RE 29583-XD
Edition: 2020-11
Replaces: 04.17
RA88690535_AA

rexroth
A Bosch Company

Directional servo valve with mechanical position feedback

Type 4WS2EM ...XD

H7684

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

CE

ATEX units
For potentially explosive atmospheres

Information on explosion protection:

- Area of application in accordance with the Explosion Protection Directive 2014/34/EU: **II 2G**
- Type of protection valve: Ex db IIB T4 Gb according to EN IEC 60079-0 / EN 60079-1 and IEC 60079-0 / IEC 60079-1

Features

- 4 or 3-way version
- For intended use in potentially explosive atmosphere
- Valve for position, force, pressure or velocity control
- Subplate mounting
- Porting pattern according to 4401-05-05-0-05
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Wear-free control spool return element
- Pressure chambers at the control sleeve with gap seal, therefore no wear of seal ring

Contents

☞ **Notice:** The documentation version with which the product was supplied is valid.

Ordering code

01	02	03		04		05	06	07	08	09	10	11	12	13	14
4WS2E	**M**	**10**	**–**	**5X**	**/**		**B**	**11**	**XD**			**C**		**V**	

01	Directional servo valve, 4-way version, 2-stage, electrically operated	**4WS2E**

Control spool return

02	Mechanical	**M**

03	Size 10	**10**

04	Component series 50 ... 59 (50 ... 59: unchanged installation and connection dimensions)	**5X**

Nominal flow

05	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**

06	Control sleeve exchangeable	**B**

07	Valve for **external** control electronics; coil no. 11 (30 mA/85 Ω per coil)	**11**

Explosion protection

08	Type of protection "db"	**XD**
	For details, see information on the explosion protection, page 7	

Pilot oil supply

09	External pilot oil supply, external pilot oil return	**–**
	Internal pilot oil supply, external pilot oil return	**E**
	Internal pilot oil supply, internal pilot oil return	**ET**
	External pilot oil supply, internal pilot oil return	**T**

Inlet pressure range

10	10 ... 210 bar	**210**
	10 ... 315 bar	**315**

Electrical connection

11	Cable connection	**C**

Control spool overlap [1)]

12	0 ... 0.5% negative	**E**
	0 ... 0.5% positive	**D**
	3 ... 5% positive	**C**

Seal material (observe compatibility of seals with hydraulic fluid used, see page 6)

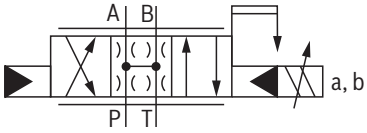
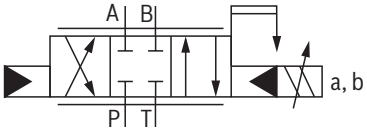
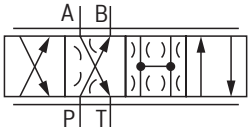
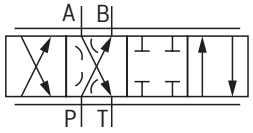
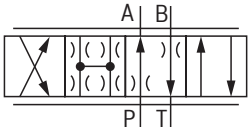
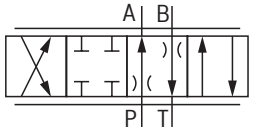
13	FKM seals	**V**

Special versions

14	Standard	**no code**
	Without control (de-energized condition), channels P → B and A → T are open 10% of the nominal quantity.	**-100**
	Without control (de-energized condition), channels P → A and B → T are open 10% of the nominal quantity.	**-102**

[1)] The control spool overlap is specified in % of the control spool stroke.

Symbols

	Control spool overlap "E"	Control spool overlap "C" and "D"
Standard		
Special version "-100"		
Special version "-102"		

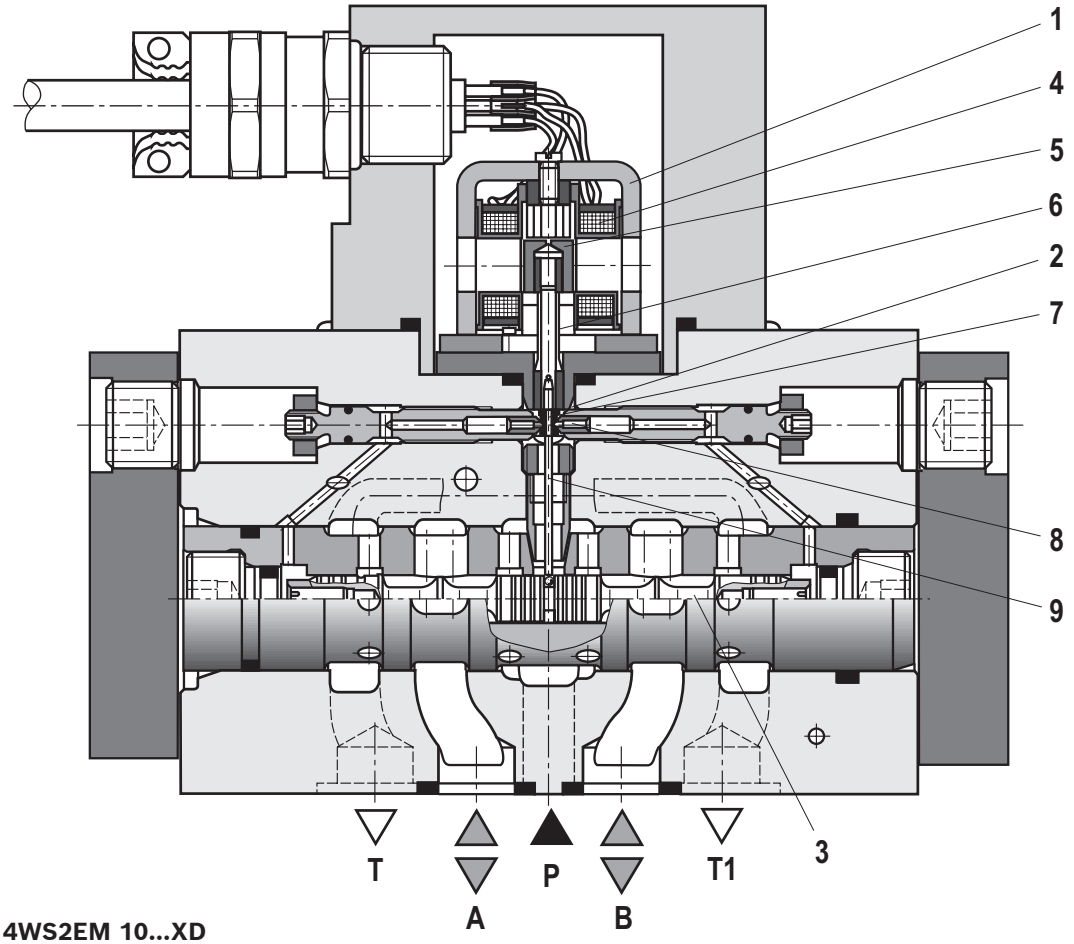
☞ **Notice:**
Representation according to DIN ISO 1219-1.

