front sides of the pilot control spool. The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

The pilot control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback).

The position of the control spool is changed until the flapper plate position and hence the pressure differential across the nozzle flapper plate system becomes zero due to the feedback torque, which acts via the bending spring against the electro-magnetic torque of the torque motor.

In doing so, the stroke of the pilot control spool and hence the flow of the pilot control valve is controlled proportionally to the electrical input signal (see data sheet 29564).

In the main stage, the main control spool (2) is operated by the pilot control valve and its position is sensed by an inductive position transducer (3). The position transducer signal is compared to the command value by integrated control electronics (4). Any possible control deviation is amplified electrically and fed to the pilot control valve as control signal. The pilot control valve starts to move and the main control spool is re-positioned.

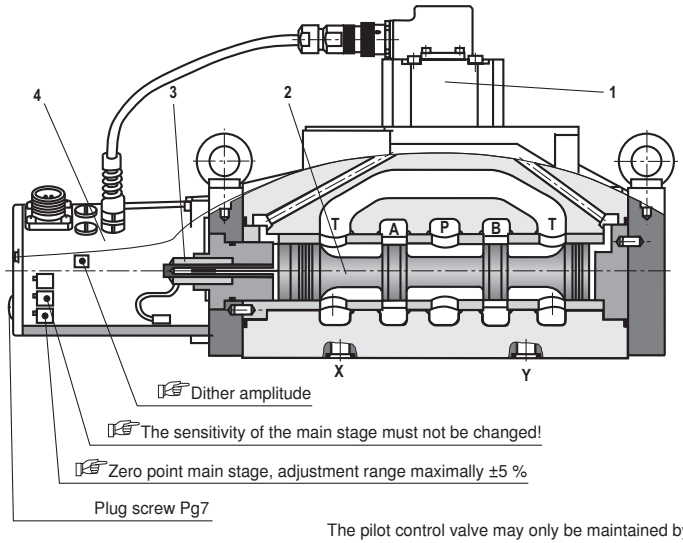
The stroke of the main control spool and consequently the flow of the servo-valve are controlled in proportion to the command value. It must be noted that the flow depends on the valve pressure differential.

The valve zero point can be adjusted by means of an externally accessible potentiometer.

The valves are factory-set with a dither default setting with the constant frequency of 400 Hz.

☞ **Notice!**

Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.



The pilot control valve may only be maintained by Bosch Rexroth employees. An exception to this is the replacement of the filter element – see data sheet 29564.

6

Technical data (For applications outside these parameters, please consult us!)

general

Weight	kg	35
Installation position		Any, if it is ensured that the pilot control is supplied with sufficient pressure (> 10 bar) during start-up of the system. In case of insufficient pressure supply, the control spool of the servo-valve can take any position. This may result in channel P being connected to the actuator and the build-up of pressure being delayed. This may be prevented by providing an external pressure supply at port X.
Storage temperature range	°C	–20 to +80
Ambient temperature range	°C	–20 to +60

hydraulic (measured with HLP 32, ϑ_{Oil} = 40 °C ± 5 °C)

Maximum operating pressure	Pilot control stage, pilot oil supply X		bar	10 to 210 or 10 to 315 (see page 2, pressure rating)
	Main valve, port P, A, B	Pilot oil supply internal	bar	315
	Main valve, port P, A, B	Pilot oil supply external	bar	315
Maximum return flow pressure	Pilot control stage, port Y		bar	Pressure peaks < 100 admissible, static < 10
	Main valve, port T	Pilot oil return internal	bar	Pressure peaks < 100 admissible, static < 10
		Pilot oil return external	bar	250
Zero flow				See page 9 (characteristic curves)
Rated flow q_{Vnom} ±10 % at Δp = 70 bar			l/min	500, 670, 890
Hydraulic fluid				See table page 5
Hydraulic fluid temperature range			°C	–20 to +80; preferably +40 to +50
Viscosity range			mm^2/s	15 to 380; preferably 30 to 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Pilot control valve	Class 18/16/13 [1]
			Main stage	Class 20/18/15 [1]
Hysteresis			%	≤ 0.10
Range of inversion			%	≤ 0.05
Response sensitivity			%	≤ 0.05
Pressure gain				≥ 90 % of p_P [2] with 1 % change in control spool stroke (from hydraulic zero point)
Zero shift upon change of:	Hydraulic fluid temperature		% / 10 K	≤ 0.3
	Ambient temperature		% / 10 K	≤ 0.3
	Operating pressure		% / 100 bar	≤ 0.3
	Return flow pressure 0 to 10 % of p_P		% / 100 bar	≤ 0.3

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.
For the selection of the filters see www.boschrexroth.com/filter

[2] p_P = Inlet pressure/operating pressure

☞ **Notice!**
For information on the **environment simulation testing** for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 29620-U.

