

Proportional pressure relief valves, pilot-operated

Types (Z)DBE and (Z)DBEE



- ▶ Size 6
- ▶ Component series 2X
- ▶ Maximum operating pressure 350 bar
- ▶ Maximum flow 30 l/min

Features

- ▶ Subplate mounting
- ▶ Sandwich plate design
- ▶ Porting pattern according to ISO 4401-03-02-0-05
- ▶ Operation by means of proportional solenoid
- ▶ Proportional solenoid with rotatable and detachable coil
- ▶ Integrated electronics (OBE) (type (Z)DBEE)
 - Low manufacturing tolerance of the pressure command value characteristic curve
- ▶ External control electronics (type (Z)DBE)
 - Amplifier in modular design and as plug-in amplifier
 - Linear pressure/command value characteristic curve

Contents

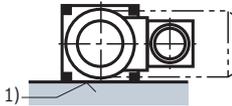
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Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14
	DBE		6		2	-	2X	/			G24		*

01	Subplate mounting	no code
	Sandwich plate design	Z
02	Proportional pressure relief valve	DBE
03	External control electronics	no code
	Integrated electronics (OBE)	E
04	Size 6	6
05	Subplate mounting	no code
	Pressure limitation in channel P	VP

Preferred position of the proportional solenoid

06	 <p>The mating connector can be brought to the desired position after loosening the nut, see "Dimensions" page 15 ... 18.</p>	2
07	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X

Pressure rating

08	Maximum set pressure 25 bar	25
	Maximum set pressure 50 bar	50
	Maximum set pressure 100 bar	100
	Maximum set pressure 200 bar	200
	Maximum set pressure 315 bar	315
	Maximum set pressure 350 bar	350

Pilot oil flow

09	Internal pilot oil return (recommendation: subplate mounting up to $q_{V \max} = 15$ l/min)	no code
	External pilot oil return ("subplate mounting" only)	Y
10	Direct voltage 24 V	G24

Electrical connection

11	- Type (Z)DBE	
	Connector, 3-pole (2 + PE) according to EN 175301-803	K4 ²⁾
	- Type (Z)DBEE	
	Connector, 7-pole (6 + PE) according to EN 175201-804	K31 ²⁾

Electrical interface

12	External control electronics	no code
	Command value input 0 ... 10 V; actual value output 0 ... 1.6 V	A1
	Command value input 4 ... 20 mA; actual value output 0 ... 1.6 V	F1

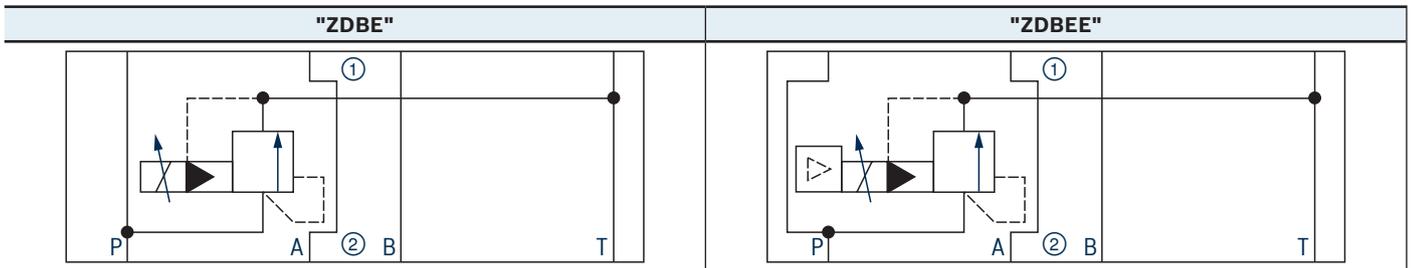
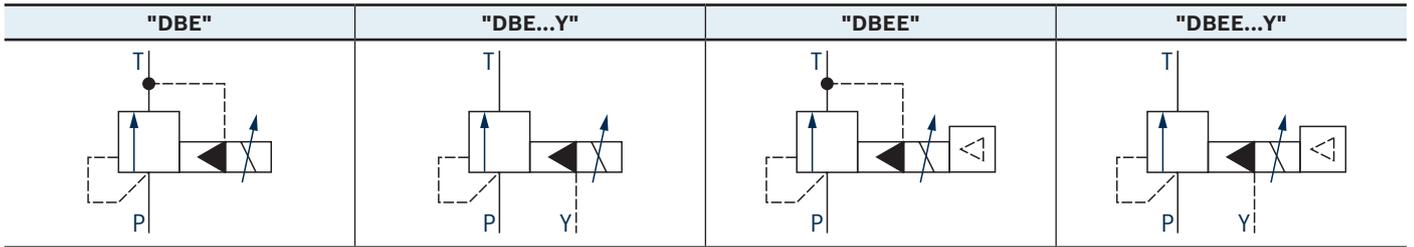
Seal material (observe compatibility of seals with hydraulic fluid used, see page 6)

13	NBR seals	M
	FKM seals	V
14	For further information, see the plain text	

¹⁾ Valve contact surface (seal ring recesses in the housing)

²⁾ Mating connectors, separate order, see page 19 and data sheet 08006.

Symbols (1) = component side, (2) = plate side)



Function, section

General information

Pilot-operated proportional pressure relief valves type (Z)DBE are operated by a proportional solenoid. The valves are used for system pressure limitation. Dependent on the electric command value, these valves can be used to steplessly set the system pressure to be limited. These valves essentially consist of a pilot control valve with a proportional solenoid (1), a poppet (2), a valve seat (3) and a main stage with a housing (4) and a main control spool (5).

Basic principle

The proportional solenoid converts the electric current proportionally into mechanical force. An increase of the current results in a correspondingly higher solenoid force. The system pressure is set in a command value-dependent form via the proportional solenoid (1). The pressure in channel P applied by the system acts on the right side of the main control spool (5). Simultaneously, the system pressure acts via the control line (7) which is equipped with the nozzle (6) on the spring-loaded side of the main control spool (5).

Via the valve seat (3), the pressure in the spring chamber at the poppet (2) acts against the force of the proportional solenoid (1). When the pressure has reached the pre-set value, the poppet (2) is lifted off the seat. The pilot oil can now (depending on the version) drain externally via port A (Y) or internally into the tank, which results in a limitation of the pressure on the spring-loaded side of the main control spool (5). If the system pressure continues to rise slightly, the higher pressure on the right