Function, section

Valves of type 4WS2EM are electrically operated, 2-stage directional servo valves. They are mainly used to control position, force, pressure or velocity.
The valves basically comprise of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (nozzle flapper plate principle) (2) and a control spool (3) in a sleeve (2ndstage) which is connected with the torque motor via a mechanical feedback.
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 bolt to move from the central position between the two control nozzles (8), and a pressure differential is created across the front sides of the control spool (3). This pressure differential results in the control spool (3) 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 (3) is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the control spool (3) is changed until the feedback torque across the bending spring and the electro-magnetic 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 (3) and consequently the flow of the servo valve are controlled proportionally to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

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.



Type 4WS2EM 10...XD

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

General		
Installation position		Any - ensure that during start-up of the system, the valve is supplied with sufficient pressure (≥ 10 bar)
Ambient temperature range	°C	–30 ... +80
Storage temperature range	°C	+5 ... +40
Maximum storage time	Years	1
Weight	kg	3.97
Surface protection		Nitro-carburated

Hydraulic									
Operating pressure range	▶ Pilot control valve								
	– Pilot oil supply	bar	10 ... 210 or 10 ... 315						
Maximum operating pressure	▶ Main valve,								
	– Port A, B, P	bar	315						
Maximum return flow pressure	▶ Port T								
	– Pilot oil return internal	bar	Pressure peaks < 100, static < 10						
	– Pilot oil return external	bar	315						
	▶ Port Y	bar	Pressure peaks < 100, static < 10						
Hydraulic fluid			See table page 6						
Hydraulic fluid temperature range		°C	–20 ... +80, preferably +40 ... +50						
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45						
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]						
Zero flow $q_{V,L}$		l/min	see characteristic curve on page 9						
Nominal flow $q_{V\,nom}$ (tolerance ±10% with valve pressure differential Δp = 70 bar)		l/min	5	10	20	30	45	60	75	90
Maximum control spool stroke with mechanical end position (in case of error) related to nominal stroke		%	120 ... 170				120 ... 150			
Feedback system			mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure amplification with 1% control spool stroke change (from the hydraulic zero point)		% of p_P	≥ 30					≥ 60		≥ 80
Zero adjustment flow across the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
	▶ Hydraulic fluid temperature	% / 20 °C	≤ 1							
	▶ Ambient temperature	% / 20 °C	≤ 1							
	▶ Operating pressure 80 ... 120% of p_P	% / 100 bar	≤ 2							
	▶ Return flow pressure 0 ... 10% of p_P	% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and simultaneously increases the life cycle of the components.
Available filters can be found at www.boschrexroth.com/filter.

$q_{V,L}$ = zero flow in l/min
$q_{V\,nom}$ = nominal flow in l/min
p_P = operating pressure in bar

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

Hydraulic fluid		Classification	Suitable sealing materials	Standards	Data sheet
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	NBR, FKM	DIN 51524	90220
Bio-degradable	▶ Insoluble in water	HETG	FKM	ISO 15380	90221
		HEES	FKM		
	▶ Soluble in water	HEPG	FKM	ISO 15380	

☞ **Important information on hydraulic fluids:**
- ▶ For further information and data on the use of other hydraulic fluids, please refer to the data sheets above or contact us.
- ▶ There may be limitations regarding the technical valve data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- ▶ The ignition temperature of the hydraulic fluid used must be at least 150 °C.

Electric			
Protection class according to EN 60529			IP65
Type of signal			analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	▶ Serial connection	H	1.0
	▶ Parallel connection	H	0.25

☞ **Notice:**
In case of control using non-Rexroth amplifiers, we recommend a superimposed dither signal.

External control electronics		
Servo amplifier in euro-card format		Type VT-SR2-1X/.60 according to data sheet 29980
Servo amplifier in modular design	analog	Type VT 11021 according to data sheet 29743

☞ **Important notice:**
The external servo amplifier and the safety barrier must be operated outside the potentially explosive atmospheres.

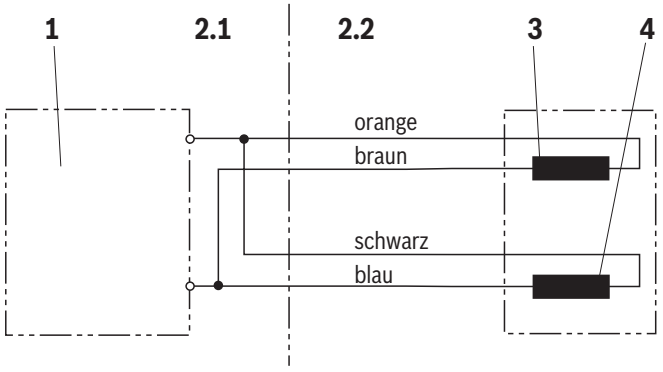
Technical data
(for applications outside these values, please consult us!)

