

**RE 29 564/10.02**

Replaces: 03.99

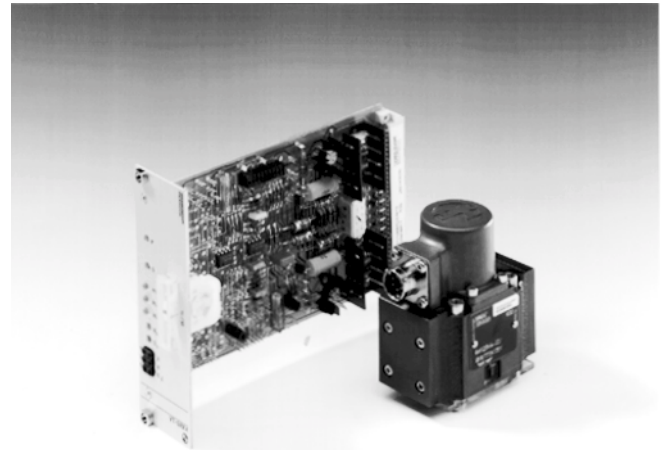
**Servo directional valve of 4-way design  
Type 4WS.2EM**

Nominal size 6

Series 2X

Maximum operating pressure 210 / 315 bar

Maximum flow 40 L/min



H/A/D 5994/98

Type 4WS2EM 6-2X/...B.ET...K17EV with associated external control electronics (separate order)

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**Features**

- Valve for position, force or pressure and velocity closed loop control
- 2-stage servo valve with mechanical feedback
- 1st stage as a flapper jet amplifier
- For subplate mounting, Porting pattern to DIN 24 340 form A6 subplates to catalogue sheet RE 45 052 (separate order)
- Dry torque motor, no contamination of the solenoid gap via the pressure fluid
- Can also be used as a 3-way version
- Wear-free spool feedback element
- Three control variants
- Control:
  - External control electronics in Eurocard or modular design (separate order), see page 6
  - Or the control electronics are integrated into the valve
- The valve and integrated electronics are adjusted and tested
- Exchangeable control bush with central fixing
- Pressure chambers in the control bush with gap seals, no o-ring wear
- The 1st stage filter is externally accessible



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## Ordering details

	<b>6 – 2X/</b>	<b>B</b>	<b>ET</b>	<b>K17</b>	<b>E</b>	<b>V</b>	<b>*</b>	
Electrically actuated 2-stage servo valve of 4-way design with mechanical feedback For <b>external</b> control electronics = <b>4WS2EM</b> With <b>integrated</b> control electronics = <b>4WSE2EM</b>								Further details in clear text
Nominal size 6 = <b>6</b>								<b>6</b> V = FKM seals, suitable for mineral oil (HL, HLP) to DIN 51 524
Series 20 to 29 (20 to 29: unchanged installation and connection dimensions) = <b>2X</b>								<b>5</b> E = <b>Spool overlap</b> 0 to 0.5 % negative
<b>Nominal flow</b> <b>1</b>								<b>Electrical connections</b>
2 L/min = <b>2</b>								<b>K17 = Without</b> plug-in connector, with component plug to VG 95 328 Plug-in connector – separate order, see page 7
5 L/min = <b>5</b>								<b>4</b> <b>Input pressure range</b>
10 L/min = <b>10</b>								<b>210 =</b> 10 to 210 bar
15 L/min = <b>15</b>								<b>315 =</b> 10 to 315 bar
20 L/min = <b>20</b>								<b>3</b> ET = Internal pilot oil supply and drain
(The tolerance field of the flow signal function on page 8 has to be taken into account)								<b>2</b> 11 = Valves for <b>external</b> control electronics Coil no. 11 (30 mA/85 Ω per coil) Valves with <b>integrated</b> control electronics Control:
								<b>8 =</b> Command value ± 10 mA / 1kΩ
								<b>9 =</b> Command value ± 10 V / 10 kΩ

### 1 Nominal flow

The nominal flow relates to a 100 % command value signal at a 70 bar valve pressure differential (per land 35 bar). This valve pressure differential is to be regarded as a reference value. Other values will give a change in the flow. A possible ± 10% nominal flow tolerance must be taken into consideration (see flow signal function on page 8).

### 2 Electronic control data

Valves for **external** control electronics: The control signal must be generated by a current regulated output stage. For servo amplifiers see page 6.