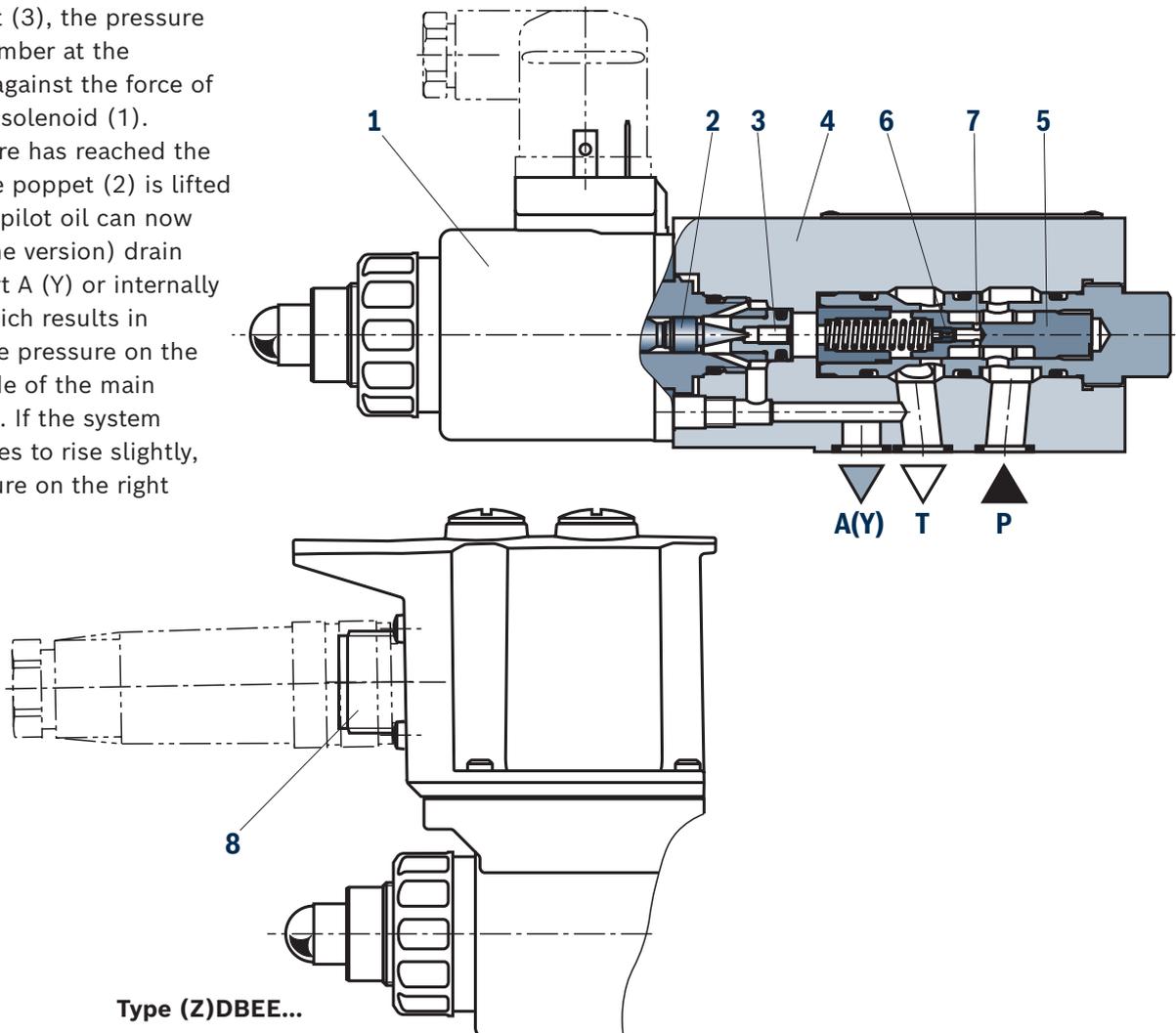
hand side of the main control spool (5) will push the spool to the left into the control position P→T. At a minimum control current (command value = zero), the minimum set pressure will be set.

Information:

The tank lines should be prevented from running empty. With corresponding installation conditions, a preload valve (preload pressure approx. 1 bar) must be installed.

Type (Z)DBEE – with integrated electronics (OBE)

Corresponding to type (Z)DBE in function and set-up. The integrated electronics unit (OBE) is located on the proportional solenoid. Supply and command value voltage are applied at the connector (8). At the factory, the command value pressure characteristic curve is adjusted with little manufacturing tolerance.



Type (Z)DBEE...

Technical data

(For device application outside the specified values, please contact us!)

General			
Type of connection			Subplate mounting; sandwich plate design
Porting pattern			ISO 4401-03-02-0-05
Weight	▶ "(Z)DBE"	kg	2.4
	▶ "(Z)DBEE"	kg	2.5
Installation position			Any
Ambient temperature range	▶ "(Z)DBE"	°C	-20 ... +70 (NBR seals) -15 ... +70 (FKM seals)
	▶ "(Z)DBEE"	°C	-20 ... +60 (NBR seals) -15 ... +60 (FKM seals)
Storage temperature range (with UV protection)		°C	+5 ... +40
Maximum storage time		Years	1 (if the storage conditions are observed, refer to the operating instructions 07600-B)
Maximum relative humidity (no condensation)		%	97
Protection class according to EN 60529			IP65 (if suitable and correctly mounted mating connectors are used)
MTTF _D value according to EN ISO 13849		Years	75 (for further details see data sheet 08012)
Sine test according to EN 60068-2-6			10 ... 2000 Hz / maximum 10 g / 20 cycles / 3 axes
Noise test according to EN 60068-2-64			20 ... 2000 Hz / 14 g _{RMS} / 24 h / 3 axes
Transport shock according to EN 60068-2-27			15 g / 11 ms / 3 shocks / 3 axes
Conformity	▶ CE according to EMC Directive 2014/30/EU, tested according to		EN 61000-6-2 and EN 61000-6-3
	▶ UKCA according to Electromagnetic Compatibility Regulations SI 2016/1091, tested according to		EN 61000-6-2 and EN 61000-6-3
	▶ RoHS directive		2011/65/EU ¹⁾

Hydraulic			
Maximum operating pressure	▶ Port P, P①→P②, A①→A②; B①→B②	bar	350
	▶ Port T	bar	50
	Port A (Y)		Separately depressurized to the tank
Hydraulic fluid			See table on page 6
Hydraulic fluid temperature range (at the valve working ports)		°C	-20 ... +80 (NBR seals) -15 ... +80 (FKM seals)
Viscosity range	▶ Recommended	mm ² /s	30 ... 46
	▶ Maximum admissible	mm ² /s	15 ... 380
Maximum admissible degree of contamination of the hydraulic fluid; cleanliness class according to ISO 4406 (c)			Class 20/18/15 ²⁾
Maximum flow		l/min	30
Maximum set pressure		bar	25; 50; 100; 200; 315; 350
Minimum set pressure (command value 0 V or 4 mA)		bar	See characteristic curves page 13
Pilot flow		l/min	0.6 ... 1.2
Minimum line volume		ml	20

¹⁾ The product fulfills the substance requirements of the RoHS Directive 2011/65/EU.

²⁾ 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 life cycle of the components.

Technical data

(For device application outside the specified values, please contact 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	ISO 15380	90221
		HEES		
	▶ Soluble in water	HEPG	ISO 15380	
Flame-resistant	▶ Water-free	HFDU (glycol base)	ISO 12922	90222
		HFDU (ester base)		
		HFDR		
	▶ Containing water	HFC (Fuchs: Hydrotherm 46M, Renosafe 500; Petrofer: Ultra Safe 620; Houghton: Safe 620; Union: Carbide HP5046)	NBR	ISO 12922

**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 restrictions on the technical data (temperature, pressure range, life cycle, maintenance intervals, etc.).
- ▶ The ignition temperature of the hydraulic fluid used must be 50 K higher than the maximum surface temperature.
- ▶ **Bio-degradable and flame-resistant – containing water:**
If components with galvanic zinc coating (e.g. version "J3" or "J5") or parts containing zinc are used, small amounts of dissolved zinc may get into the hydraulic system and cause accelerated aging of the hydraulic fluid. Zinc soap may form as a chemical reaction product, which may clog filters, nozzles and solenoid valves – particularly in connection with local heat input.

▶ Flame-resistant – containing water:

Due to an increased cavitation tendency with the use of HFC hydraulic fluids, the life cycle of the component may be reduced by up to 30% as compared to use with HLP mineral oil. In order to reduce the cavitation effect, it is recommended – if possible, specific to the installation – to back up the return flow pressure in ports T to approx. 20% of the pressure differential at the component.