Information on explosion protection		
Area of application according to Directive 2014/34/EU		II 2G
Type of protection according to EN IEC 60079-0 / EN 60079-1 and IEC 60079-0 / IEC 60079-1		Ex db IIB T4 Gb
IECEx Certificate of Conformity		IECEx BVS 13.0120 X
EU type examination certificate		BVS 09 ATEX E 116 X
Maximum current per coil	mA	100

☞ **Special application conditions for safe application:**
For ensuring the type of protection d "flameproof enclosure", the occurrence of explosive atmospheres in the hydraulic area of the valve must be securely avoided. This may be ensured by applying a sufficiently high pilot pressure (≥ 10 bar in channel P and/or X) before applying an electrical signal at the coils or the electronics.

Electrical connection

Example: Parallel connection



1 Control electronics
2.1 Non-explosive area
2.2 Explosive area
3 Valve, coil A
4 Valve, coil B

Connection line		
Line type		non-exchangeable, four-wire connection line
Line cross-section	mm^2	0.75 finely stranded
Line diameter	mm	5.9 ±0.3
Length	m	3

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 parallel connection.

- **Parallel connection:**
  Connect the "orange" cable connector with "black" and "brown" with "blue".
- **Serial connection:**
  Connect the "brown" cable connector with "black".

The electrical control at "orange" (+) and "blue" (–) provides for the direction of flow P → A and B → T. Reverse electrical control provides for direction of flow P → B and A → T.

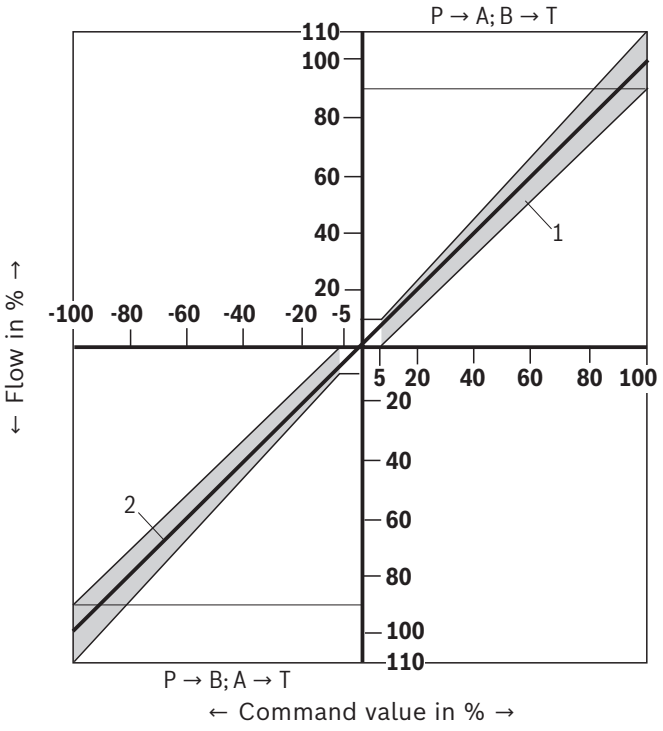
☞ **Notes:**
- The free end of the connection cable must be connected as follows according to the construction provisions:
  – outside the potentially explosive area or
  – within the potentially explosive area in terminal boxes of an acknowledged type of protection
- Only use finely stranded conductors if they have pressed-on wire end ferrules.

Characteristic curves

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

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

Standard



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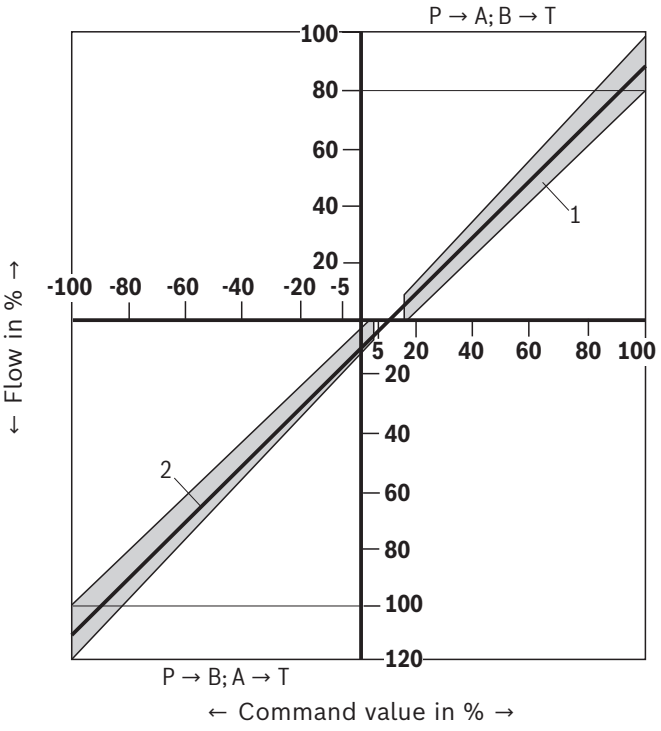