Valves with **integrated** control electronics: For the integrated electronics the command value can be a voltage signal, (ordering code „9“) or where there is extensive cabling (> 25 m between the control and valve) as a current signal (ordering code „8“) can be used.

### 3 Pilot oil

These valves are only available with internal pilot oil supply and drain.

### 4 Input pressure range

The system pressure should be as constant as possible.

With regard to the dynamics within the permissible pressure of 10 to 210 bar or 10 to 315 bar, the frequency relationship must be taken into account.

### 5 Spool overlap

The spool overlap given in % refers to the nominal control spool stroke ± 0.5 mm.

Other spool overlaps available on request!

### 6 Seal material

Other seal materials are available on request!

### 7 Details in clear text

Here special requirements should be specified in clear text. Following receipt of an order these will be checked at the factory and valve code supplemented by an additional number.

**Test unit** (battery operated, optionally with a power supply) to catalogue sheet RE 29 681

#### Attention:

- Only for valves with external electronics

#### Test unit for servo/proportional valves that are fitted with integrated electronics

**Type VT-VET-1, series 1X** to catalogue sheet RE 29 685.

The test unit is used to control and functionally test servo/proportional valves with integrated electronics. It is suitable for testing valves that have an operating voltage of ± 15 V or 24 V.

#### The following operating modes are possible:

- External operation → passing on the operating voltage and command values from the control cabinet to the valve
- Internal/external operation → command value via the test unit; operating voltage from the control cabinet
- Internal operation → operating voltage via a separate power supply; command values via the test unit
- Command values via the BNC socket → optional operational voltage.

**Preferred types** (readily available)

**Valves for external control electronics**

Material No.	Type 4WS2EM
00950929	4WS2EM 6-2X/2B11ET315K17EV
00951449	4WS2EM 6-2X/5B11ET315K17EV
00951450	4WS2EM 6-2X/10B11ET315K17EV
00951451	4WS2EM 6-2X/15B11ET315K17EV
00951452	4WS2EM 6-2X/20B11ET315K17EV

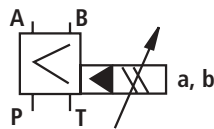
**Valves with integrated control electronics**

Material No.	Type 4WSE2EM
00952164	4WSE2EM 6-2X/2B9ET315K17EV
00952165	4WSE2EM 6-2X/5B9ET315K17EV
00952166	4WSE2EM 6-2X/10B9ET315K17EV
00952167	4WSE2EM 6-2X/15B9ET315K17EV
00952168	4WSE2EM 6-2X/20B9ET315K17EV

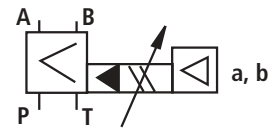
**Symbols**

**Valves for external control electronics**

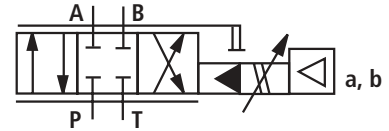
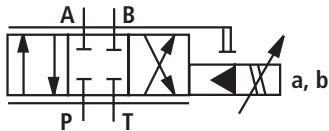
Simplified



**Valves with integrated control electronics**



Detailed



## Function, section

### 4WS(E)2EM6-2X/...

Type 4WS(E)2EM6-2X/... valves are electrically operated, 2-stage directional servo valves with a porting pattern to DIN 24 340 form A6. They are used primarily for the closed loop control of position, force or pressure and velocity.

These valves comprise of a electro-mechanical convertor (torque motor) (1), a hydraulic amplifier (flapper jet principle) (2) and a control spool (3) in a bush (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 (3). 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 or 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.