Static/dynamic

Hysteresis ³⁾		%	±3
Manufacturing tolerance ³⁾ (of the command value pressure characteristic curve, related to the hysteresis characteristic curve, pressure increasing)	▶ "(Z)DBE"	%	±5
	▶ "(Z)DBEE"	%	±1.5
Linearity ³⁾		%	±3.5
Repetition accuracy ³⁾		%	<±2
Step response $T_u + T_g$ ⁴⁾	▶ 10 ... 90%	ms	130 (system dependent)
	▶ 90 ... 10%	ms	110 (system dependent)

³⁾ Of the maximum set pressure

⁴⁾ Line volume <20 cm³, $q_V = 5$ l/min

Technical data

(For device application outside the specified values, please contact us!)

Electrical			
Minimum solenoid current		mA	≤100
Maximum solenoid current		mA	1600±10%
Solenoid coil resistance	▶ Cold value at 20 °C	Ω	5.5
	▶ Maximum hot value	Ω	8.05

Electrical, integrated electronics (OBE) – interface "A1"			
Supply voltage	▶ Nominal value	VDC	24
	▶ Minimum	VDC	21
	▶ Maximum	VDC	35
	▶ Maximum residual ripple	V _{pp}	2.5
	▶ Maximum power consumption	VA	40
	▶ Current consumption during operation ⁵⁾		
	– Rated current	A _{eff}	<2
– Impulse current	A	3.2	
▶ Fuse protection, external	A _T	2 (time-lag)	
Charging capacity (externally effective)		μF	<1000
Relative duty cycle time according to VDE 0580			S1 (continuous operation)
Functional ground and screening			See pin assignment, page 9
Command value (differential amplifier)	▶ Measurement range	V	0 ... 10
	▶ Input resistance	kΩ	>100
Actual value (test signal)	▶ Output range	V	0 ... 1.6 (1 mV ± 1 mA)
	▶ Minimum load impedance	kΩ	>2

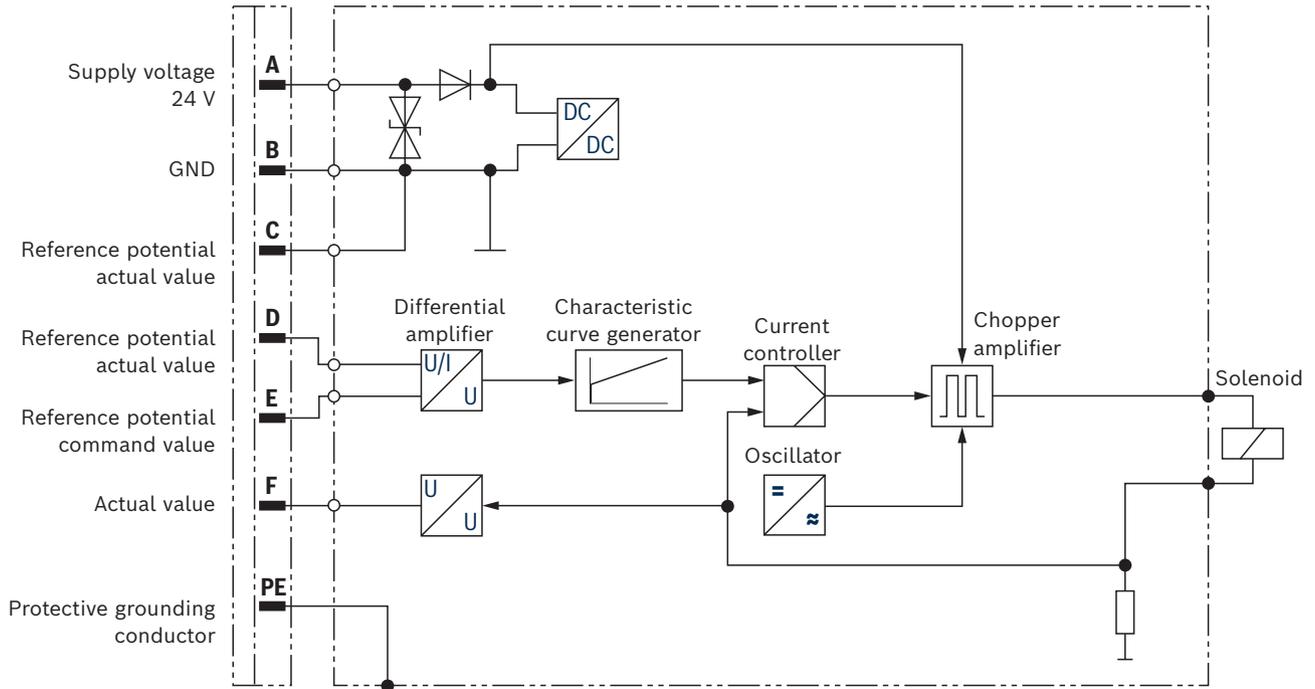
Electrical, integrated electronics (OBE) – interface "F1"			
Supply voltage	▶ Nominal value	VDC	24
	▶ Minimum	VDC	21
	▶ Maximum	VDC	35
	▶ Maximum residual ripple	V _{pp}	2.5
	▶ Maximum power consumption	VA	40
	▶ Current consumption during operation ⁵⁾		
	– Rated current	A _{eff}	<2
– Impulse current	A	3.2	
▶ Fuse protection, external	A _T	2 (time-lag)	
Charging capacity (externally effective)		μF	<1000
Relative duty cycle time according to VDE 0580			S1 (continuous operation)
Functional ground and screening			See pin assignment, page 9
Command value	▶ Input current range	mA	4 ... 20
	▶ Input resistance	Ω	100
Actual value (test signal)	▶ Output range	V	0 ... 1.6 (1 mV ± 1 mA)
	▶ Maximum load	kΩ	>2

⁵⁾ The making current peak is usually higher (depending on power supply unit, supply line, and capacities).

**Notice:**

EMC directive requirements see page 19.

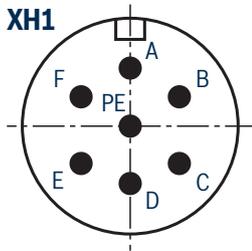
Block diagram/pin assignment



Electrical connections and assignment

Connector pin assignment "XH1", 6-pole + PE according to DIN 43563

Pin	Interface assignment	
	"A1"	"F1"
A	Supply voltage	Supply voltage
B	GND	GND
C	Reference potential actual value (connect with GND on control side)	Reference potential actual value (connect with GND on control side)
D	Command value	Command value
E	Reference potential command value (connect with GND on control side)	Reference potential command value (connect with GND on control side; current loop I_{D-E} feedback)
F	Actual value	Actual value
PE	Functional ground (directly connected to the valve housing)	



Command value:

- ▶ "A1": 0 ... +10 V
- ▶ "F1": 4 ... 20 mA

Connection cable:

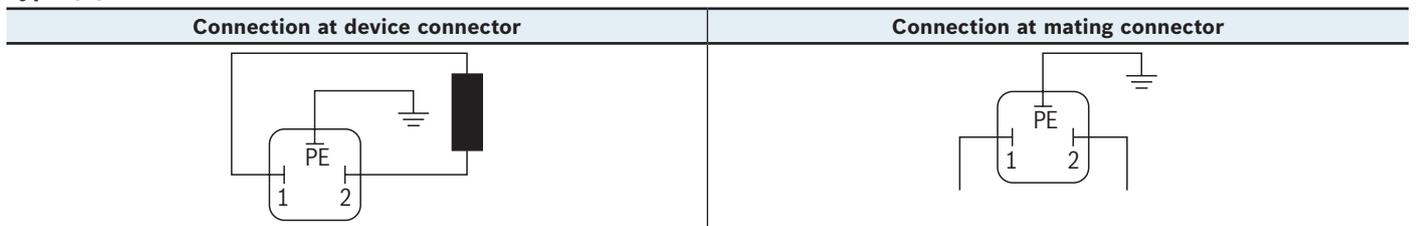
- ▶ Up to 20 m cable length type LiYCY 7 x 0.75 mm²
- ▶ Up to 40 m cable length type LiYCY 7 x 1.0 mm²



Information:

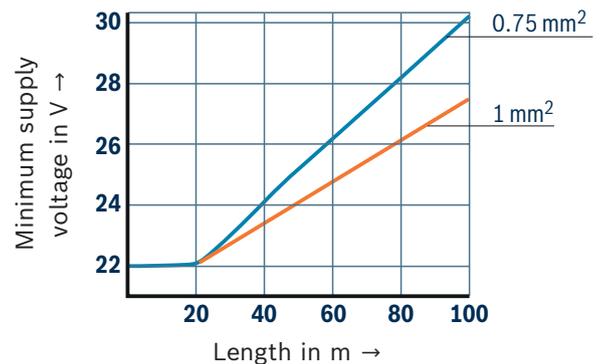
- ▶ Mating connectors, separate order, see page 19 and data sheet 08006.
- ▶ EMC directive requirements see page 19.

Type (Z)DBE



Connection cable (recommendation):

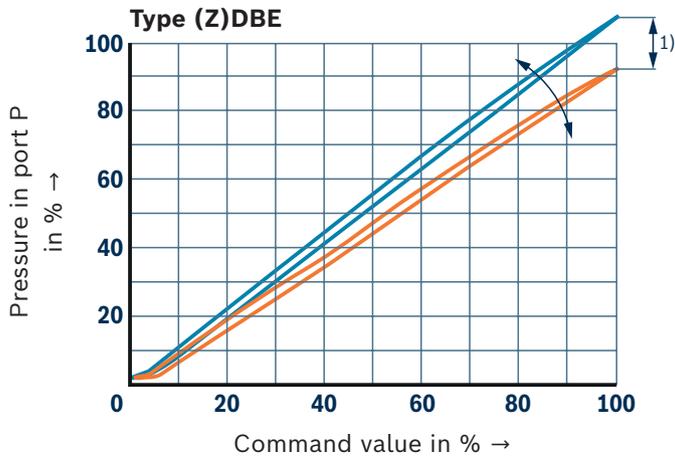
- ▶ 6-wire, 0.75 or 1 mm² plus protective grounding conductor and screening
 - ▶ Only connect the screening to PE on the supply side
 - ▶ Maximum admissible length = 100 m
- The minimum supply voltage at the power supply unit depends on the length of the supply line (see diagram).



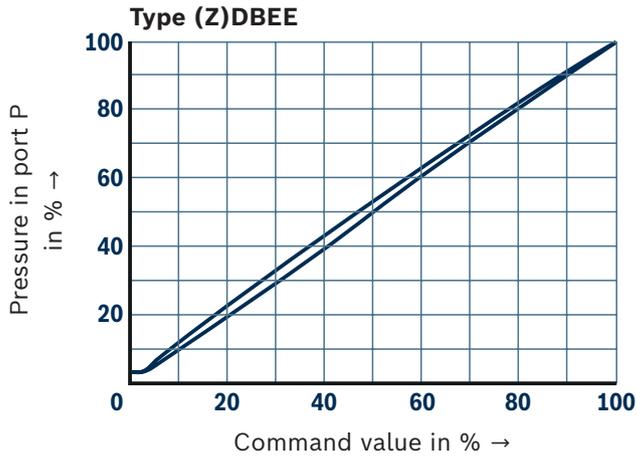
Characteristic curves

(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

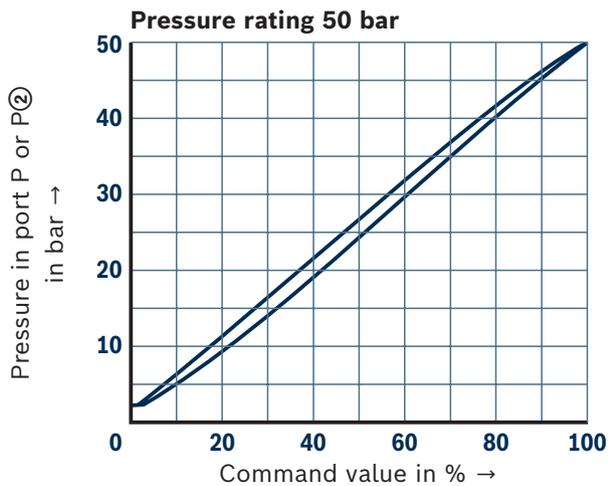
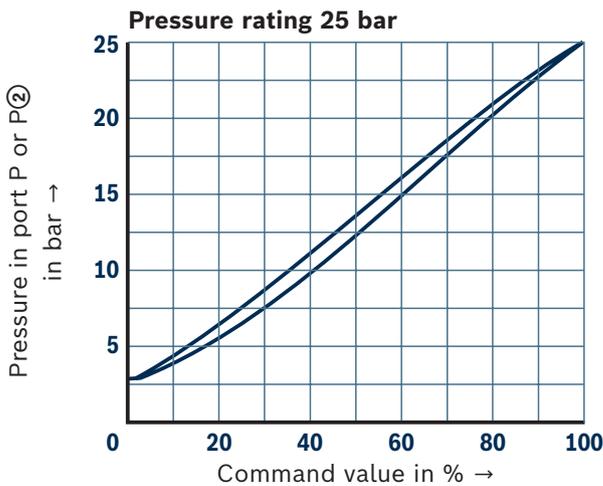
Pressure in port P dependent on the command value (flow = 5 l/min)



1) In order to be able to adjust several valves to the same characteristic curve, the manufacturing tolerance can be changed with version "DBE" at the external amplifier (see page 19) using the command value attenuator "G". In this connection, do not set the pressure higher than the maximum set pressure of the pressure rating with command value 100%.



Pressure in port P or P② dependent on the command value (flow = 5 l/min)