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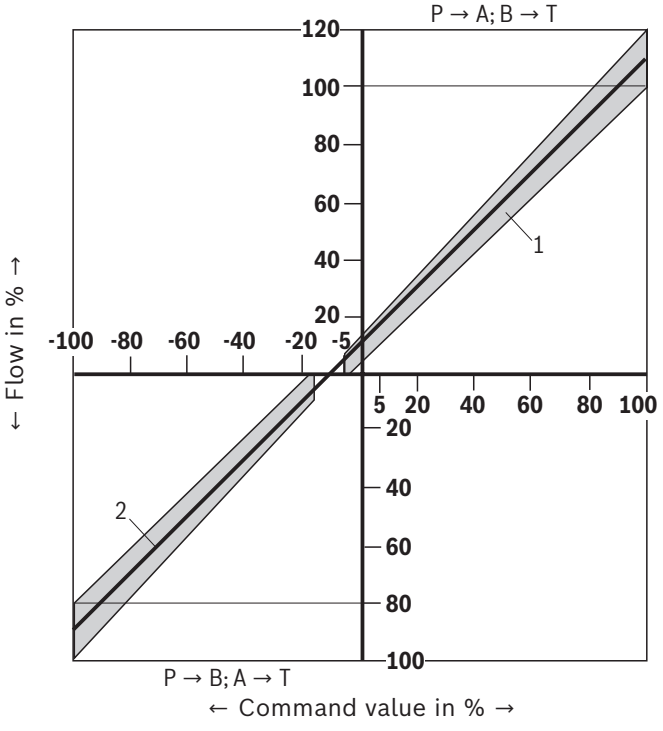


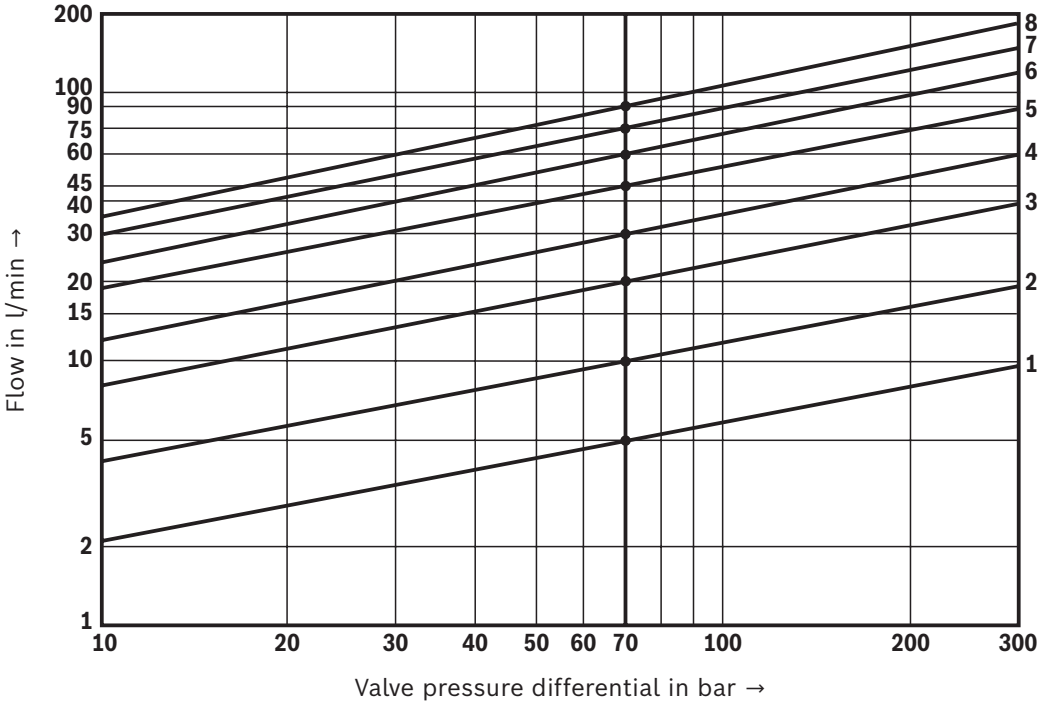
1 Tolerance field
2 Typical flow curve

Characteristic curves

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

Flow/load function

(tolerance ±10%) with 100% command value signal

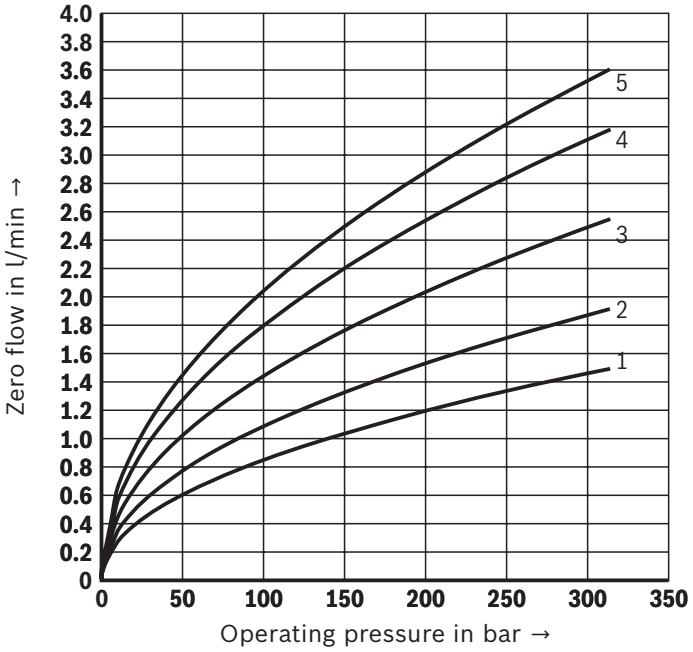


Version	Characteristic curve
"5"	1
"10"	2
"20"	3
"30"	4
"45"	5
"60"	6
"75"	7
"90"	8

☞ **Notes:**

- Flow values in the maximum command value range (see "Tolerance field of the flow/signal function")
- $\Delta p = p_P - p_L - p_T$
  Δp valve pressure differential
  p_P inlet pressure
  p_L load pressure
  p_T return flow pressure

Zero flow (with control spool overlap "E", measured without dither signal)