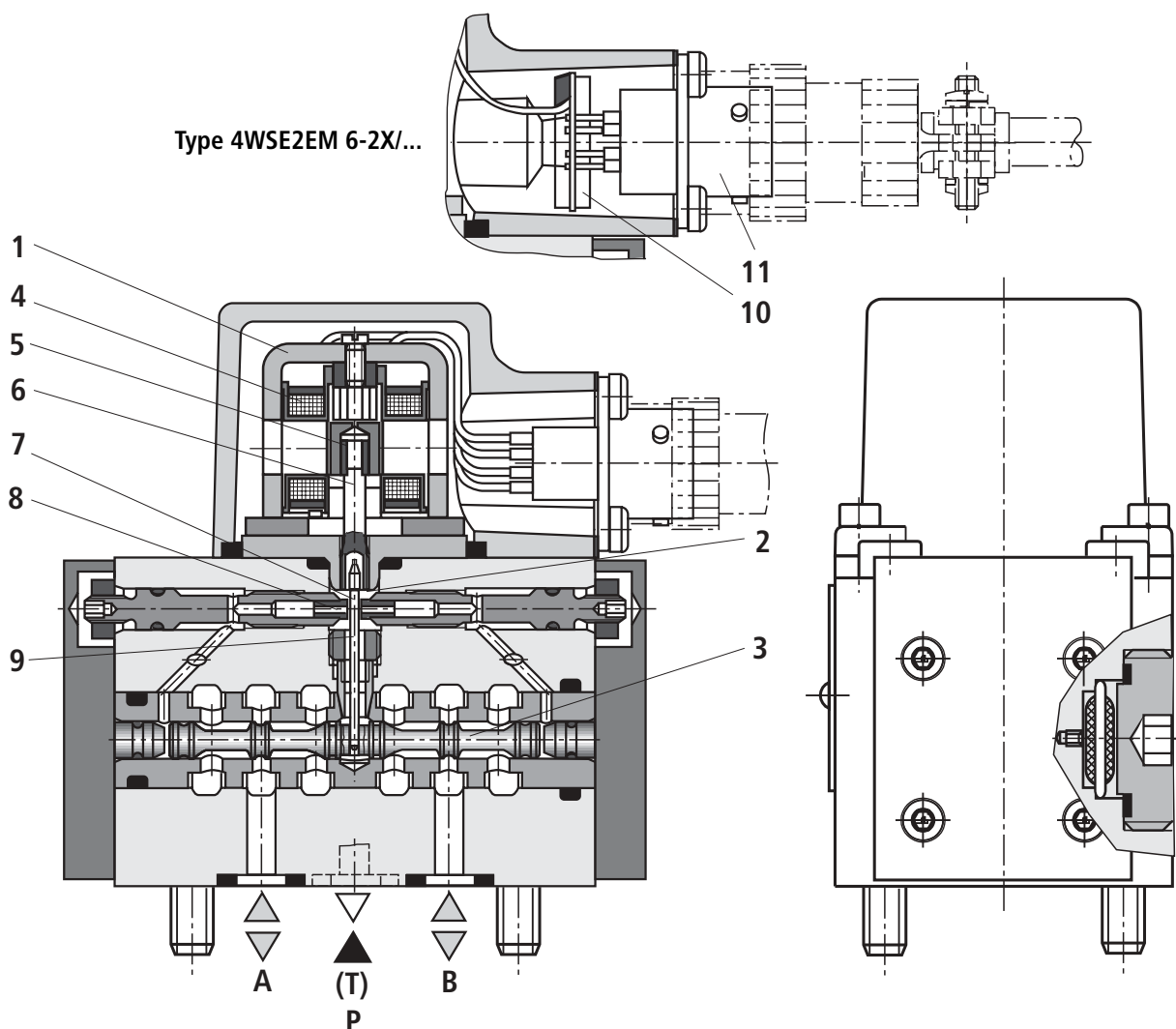
The stroke of the control spool and thus the flow through the servo valve is closed loop controlled in proportional to the electrical input signal. It has, however, to be taken into account that the flow is dependent on the valve pressure drop.

**External control electronics, type 4WS2EM6-2X/...** (separate order)

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

**Integrated control electronics, type 4WSE2EM6-2X/...**

For amplification of the analogue input signal control electronics (10), which are specially matched to this valve type, are integrated into the valve. They are built into the component plug (11) of the torque motor cover plate.



Type 4WS2EM 6-2X/...

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

### General

Porting pattern		DIN 24 340 form A 6
Installation		Optional, provided that during system start-up, the pilot control is supplied with sufficient pressure ( $\geq 10$ bar)!
Storage temperature range	°C	-20 to +80
Ambient temperature range	°C	-30 to +70 valves for external control electronics -20 to +60 valves with integrated control electronics
Weight	kg	1.1