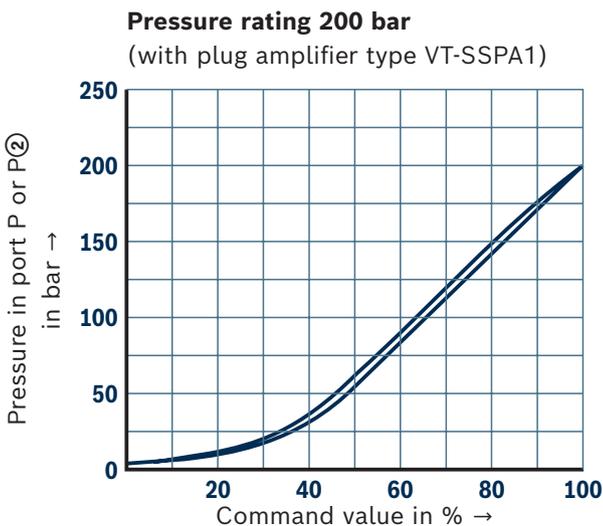
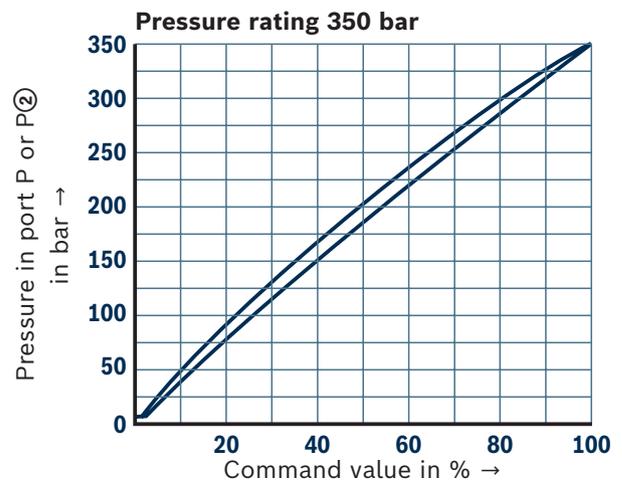
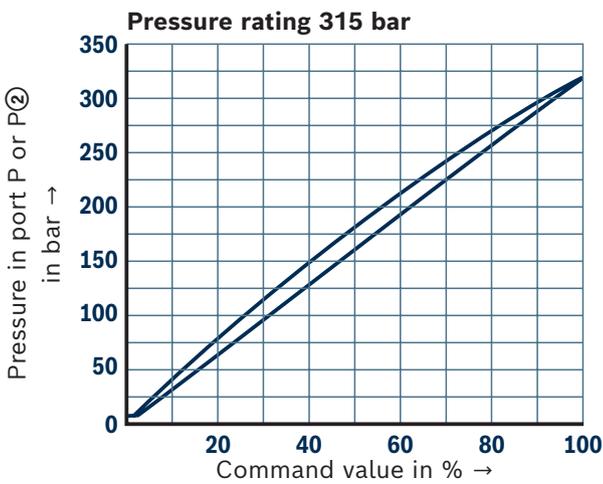
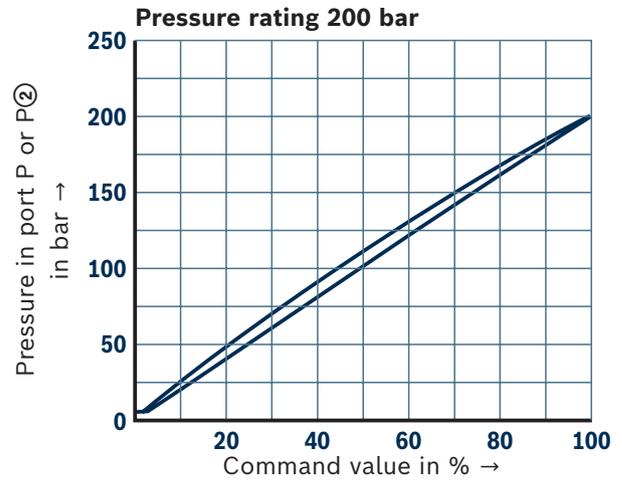
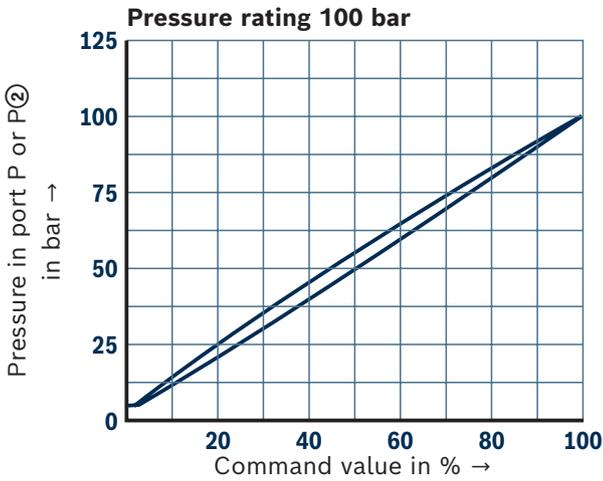
Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves

(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Pressure in port P or P② dependent on the command value (flow = 5 l/min)



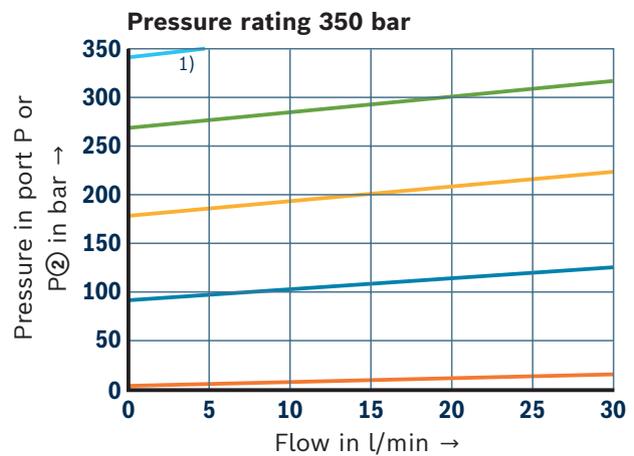
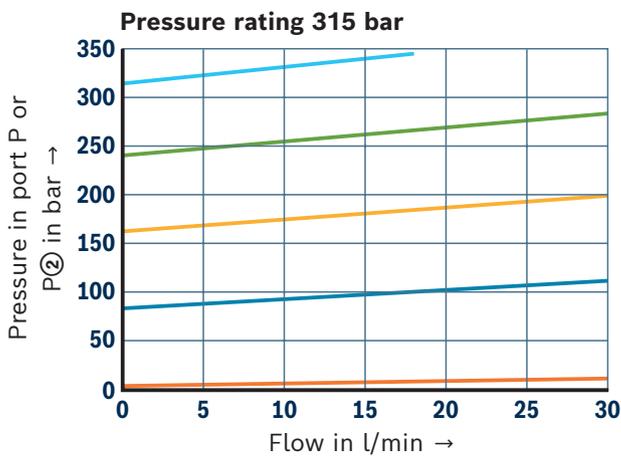
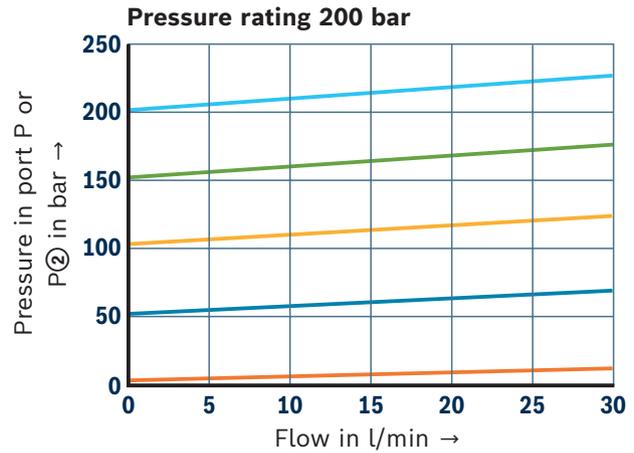
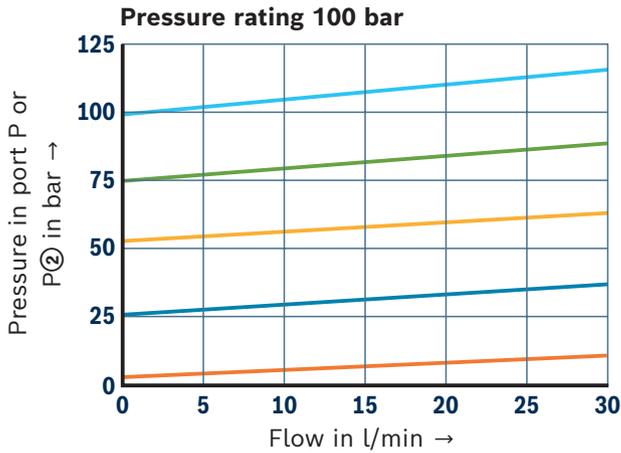
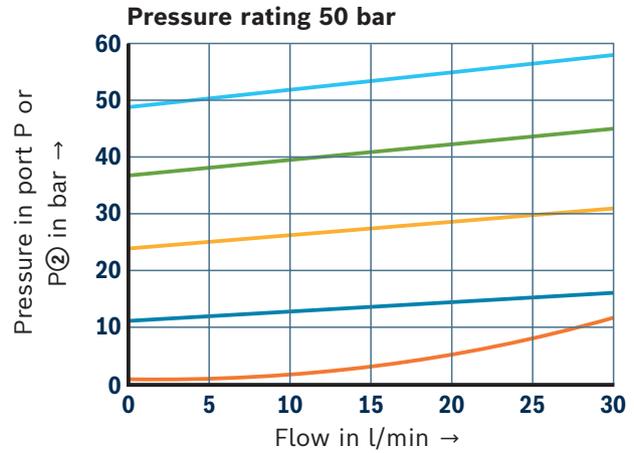
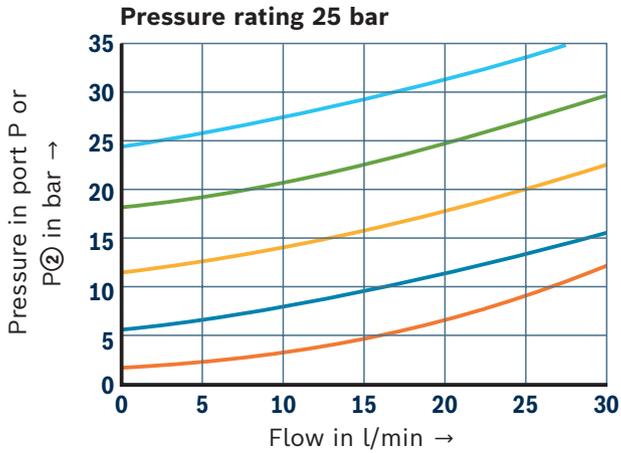
Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves

(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Pressure in port P or P[Ⓜ] dependent on the flow



1) The command value must not exceed the maximum flow of 5 l/min.

Notice:

- ▶ The characteristic curves were measured without counter pressure in port A (pilot oil return external) and T (pilot oil return internal).
- ▶ With internal pilot oil returns, the pressure in P or P[Ⓜ] increases by the output pressure present in port T.

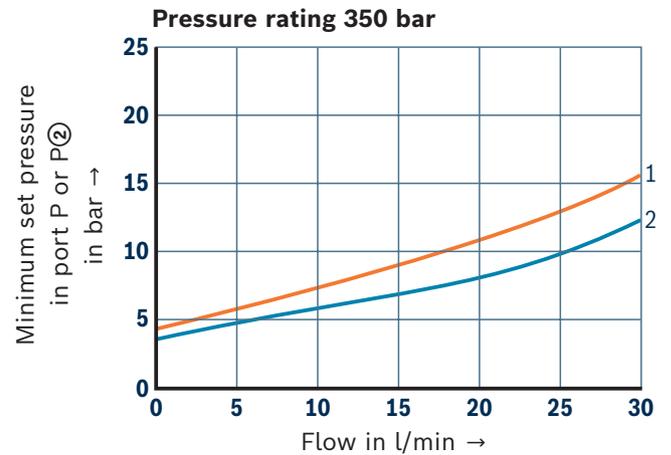
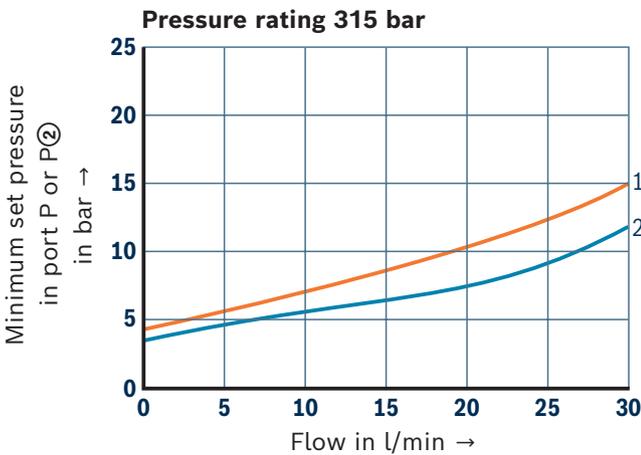
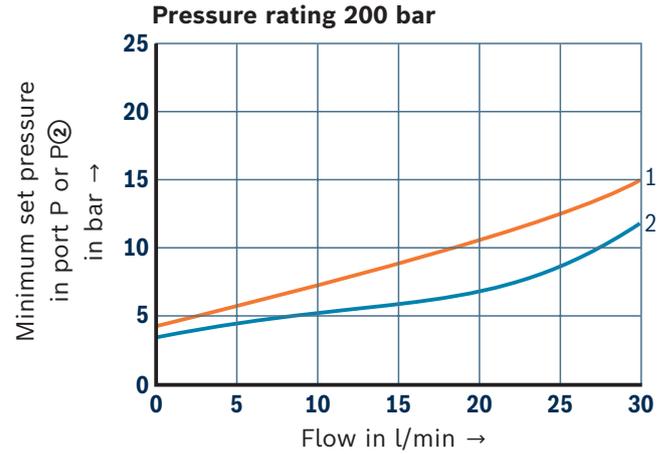
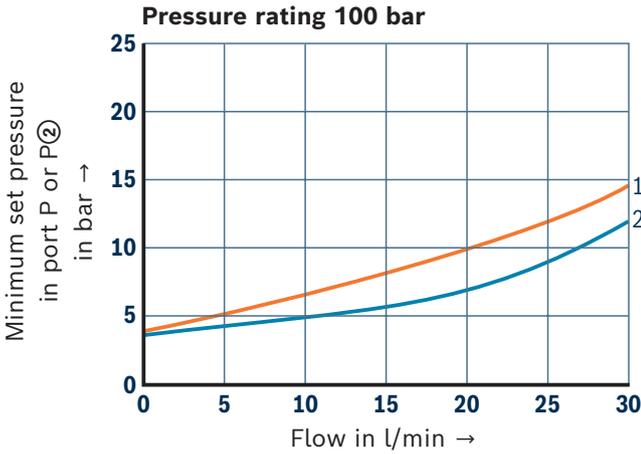
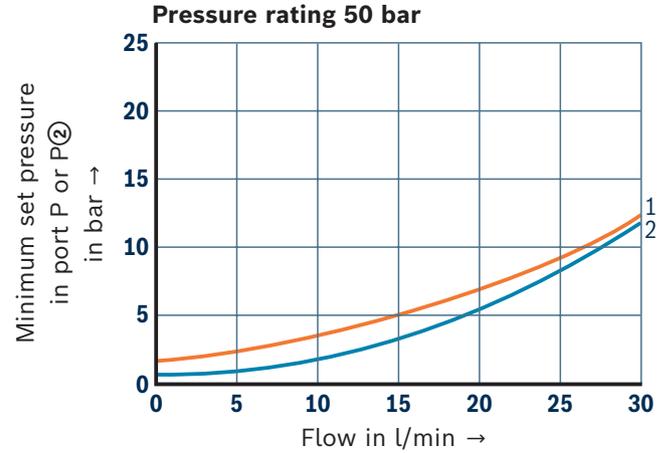
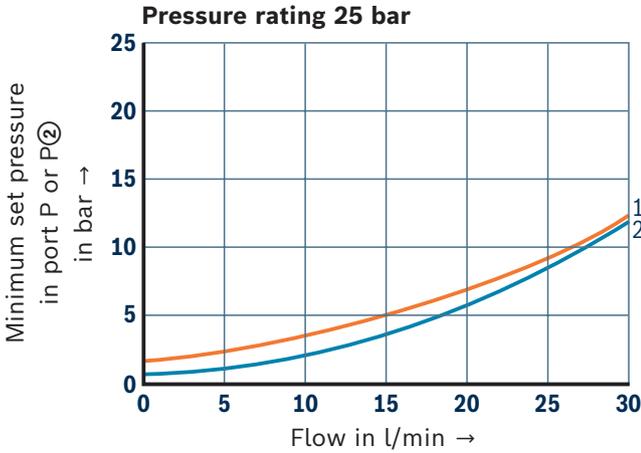
Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves

(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Minimum set pressure in port P or P② dependent on the flow (command value 0 V or 4 mA)



- 1 Internal pilot oil return
- 2 External pilot oil return

Notice:

- ▶ The characteristic curves were measured without counter pressure in port A (pilot oil return external) and T (pilot oil return internal).
- ▶ With internal pilot oil returns, the pressure in P or P② increases by the output pressure present in port T.

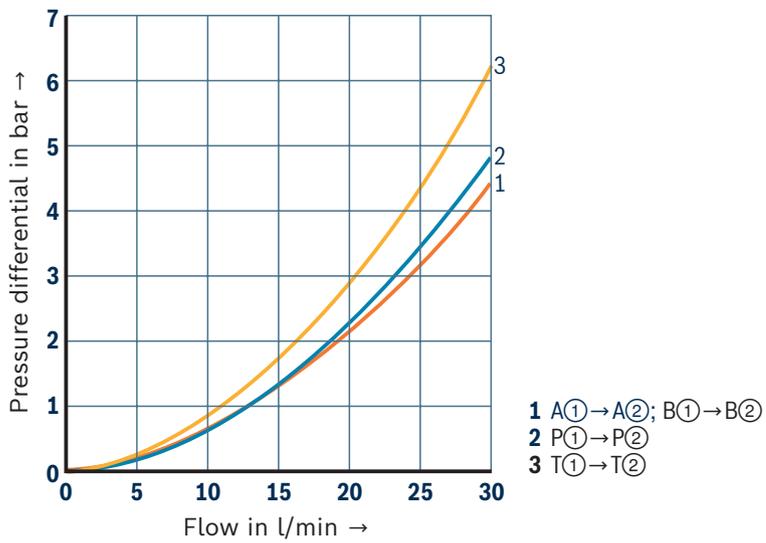
Notice:

Typical characteristic curves which are subject to tolerance variations.

Characteristic curves

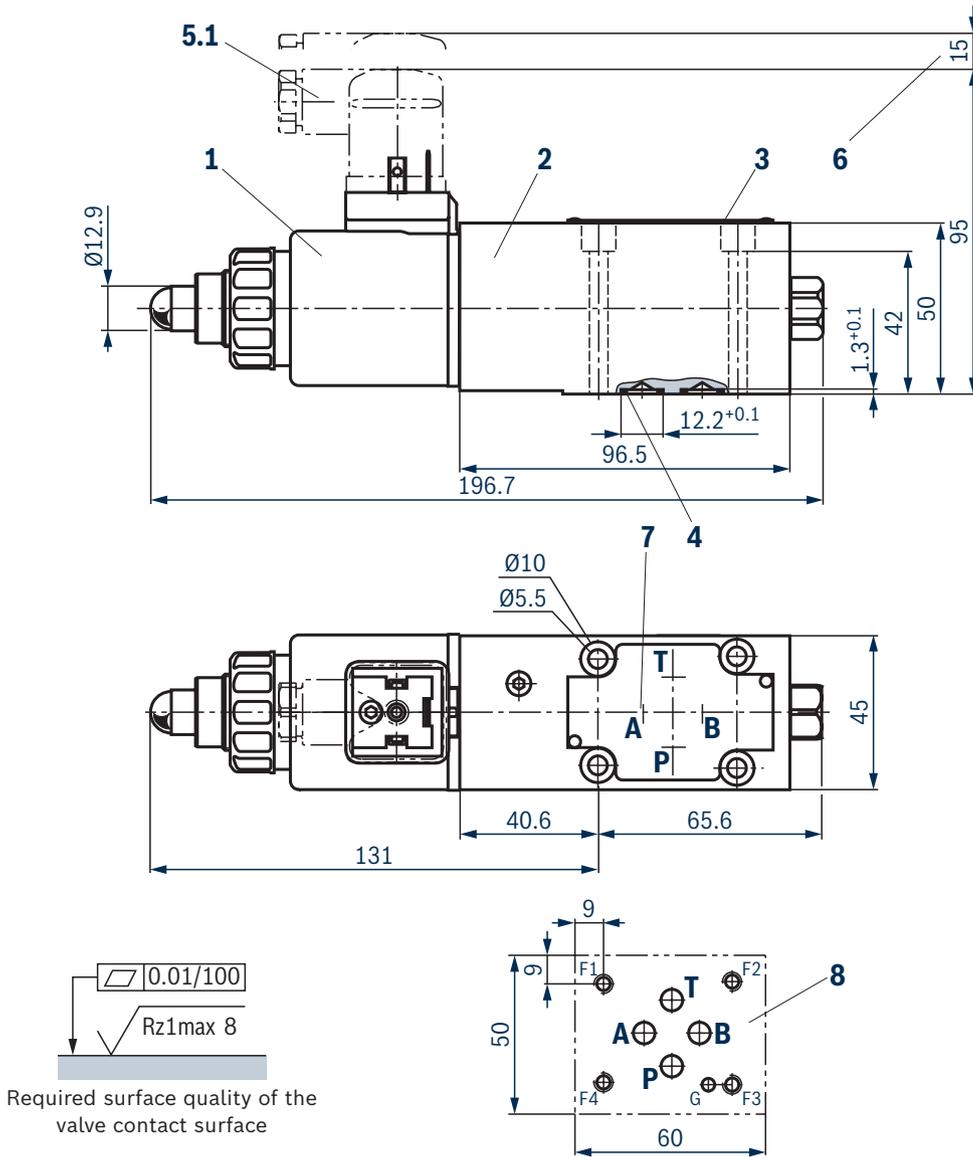
(measured with HLP46, $\vartheta_{oil} = 40 \pm 5 \text{ }^\circ\text{C}$)

Δp - q_V characteristic curves

**Notice:**

Typical characteristic curves which are subject to tolerance variations.