Technical data (For applications outside these parameters, please consult us!)

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils and related hydrocarbons	HL, HLP	NBR, FKM	DIN 51524
Flame-resistant – containing water	HFC Fuchs Hydrotherm 46M Petrofer Ultra Safe 620	NBR	ISO 12922

☞ **Important information on hydraulic fluids!**

- For more information and data on the use of other hydraulic fluids refer to data sheet 90220 or contact us!
- There may be limitations regarding the technical valve data (temperature, pressure range, service life, maintenance intervals, etc.)!
- **Flame-resistant – containing water**:

  Maximum pressure differential per control edge 210 bar, otherwise, increased cavitation erosion!
  Tank pre-loading < 1 bar or > 20 % of the pressure differential of the tank edge. The pressure peaks should not exceed the maximum operating pressures!

  Maximum fluid temperature 60 °C

Technical data (For applications outside these parameters, please consult us!)

electric

Protection class according to EN 60529	IP 65 with mating connector mounted and locked
Type of signal	Analog

Electronics interface		**A1**	**C1**	**F1**
Current consumption at the mating connector	Pin			
	A	< ±150 mA at ±15 V < 200 mA at 24 V		< 200 mA at 24 V
	B			
	D	0 to ±0.05 mA	0 to ±10 mA	4 to 20 mA
	E			

Device connector allocation	**Pin**	**Supply voltage 15**		**Supply voltage 24**		
Interface		A1	C1	A1	C1	F1
Supply voltage	A	+15 VDC		+24 VDC		
	B	–15 VDC		0 VDC		
M0	C	0 VDC / reference to pins A, B		Not used		
Differential command value input	D	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	0 to ±10 V R_e >100 kΩ	0 to ±10 mA R_e = 100 Ω	4 to 20 mA R_e = 100 Ω
	E					
Actual value The reference with +24 V is pin B The reference with ±15 V is pin C	F	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	0 to ±10 V R_i ≈ 1 kΩ	0 to ±10 mA Load max. 1 kΩ	4 to 20 mA Load max. 500 Ω
Protective earth	PE	Connected to valve housing				

☞**One end of the shield must be connected to the control!**

Supply voltage: ±15 V ±3 %, residual ripple < 1 %
+24 VDC / 18 V to 35 V; full bridge rectification with smoothing capacitor
2200 µF = I_{max} = 230 mA

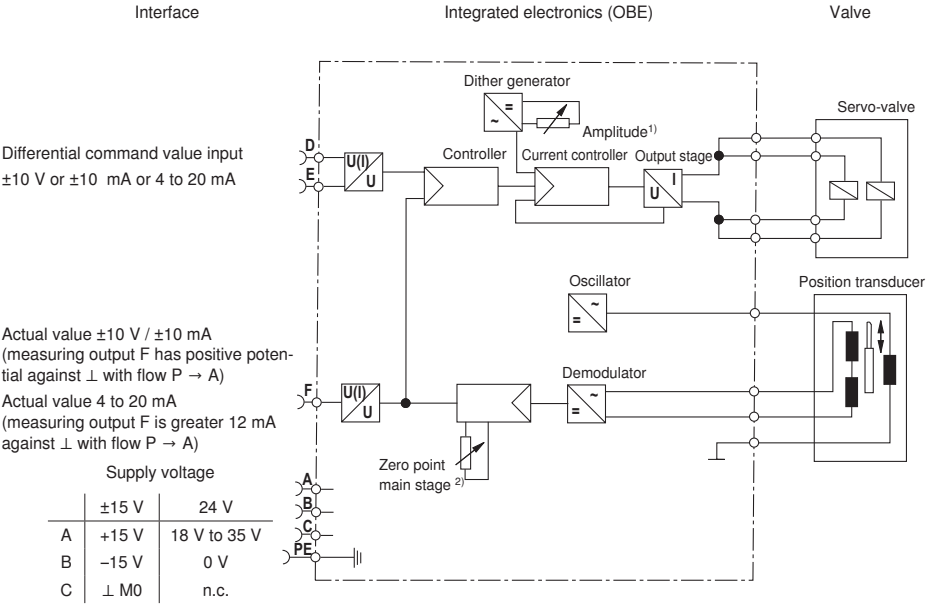
Command value: **A1, C1:**
Reference potential at E and positive command value at D result in flow from P → A and B → T.
Reference potential at E and negative command value at D result in flow from P → B and A → T.
F1:
Reference potential at E and signal 12 to 20 mA at D result in flow from P → A and B → T.
Reference potential at E and signal 12 to 4 mA at D result in flow from P → B and A → T.