### Hydraulic (measured with HLP 32, $\vartheta_{oil} = 40 \text{ °C} \pm 5 \text{ °C}$ )

Operating pressure (ports A, B, P)	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, further pressure fluids on request!
Pressure fluid temperature range	°C	-20 to +80; preferably +40 to +50
Viscosity range	mm <sup>2</sup> /s	15 to 380; preferably 30 to 45
Cleanliness class to ISO codes		Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (C) class 18/16/13 <sup>1)</sup>
Zero flow $q_{V,L}$ <sup>2)</sup> with spool overlap E, measured without dither signal	L/min	$\sqrt{\frac{p_p}{70 \text{ bar}}}$ • (0.4 L/min + 0.02 • $q_{V,nom}$ <sup>3)</sup> )
Nominal flow $q_{V,nom} \pm 10 \%$ at a valve pressure differential $\Delta p = 70$ bar	L/min	2; 5; 10; 15; 20
Control spool stroke	mm	$\pm 0.5$
Max. possible control spool stroke at mechanical stops (in the case of a fault) referring to the nominal stroke	%	120 to 170
Feedback system		Mechanical
Hysteresis (dither optimised)	%	$\leq 1.5$ of $p_p = 210 \text{ bar}$ <sup>4)</sup>
Reversal span (dither optimised)	%	$\leq 0.2$ of $p_p = 210 \text{ bar}$ <sup>4)</sup>
Response sensitivity (dither optimised)	%	$\leq 0.2$ of $p_p = 210 \text{ bar}$ <sup>4)</sup>
Pressure amplification at 1 % spool stroke change (from the hydraulic zero point)	% of $p_p$	$\geq 50$
Balance current over the entire operating pressure range	%	$\leq 3$ , long term $\leq 5$
Zero displacement with changes to:		
Pressure fluid temperature	%/20 °C	$\leq 1$
Ambient temperature	%/20 °C	$\leq 1$
Operating pressure 80 to 120 % of $p_p$ <sup>4)</sup>	%/100 bar	$\leq 2$
Return pressure 0 to 10 % of $p_p$	%/bar	$\leq 1$

<sup>1)</sup> The cleanliness class stated for the components must be adhered to in hydraulic systems. Effective filtration prevents faults from occurring and at the same time increases the component service life. For the selection of filters see catalogue sheets RE 50 070, RE 50 076 and RE 50 081.

<sup>2)</sup>  $q_{V,L}$  = Zero flow in L/min

<sup>3)</sup>  $q_{V,nom}$  = Nominal flow (Gesamtventil) in L/min

<sup>4)</sup>  $p_p$  = Operating pressure in bar

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

### Electrical

Valve protection to EN 60 529		IP 65 with mounted and fixed plug-in connector
Signal type		Analogue
Nominal current per coil	mA	30
Resistance per coil	$\Omega$	85
Inductivity at 60 Hz and 100% nominal current:		
	Series circuit	H 1.0
	Parallel circuit	H 0.25
Recommended super-imposed dither signal: $f = 400$ Hz		Amplitude dependent on the hydraulic installation: Max. $\pm 3$ % of the nominal current

### Electrical, external control electronics

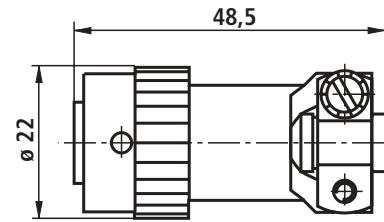
Amplifier in (separate order)	Eurocard format	analogue	Type VT-SR2-1X/..., to catalogue sheet RE 29 980
	Modular design	analogue	Type VT 11021, to catalogue sheet RE 29 743



**Note:** For details regarding the **environmental simulation test** covering EMC (electro-magnetic compatibility), climate and mechanical loading see RE 29 564-U (Declaration regarding environmental compatibility).

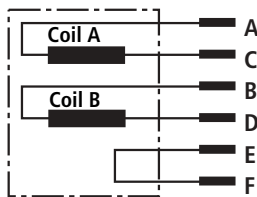
## Plug-in connector

Plug-in connector to VG 95 328  
 Separate order under Material No. **00005414**



**Connection cable:** 4 or 6 core, 0.75 mm<sup>2</sup>, screened (e.g. cable type LiYCY 4 or 6 x 0.75 mm<sup>2</sup>), to DIN VDE 0812 outside diameter 5 to 8.5 mm

## Electrical connections, external electronics



The electrical connection can either be in parallel or series. Due to reasons of operational safety and the resulting low spool inductivity, we recommend the parallel circuit.

The E-F bridge can be used for the electrical recognition of correct plug connection or can be used for cable brake recognition.