Nominal flow

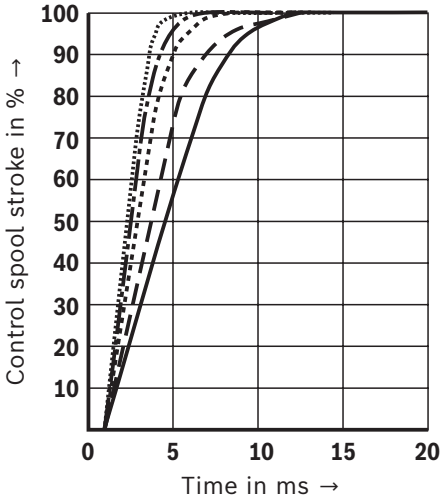
- **1** 5 l/min
- **2** 10 l/min
- **3** 20, 30, 45 l/min
- **4** 60, 75 l/min
- **5** 90 l/min

Characteristic curves

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

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

Version "5", "10" and "20"



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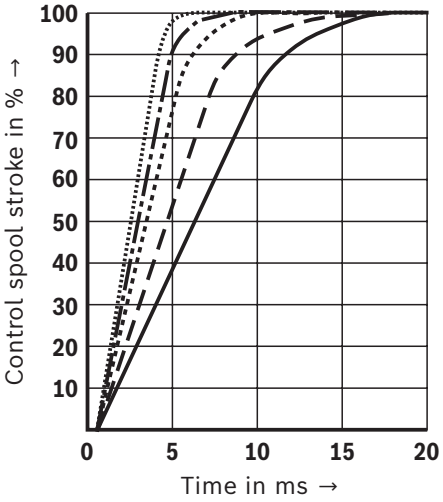

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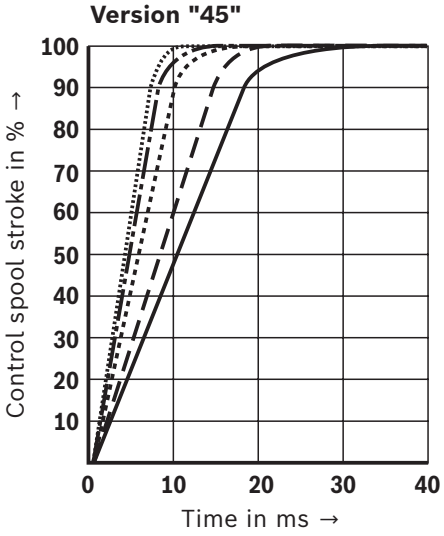

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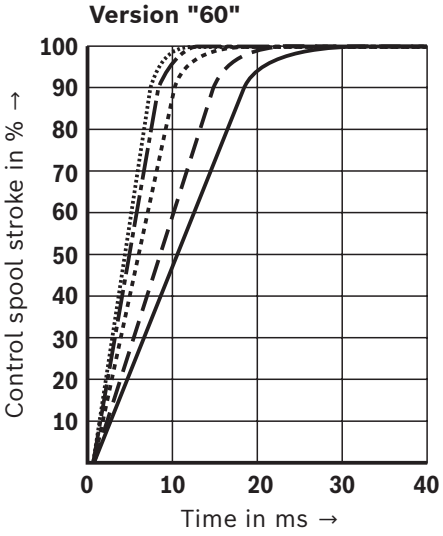

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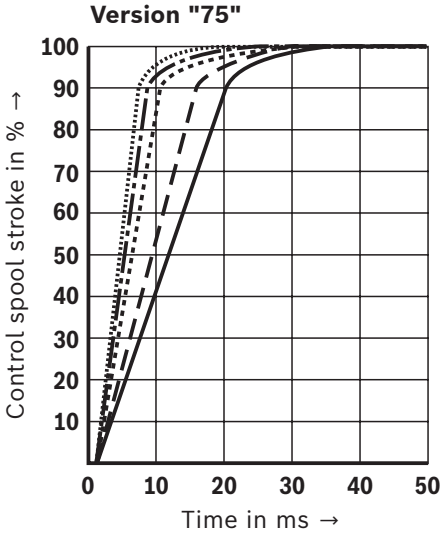

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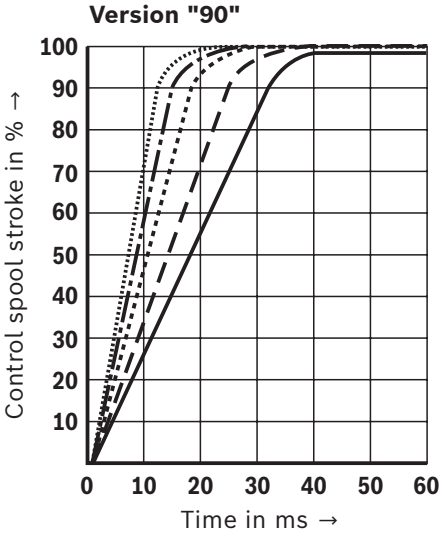
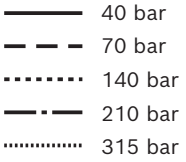


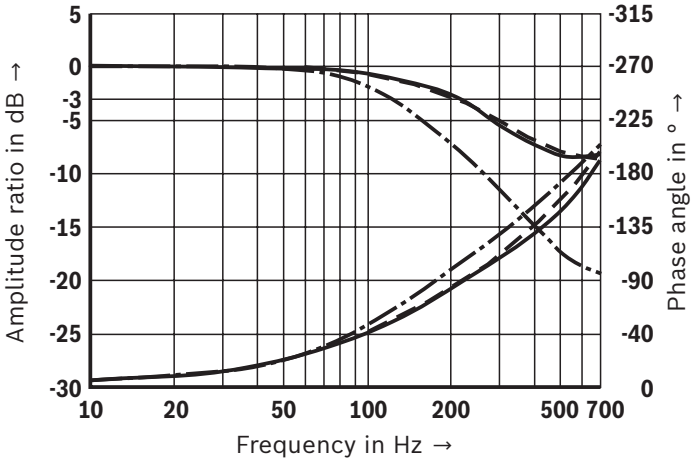


Characteristic curves

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

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

Version "5", "10" and "20"