Actual value / measuring output: The voltage / current signal is proportional to the control spool stroke and has the same sign as the command value.

Connection cable: Recommendation: – up to 25 m line length: Type LiYCY 7 x 0.75 mm²
– up to 50 m line length: Type LiYCY 7 x 1.0 mm²
Only connect the shield to ⊥ on the supply side.

Notice: **Electric signals taken out via valve electronics (e.g. actual value) must not be used for switching off safety-relevant machine functions!**

Block diagram of the integrated electronics (OBE)



	±15 V	24 V
A	+15 V	18 V to 35 V
B	−15 V	0 V
C	⊥ M0	n.c.

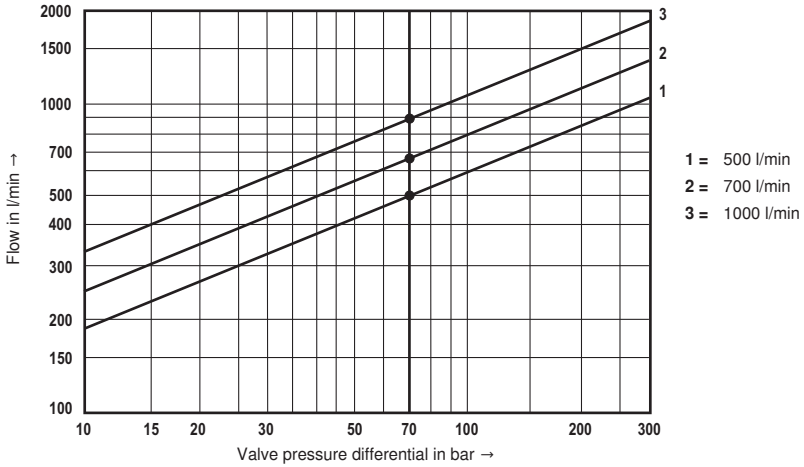
1) 2)

☞ **Changes in the zero point and/or the dither amplitude may result in damage to the system and may only be implemented by instructed specialists.**

6

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

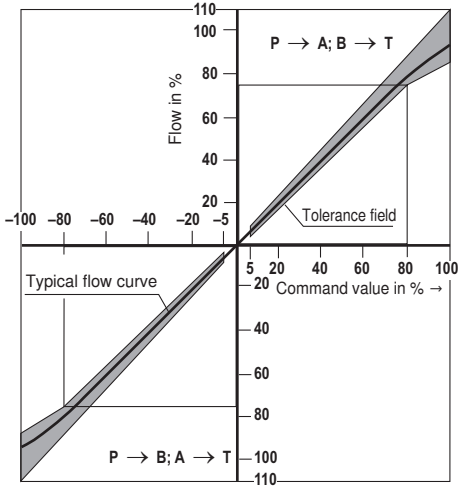
Flow/load function (tolerance ±10 %) with 100 % command value signal



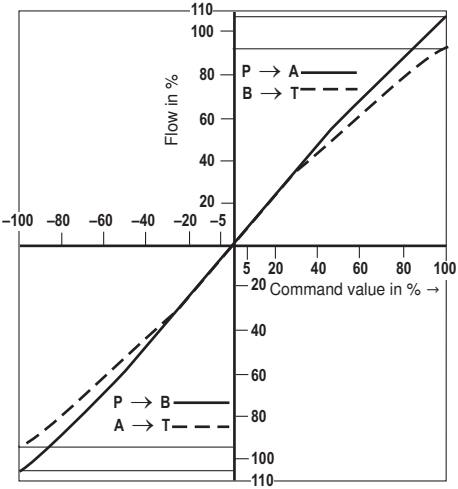
Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function with constant valve pressure differential