**Parallel circuit:** Connect contact A with B and C with D

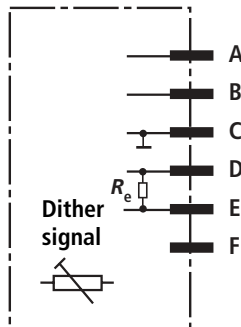
**Series circuit:** Connect contact B with C

An electrical control from A (+) to D (-) causes a flow from P to A and B to T. A reversed electrical control causes a flow from P to B and A to T.

E → F = Bridge

## Electrical connections, integrated electronics

Type 4WSE2EM 6-2X/...



	Plug-in connector allocation	Current controlled	Voltage controlled
		Ansteuerung "8"	Ansteuerung "9"
Supply voltage (± 3 %)	A	+15 V	+15 V
	B	-15 V	-15 V
	C	⊥	⊥
Command value	D	± 10 mA;	± 10 V
	E	$R_e = 1 \text{ k}\Omega$	$R_e \geq 10 \text{ k}\Omega$
	F	Not allocated	
Current consumption at the plug-in connector	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 %, current max. consumption 100 mA

**Command value:** Command value at plug-in connector terminal D = positive against plug-in connector, terminal E results in a flow from P to A and B to T.

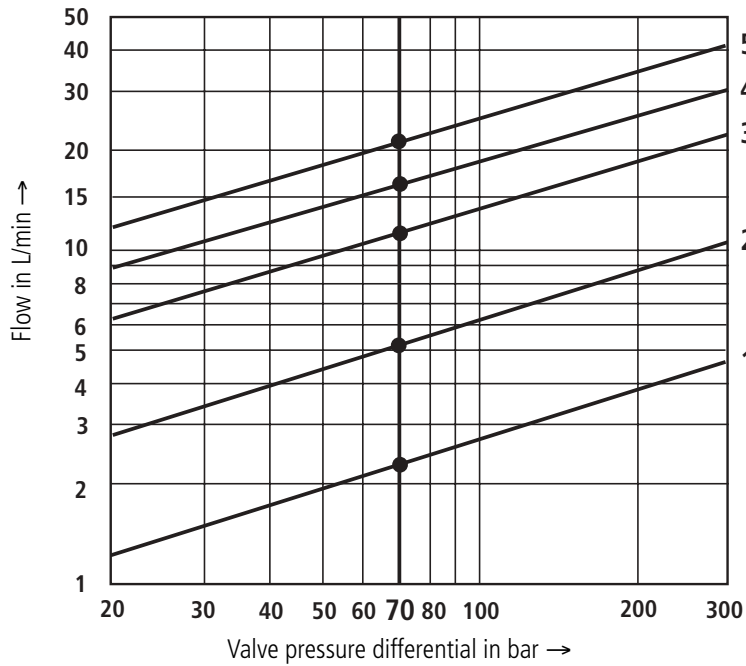
Command value at plug-in connector terminal D = negative against plug-in connector, terminal E results in a flow from P to B and A to T.

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

(Also see the European Standard "Safety requirements of fluid technology systems and components – hydraulics" EN 982!)

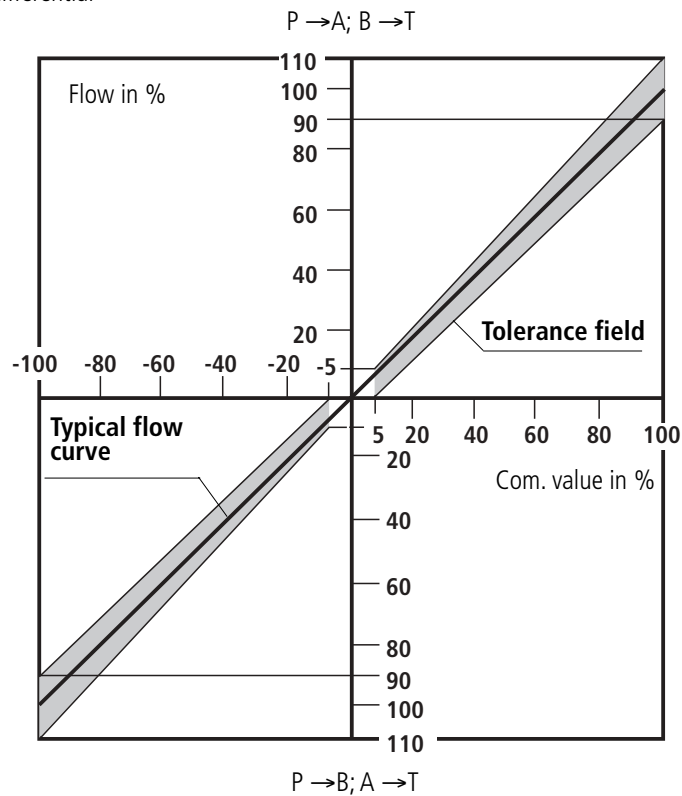
## Characteristic curves (measured with HLP 32, $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$ )