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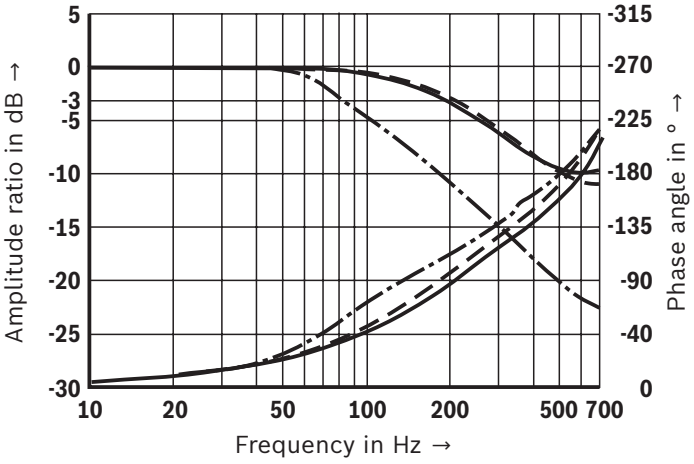

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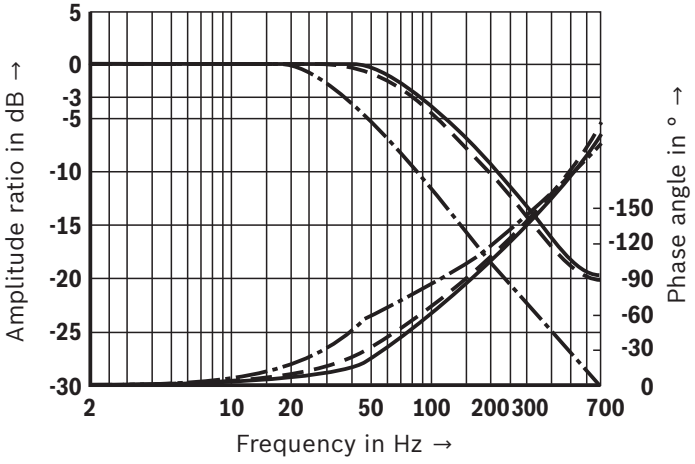

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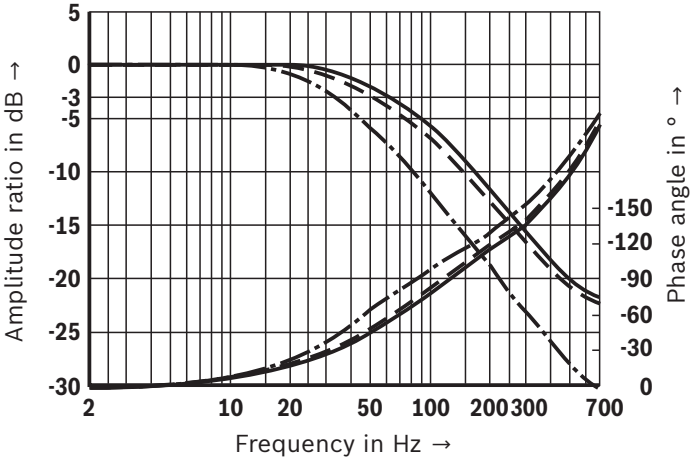

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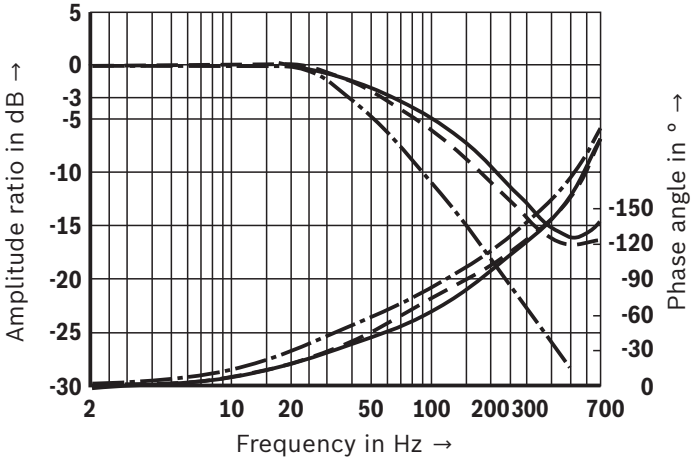

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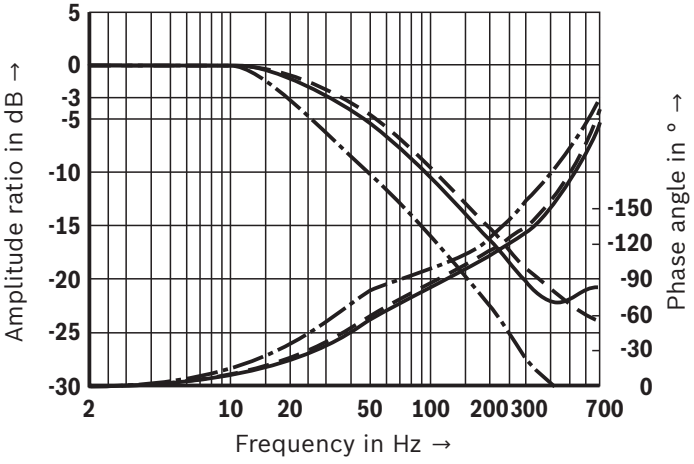
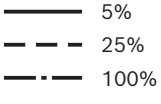


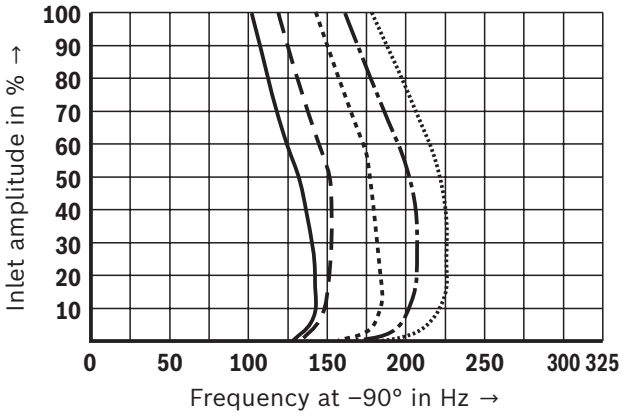


Characteristic curves

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

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

Version "5", "10" and "20"