Summated edge Δp_V = 70 bar



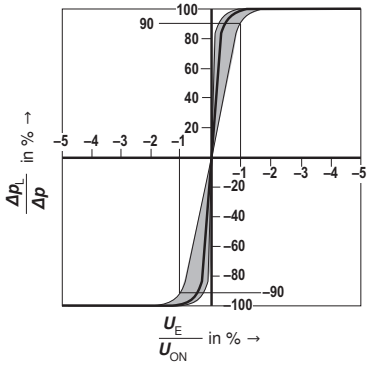
Single edge Δp_V = 35 bar (tolerance ±5 %)



* With interface F1, the negative command value axis corresponds to 4 to 12 mA, the positive command value axis to 12 to 20 mA

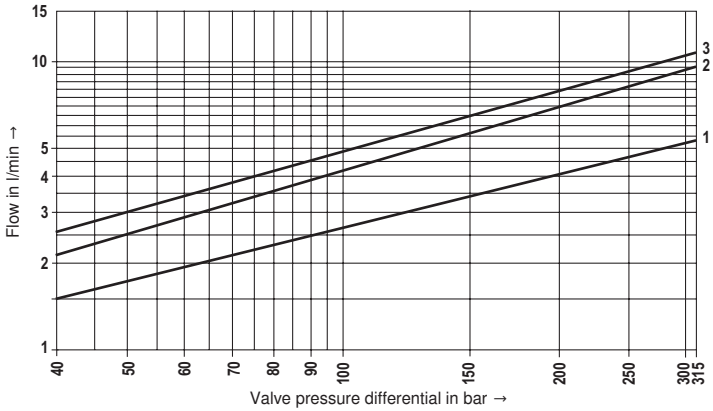
Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Pressure signal characteristic curve



Measured at
280 bar operating pressure

Leakage flow total with "D" overlap (pilot control valve and main stage)
Tolerance ±20 %



1 = 500 l/min
2 = 700 l/min
3 = 1000 l/min

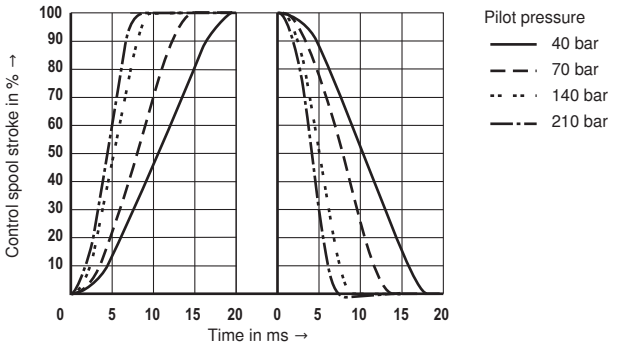
Zero flow Data valid for overlap "E"	Pilot control valve L1	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.8$
	Overall valve q_V	l/min	$\leq \sqrt{\frac{p_P}{70\ bar}} \cdot 0.015 \cdot q_{Vnom}$

q_{Vnom} Rated flow (overall valve) in l/min 500, 670, 890
p_P Operating pressure in bar
Δp Valve pressure differential in bar
q_V 500, 700, 1000 l/min

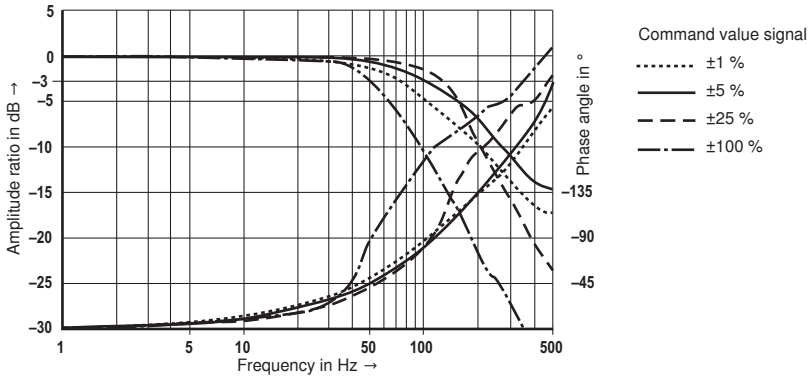
6

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

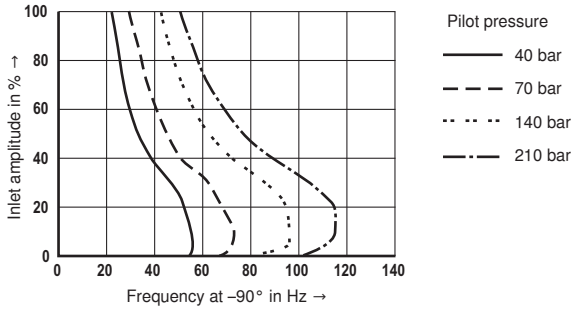
Transition function – measured with 210 bar pressure rating