Flow-load function (tolerance  $\pm 10\%$ ) at a 100% command value signal



### The flow signal function tolerance field

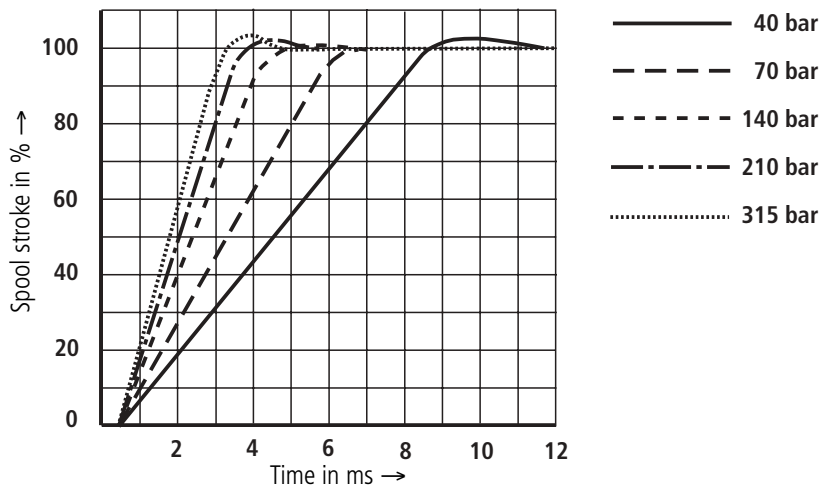
with a constant valve pressure differential



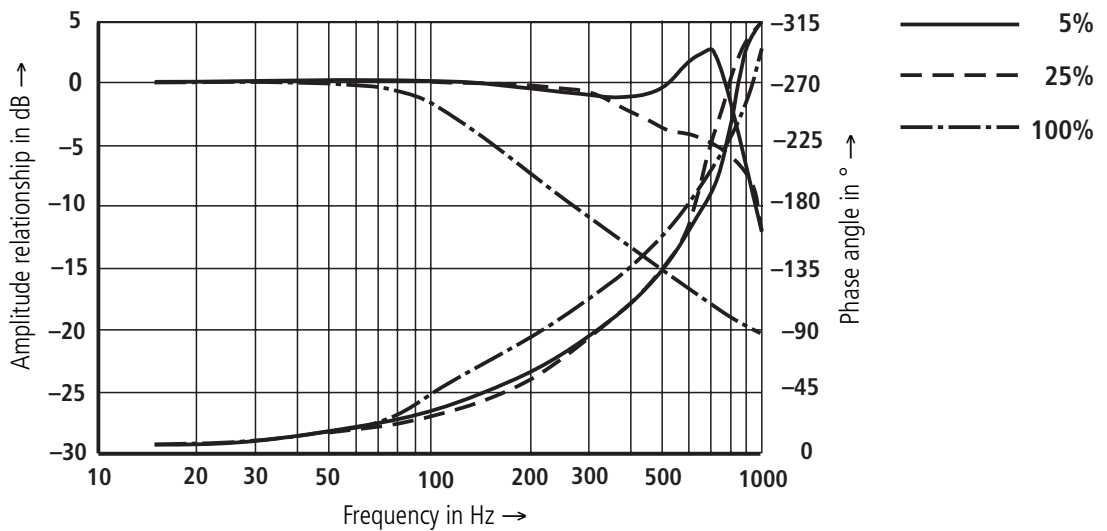


**Characteristic curves** (measured with HLP 32,  $\vartheta_{oil} = 40 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ )

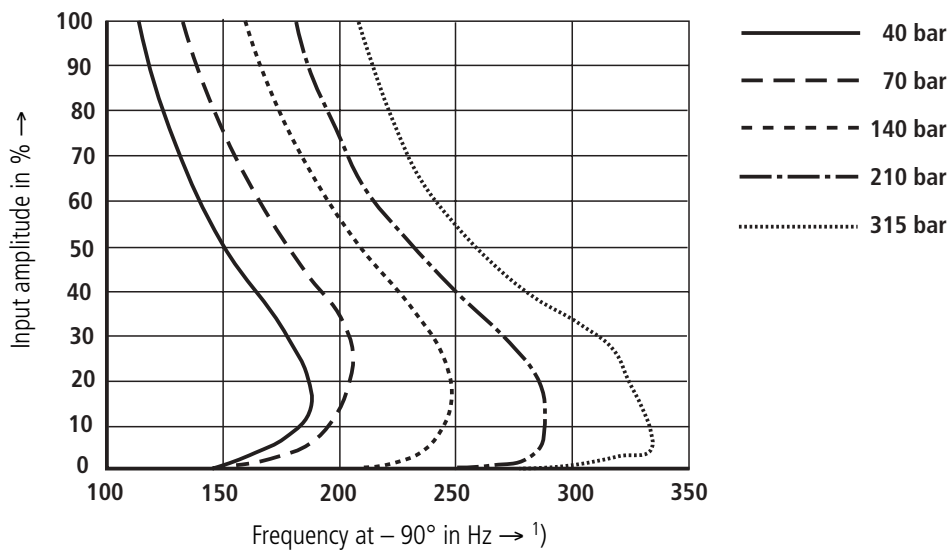
**Transient function measured with a pressure stage = 315 bar**