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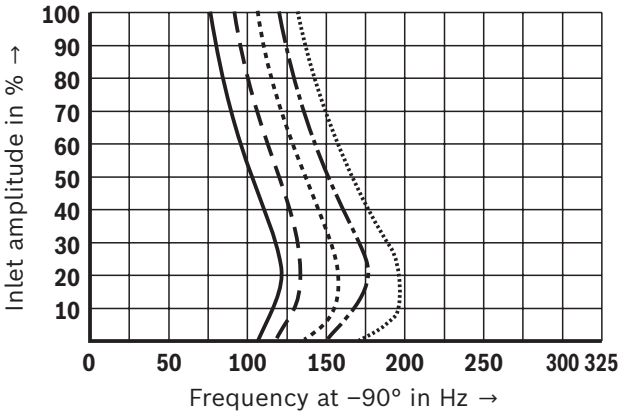

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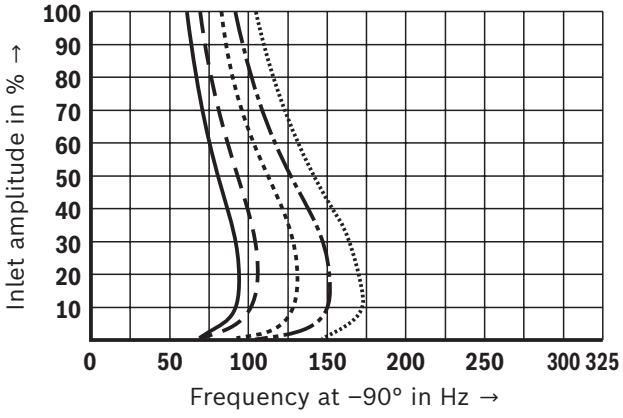

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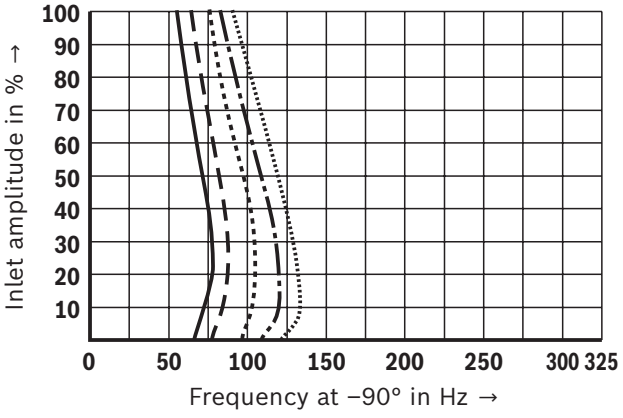

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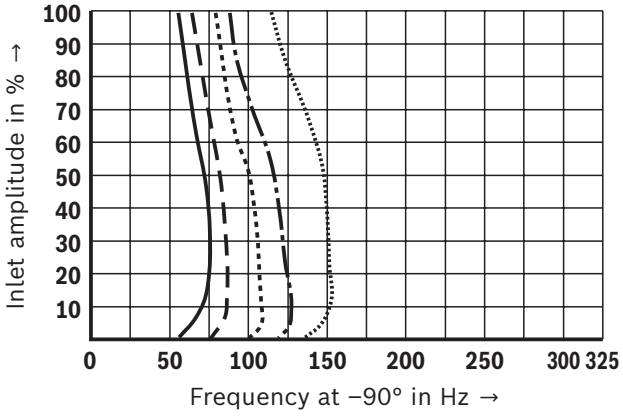
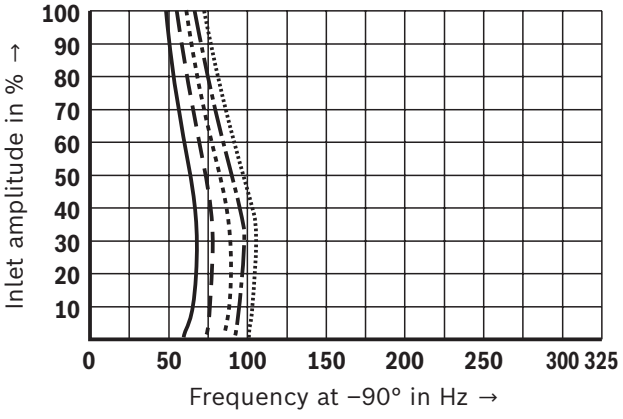
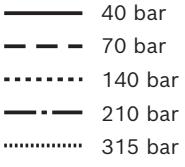
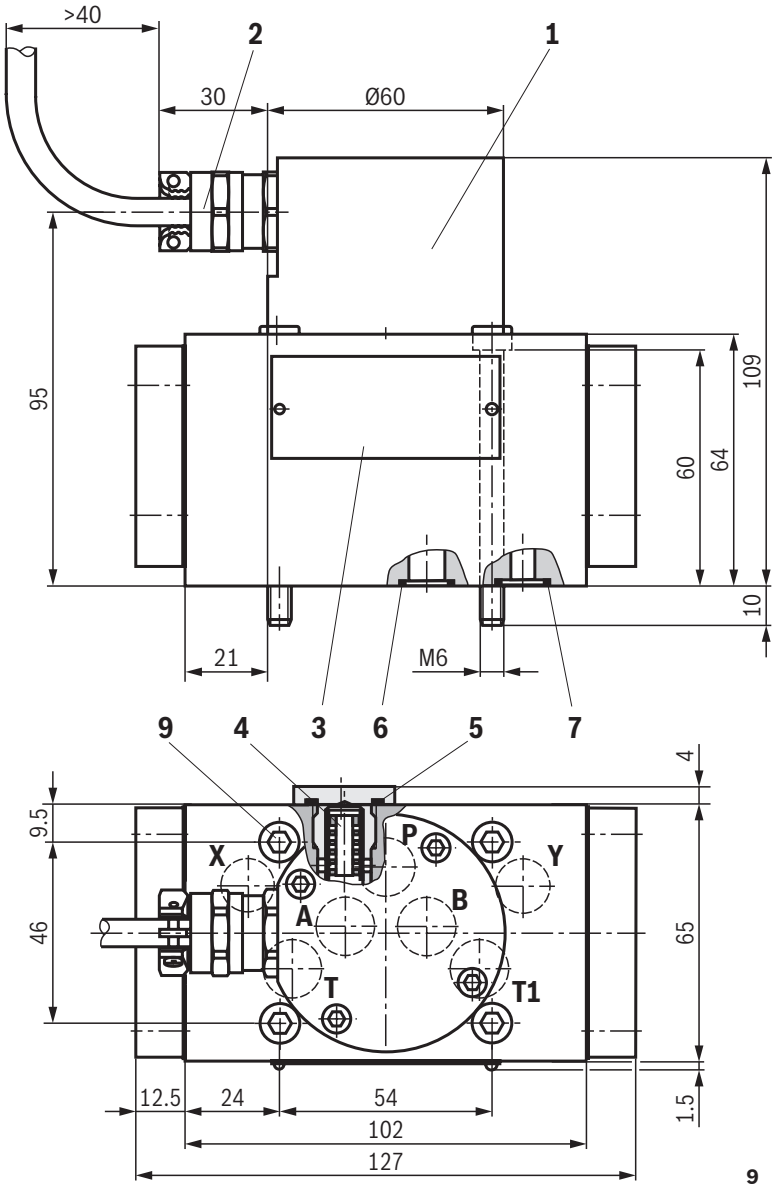