Frequency response at p_P = 210 bar – measured with 210 bar pressure rating

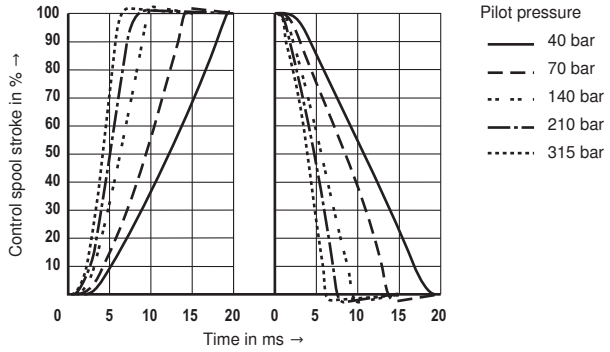


Dependence of the –90° frequency of the pilot pressure – measured with 210 bar pressure rating

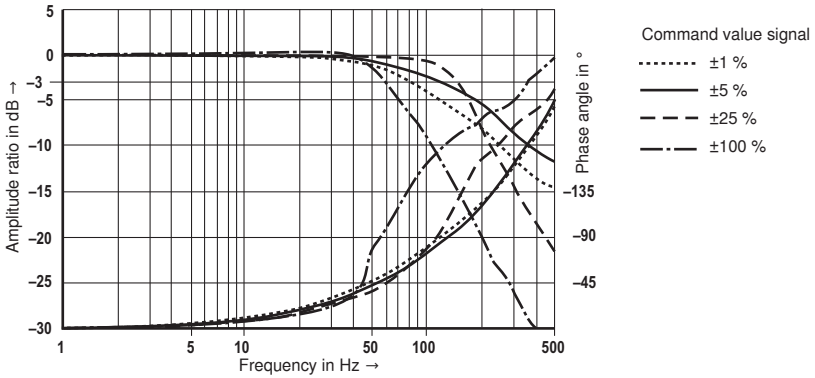


Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

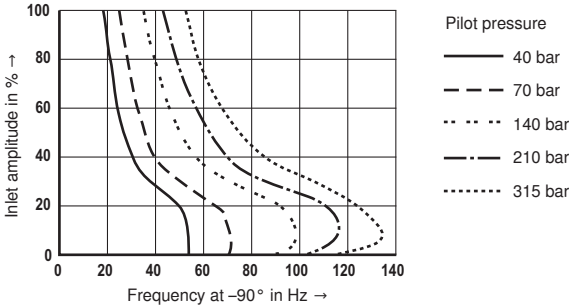
Transition function – measured with 315 bar pressure rating



Frequency response at p_P = 315 bar – measured with 315 bar pressure rating

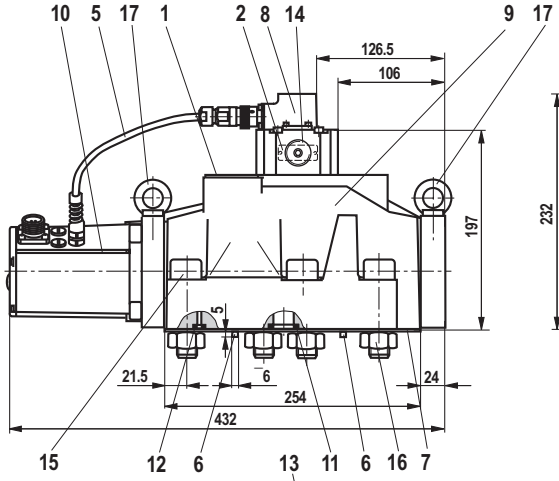


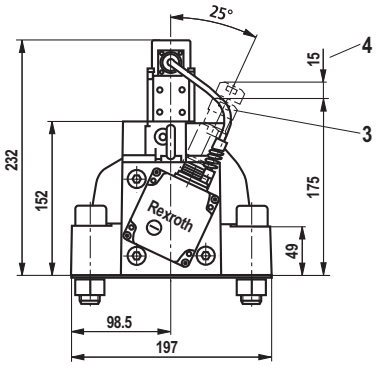
Dependence of the –90° frequency of the pilot pressure – measured with 315 bar pressure rating