**Frequency response at an operating pressure = 315 bar**



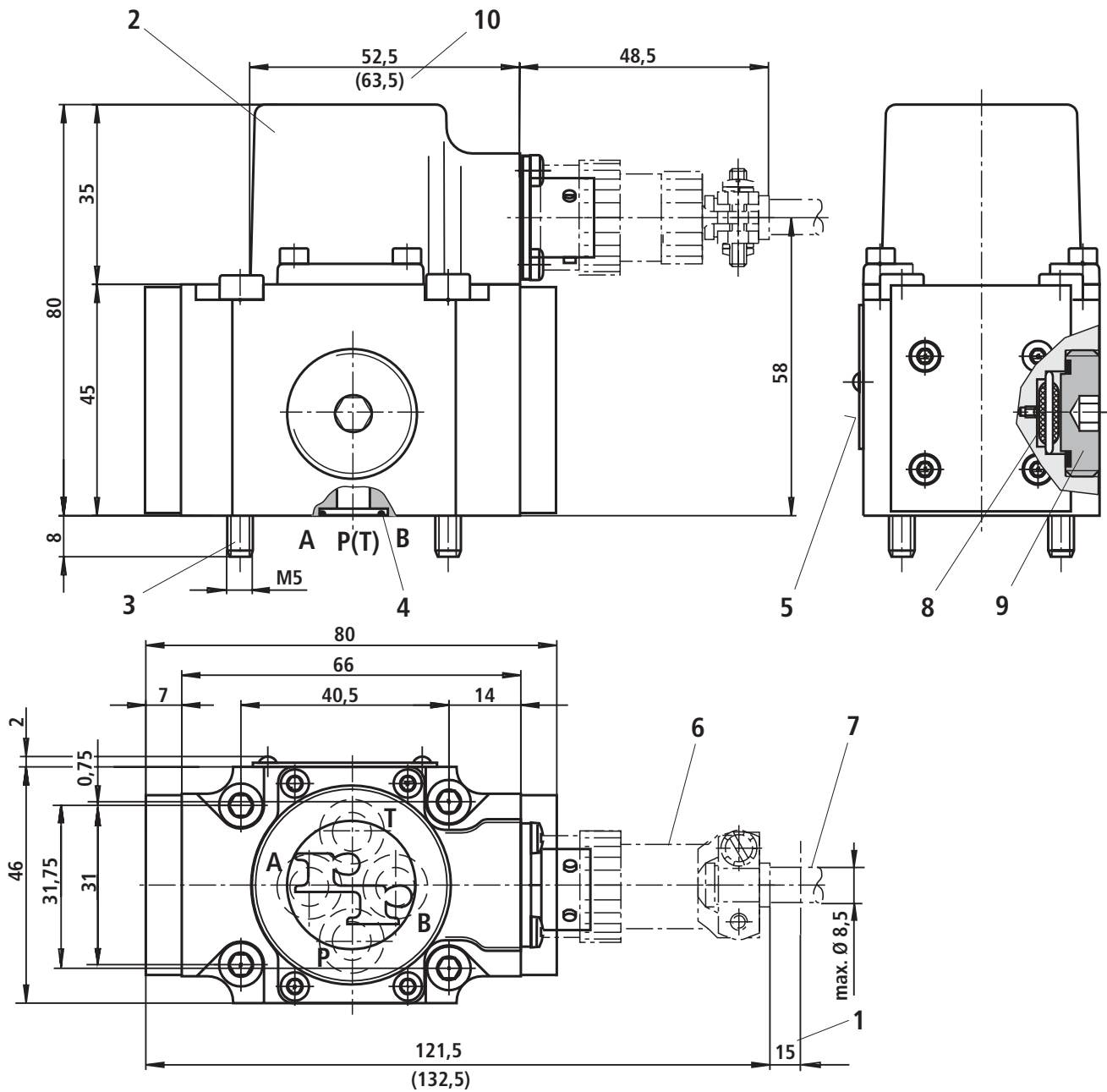
**Frequency response relationship**



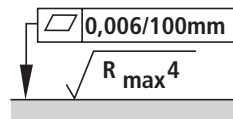
Output signal  $\hat{=}$  spool stroke with a flow without load pressure

1) Correction value at  $q_{V,nom}$ : 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 4WS2E 6 and 4WSE2EM 6 (dimensions in mm)**



- 1 Space required to remove the plug-in connector, take the connection cable into account!
- 2 Cover rotatable through 180°
- 3 Valve fixing screws (4A/F)  
4 off M5 x 50 DIN 912–10.9 NEL;  $M_A = 9.3 \text{ Nm}$   
(are included within the scope of supply)
- 4 Identical seal rings for ports P, T, A and B
- 5 Name plate
- 6 Plug-in connector (separate order, see page 7)
- 7 Connection cable, see page 7
- 8 Filter  
– Filter: Material No.: **00218621**  
– Seal: Material No.: **00012505**
- 9 After changing the filter tighten the screws (6A/F) to  $M_A = 20 \text{ Nm}$
- 10 Dim. ( ) → valve with integrated control electronics



Required surface finish of the mating piece

**Subplates**

To catalogue sheet RE 45 052, must be ordered separately.

- G 341/01 (G 1/4)
- G 342/01 (G 3/8)
- G 502/01 (G 1/2)

## Flushing plate with porting pattern to DIN 24 340 form A6 (dimensions in mm)

Symbol



With FKM seals Material No. **00936049**

Weight: 0.6 kg

- 1 4 off R-rings 9.81 x 1.5 x 1.78
- 2 4 off S.H.C.S. M5 x 40 DIN 912– 10.9  
(are included within the scope of supply);  $M_A = 8,9 \text{ Nm}$

In order to guarantee that the servo valves function correctly, it is absolutely necessary to flush the system before commissioning. The following is a guide to the flushing time necessary for the installation:

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

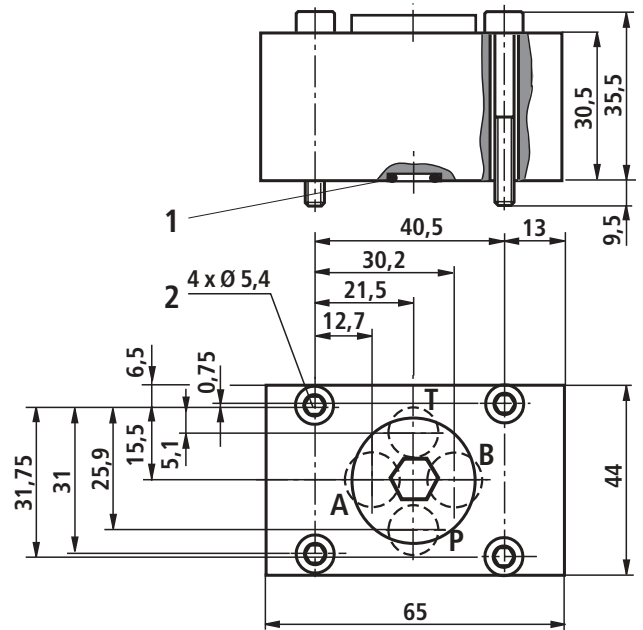
$t$  = Flushing time in hours

$V$  = Tank capacity in litres

$q_V$  = Pump flow in L/min

If the tank needs to be refilled with more than 10 % of its capacity it will be necessary to reflush the system.

A directional control valve with a porting pattern to DIN 24 340 form A6 is more suited than a flushing plate for the flushing operation, as the actuator lines can also be flushed. Also see catalogue sheet RE 07 700.



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