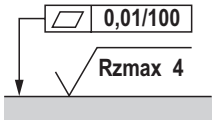
Version "90"



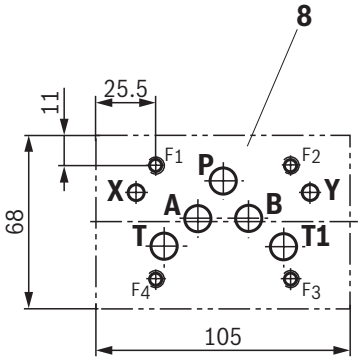


Dimensions
(dimensions in mm)





Required surface quality
of the valve contact surface



1 Cap
2 Cable gland with 3 m cable
3 Name plate
4 Exchangeable filter element, material no.: **R961001950**
5 Profile seal for filter screw M16 x 1.5 (part of item 4)
6 Identical seal rings for ports P, A, B, T and T1
7 Identical seal rings for ports X and Y;
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return
8 Machined valve contact surface;
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.

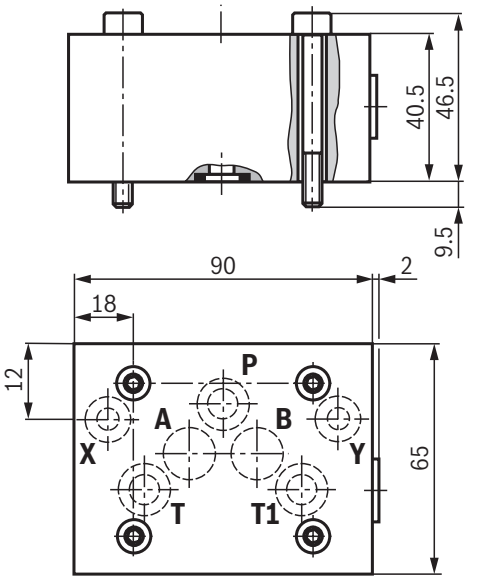
9 **Valve mounting screws** (included in the scope of delivery)
Only use valve mounting screws with the subsequently listed thread diameters and strength properties. Observe the screw-in depth.
4 hexagon socket head cap screws ISO 4762 - M6 x 70 - 10.9
(Friction coefficient μ_{total} = 0.09 ... 0.14)
Tightening torque M_A = 12.5 Nm ± 1.5 Nm

Subplates (separate order) with porting pattern according to ISO 4401-05-05-0-05, see data sheet 45100.

☞ **Notes:**
- The dimensions are nominal dimensions which are subject to tolerances.
- Subplates are no components in the sense of Directive 2014/34/EU and can be used after the manufacturer of the overall system has conducted an assessment of the risk of ignition. The "G...J3" versions are free from aluminum and/or magnesium and galvanized.

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

Symbol



Ordering code and further information

- Material number **R901541299**
- Weight 2.0 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws (included in the scope of delivery)
  For reasons of stability, exclusively the following mounting screws are to be used:
  4 hexagon socket head cap screws
  ISO 4762 - M6 x 50 - 10.9
  (friction coefficient μ_{total} = 0.09 ... 0.14);
  Tightening torque M_A = 12.5±1.5 Nm

☞ **Notice:**
Before assembly and operation, please observe the information in the 29583-XD-B operating instructions.

Further information

▶ Analog amplifier module type VT 11021	Data sheet 29743
▶ Analog amplifier type VT-SR2-1X/.60	Data sheet 29980
▶ Subplates	Data sheet 45100
▶ Hydraulic fluids on mineral oil basis	Data sheet 90220
▶ Environmentally compatible hydraulic fluids	Data sheet 90221
▶ Use of non-electrical hydraulic components in an explosive environment (ATEX)	Data sheet 07011
▶ Selection of filters	www.boschrexroth.com/filter
▶ Information on available spare parts	www.boschrexroth.com/spc

Notes

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