Dimensions: Type DBE
(Dimensions in mm)

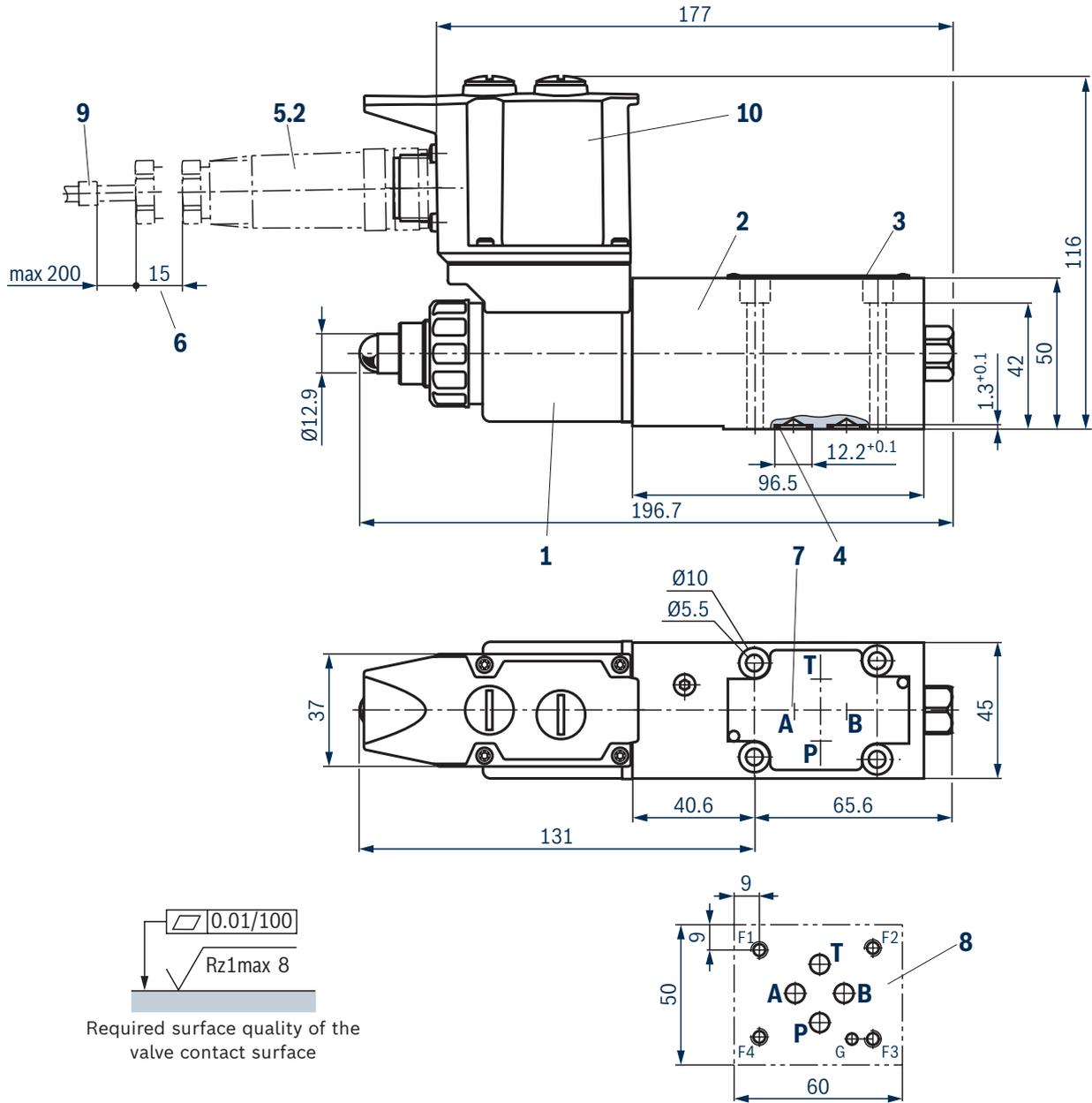


- 1 Proportional solenoid
- 2 Valve housing
- 3 Name plate
- 4 Identical seal rings for ports P, T, A and B
- 5.1 Mating connector without circuitry for connector "K4" (separate order, see page 19 and data sheet 08006)
- 6 Space required for removing the mating connector
- 7 External pilot oil return "Y" over port A (Y)
- 8 Machined valve contact surface; porting pattern according to ISO 4401-03-02-0-05

Valve mounting screws and subplates, see page 19.

Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions: Type DBEE
(Dimensions in mm)



- 1 Proportional solenoid
- 2 Valve housing
- 3 Name plate
- 4 Identical seal rings for ports P, T, A and B
- 5,2 Mating connectors with version "A1" and "F1" (separate order, see page 19 data sheet 08006)
- 6 Space required for removing the mating connector
- 7 External pilot oil return "Y" over port A (Y)
- 8 Machined valve contact surface; porting pattern according to ISO 4401-03-02-0-05
- 9 Cable fastening
- 10 Integrated electronics (OBE)

Valve mounting screws and subplates, see page 19.

Notice:
The dimensions are nominal dimensions which are subject to tolerances.

Dimensions

Valve mounting screws (separate order)

Type	Quantity	Hexagon socket head cap screws	Material number
DBE(E)	4	ISO 4762 - M5 x 50 - 10.9-ISO4042-ZnNi-5-Cn-T0-H-B Friction coefficient $\mu_{\text{total}} = 0.09 \dots 0.14$; tightening torque $M_A = 7 \text{ Nm} \pm 10\%$	R913043758

Information:

- ▶ The tightening torque of the hexagon socket head cap screws refers to the maximum operating pressure.
- ▶ Length and tightening torque of the valve mounting screws must be calculated in connection with the components mounted underneath and above the sandwich plate valve.

Subplates (separate order) with porting pattern according to ISO 4401-03-02-0-05 see data sheet 45100.

Accessories (separate order)

Mating connectors

Item ¹⁾	Designation	Version	Short designation	Material number	Data sheet
5,1	Mating connector; for valves with "K4" connector, 2-pole + PE, design A	Without circuitry, M16 x 1.5, 0 ... 250 V, "b"	Z4	R901017011	08006
5,2	Mating connector; for valves with round connector, 6-pole + PE	Straight, metal, PG11	7PZ31...M	R900223890	08006

¹⁾ See dimensions page 15 ... 18.

External control electronics

	Type	Material number	Data sheet
Modular design	VT-MSPA1-2X/A5/000/000	R901439034	30232
Modular design	VT-MSPA1-2X/F5/000/000	R901439036	
Connector design	VT-SSPA1-1-1X/V0/0-24	R900779643	30116

EMC directive requirements

- ▶ Shielded connection cables must be used for the electrical connection. The shielding must be placed on both sides.
- ▶ A metal mating connector must be used to make contact between the cable shielding and the valve.
- ▶ A separate EMC-approved power supply unit must be provided for each valve, e.g. one that is CE-compliant.
- ▶ The production of a low impedance connection is established via the professional installation of the valve on a grounded metal manifold block in the system.
- ▶ For electric supply lines over 30 m, overvoltage protection must be provided in the control cabinet.
- ▶ In a strong electro-magnetic environment, further EMC measures may be required, such as shielding of the complete device via metal housings or the use of ferrites on supply and signal lines.

Further information

- ▶ Hydraulic valves for industrial applications
- ▶ Subplates
- ▶ Hydraulic fluids on mineral oil basis
- ▶ Environmentally compatible hydraulic fluids
- ▶ Flame-resistant, water-free hydraulic fluids
- ▶ Flame-resistant hydraulic fluids – containing water (HFAE, HFAS, HFB, HFC)
- ▶ Reliability characteristics according to EN ISO 13849
- ▶ Mating connectors and cable sets for valves and sensors
- ▶ Assembly, commissioning and maintenance of hydraulic systems
- ▶ Information on available spare parts