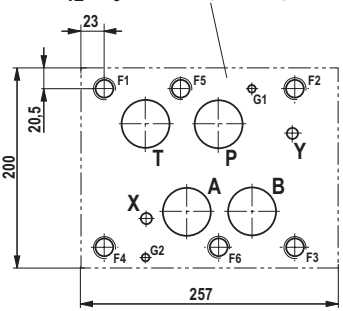


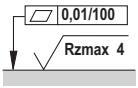
6

Unit dimensions: Type 4WSE3E 32 (dimensions in mm)









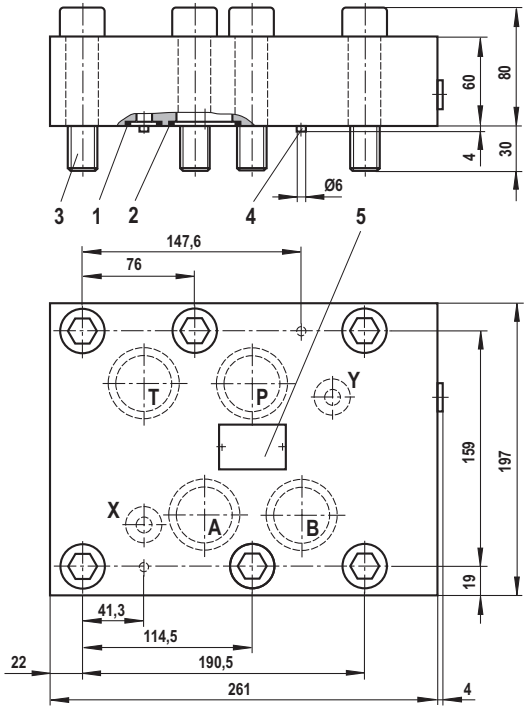
Required surface quality of the valve mounting face

1 Name plate – overall valve
2 Name plate – pilot control valve
3 Mating connector according to EN 175201-804, separate order, see page 13
4 Space required to remove the mating connector, take connection cable into account!
5 PVC cable not resistant when in contact with HFD-R fluid
6 Locating pin (2x) G1 and G2
7 Cover plate (for transport only)
8 Pilot control valve (2-stage)
9 Main stage (3rd stage)
10 Integrated control electronics
11 Identical seal rings for ports A, B, P, and T
12 Identical seal rings for ports X and Y
The ports X and Y are also pressurized in the case of "internal" pilot oil supply
13 Machined valve mounting face, porting pattern according to ISO 4401-10-09-0-05
14 Exchangeable filter element with seal, material no. **R961000194**
15 Valve mounting screws
16 Hexagon nuts (for transport only)
17 Ring bolts (for transport only)

Hexagon socket head cap screws (included in the scope of delivery)		**Material number**
Size 32	6x ISO 4762 - M20 x 80 - 10.9-flZn-240h-L Tightening torque M_A = 340 Nm ±10 %	R901035246

Notice: This tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure!

Flushing plate with porting pattern according to ISO 4401-10-09-0-05 (dimensions in mm)



1 R-ring 19x3x3 (X, Y) included in scope of delivery

2 R-ring 42.5x3x3 (P, T, A, B) included in scope of delivery

3 6 hexagon socket head cap screws (included in scope of delivery)
ISO4762-M20x90-10.9flZn-240h-L
(friction coefficient 0.09 to 0.14 according to VDA 235-101)
M_A = 340 Nm
Material no. **R913000397**

4 2 locating pins 6x12-6.8 DIN EN 28741

5 Name plate

To ensure proper operation of the servo-valves, it is necessary to flush the system before commissioning.

The following values are guidelines for the flushing time per system:

$$t \geq \frac{V}{q_V} \cdot 5$$

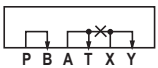
t = Flushing time in hours
V = Tank capacity in liters
q_V = Pump flow in liters per minute

When topping up more than 10 % of the tank capacity, the flushing procedure must be repeated.

The use of a directional valve with port in accordance with ISO 4401-10-09-0-05 is better suited than a flushing plate. With this valve, you can also flush the actuator ports.

Symbols

with FKM seals
Material no. **R900550597**
Weight: 22.3 kg



with FKM seals
Material no. **R900959396**
(without fig.)
Weight: 22.3 kg

6

Accessories (not included in the scope of delivery)

Mating connectors		Material number
Mating connector for servo-valve	DIN EN 175201-804, see data sheet 08006	R900223890 (metal)

Subplates	Data sheet
Size 32	45060