Rexroth
Bosch Group

Variable Plug-in Motor A6VE

Data sheet

Series 63
Size   Nominal pressure/Maximum pressure
28 to 160   400 bar/450 bar
250   350 bar/400 bar
Open and closed circuits

Contents

Features

– Variable plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits

– Far-reaching integration in mechanical gearbox due to a recessed mounting flange located on the center of the case (extremely space-saving construction)

– Easy to install, simply plug into the mechanical gearbox (no configuration specifications to be observed)

– Tested unit ready to install

– For use especially in mobile applications

– The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.

– The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.

– The output speed is dependent on the flow of the pump and the displacement of the motor.

– The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.

Ordering code for standard program

A6V	E				/	63	W		–	V								
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18

Axial piston unit

01	Bent-axis design, variable							A6V

Operating mode

02	Motor, plug-in version	E

Sizes (NG)

03	Geometric displacement, see table of values on page 7	28	55	80	107	160	250

Control devices

				28	55	80	107	160	250	
04	Proportional control hydraulic		$\Delta p = 10$ bar	●	●	●	●	●	●	HD1
			$\Delta p = 25$ bar	●	●	●	●	●	●	HD2
	Two-point control hydraulic			–	–	–	–	–	●	HZ
				●	–	–	–	●	–	HZ1
				–	●	●	●	●[1]	–	HZ3
	Proportional control electric		12 V	●	●	●	●	●	●	EP1
			24 V	●	●	●	●	●	●	EP2
	Two-point control electric		12 V	●	–	–	–	●	●	EZ1
			24 V	●	–	–	–	●	●	EZ2
			12 V	–	●	●	●	–	–	EZ3
			24 V	–	●	●	●	–	–	EZ4
	Automatic control high-pressure related	with minimum pressure increase $\Delta p \leq 10$ bar		●	●	●	●	●	●	HA1
		with pressure increase $\Delta p = 100$ bar		●	●	●	●	●	●	HA2
		with minimum pressure increase $\Delta p \leq 10$ bar		–	●	●	●	●	–	HA3[1]
	Automatic control speed related $p_{St}/p_{HD} = 3/100$, hydraulic travel direction valve			–	–	–	–	–	●	DA
	$p_{St}/p_{HD} = 5/100$, electric travel direction valve + electric $V_{g\,max}$-circuit		24 V	●	●	●	●	●	–	DA3

Pressure control (only for HD, EP)

05	Without pressure control (without code)	
	Pressure control, fixed setting	D

Override of controls HA

06	Without override (without code)	
	Hydraulic override, remote control, proportional	T

Series

07	Series 6, index 3	63

Direction of rotation

08	Viewed on drive shaft, bidirectional	W

Setting ranges for displacement[2]

			28	55	80	107	160	250	
09	$V_{g\,min} = 0$ to $0.7\,V_{g\,max}$ (without code)		●	●	●	●	●	–	
	$V_{g\,min} = 0$ to $0.4\,V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\,V_{g\,max}$	–	–	–	–	–	●	1
	$V_{g\,min} > 0.4\,V_{g\,max}$ to $0.8\,V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\,V_{g\,max}$	–	–	–	–	–	●	2

Seals

		28	55	80	107	160	250	
10	FKM (fluor-caoutchouc)	●	●	●	●	●	●	V

● = Available   ○ = On request   – = Not available   ▨ = Preferred program

[1] Only possible in combination with port plate 22 (integrated counterbalance valve).

[2] Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min} = ...$ cm^3, $V_{g\,max} = ...$ cm^3

Ordering code for standard program

A6V	E					/	63	W		–	V							
01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16	17	18

Drive shafts

		28	55	80	107	160	250	
11	Splined shaft DIN 5480	●	–	●	–	●	–	A
		–	●	–	●	–	●	Z

Mounting flanges

			28	55	80	107	160	250	
12	Similar to ISO 3019-2	2-hole	●	●	●	●	●	–	L
		4-hole	–	–	–	–	–	●	M
	Modified adapter flange	2-hole	–	–	–	●	–	–	U

Port plates for service lines[3]

					28	55	80	107	160	250	
13	SAE flange ports A and B at side, opposite	02	0	0	●	●	●	●	●	●	020
				7	●	●	●	●	●	●	027
	SAE flange ports A and B at bottom only with integrated counterbalance valve BVI[4]	22	1		–	●	●	●	●	–	221
			2		–	●	●	●	●	–	222
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5][7]	BVD 37	0		–	–	–	●	–	–	370 378
		38	8		–	●	●	●	●	●[9]	380
		BVE 38			–	–	–	●	●	–[9]	388

Valves (see pages 29 to 37)

14	Without valve		0
	Brake release valve integrated (pilot pressure for brake release)	internal ducting	1
		external piping	2
	Flushing and boost pressure valve mounted		7
	Counterbalance valve mounted[6][7]		8

Speed sensor (see page 38)

		28	55	80	107	160	250	
15	Without speed sensor	●	●	●	●	●	●	0
	Prepared for DSA speed sensor	○	○	○	○	○	○	U
	DSA speed sensor mounted[8]	○	○	○	○	○	○	V

Connector for solenoids (see page 28)

		28 to 160	250	
16	Without connector (without solenoid, only with hydraulic controls)	●	–	0
	(size 250 without code)	–	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode	●	–	P
	HIRSCHMANN connector – without suppressor diode (without code)	–	●	

Beginning of control

			28	55	80	107	160	250	
17	Port plate 02, 37, 38	at $V_{g\,min}$ (standard for HA)	●	●	●	●	●	●	A
		at $V_{g\,max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	B
	Port plate 22	at $V_{g\,min}$ (standard for HA3)	–	●	●	●	●	–	B
		at $V_{g\,max}$ (standard for HZ3)	–	●	●	●	●	–	B

Standard / special version

18	Standard version (without code)	
	Standard version with installation variants (e. g. T ports against standard open or closed)	-Y
	Special version	-S

● = Available   ○ = On request   – = Not available   ▨ = Preferred program

3) Metric fastening thread
4) Only for HZ3 and HA3. Add specification of integrated counterbalance valve BVI, see separate ordering code on page 35. Note the restrictions on page 36.
5) Only possible in conjunction with HD, EP and HA1 and HA2 control
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE - RE 95525) separately.
7) Note the restrictions on page 32.
8) Specify ordering code of sensor according to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.
9) Counterbalance valve MHB32, please contact us.

Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids), RE 90222 (HFD hydraulic fluids) and RE 90223 (HFA, HFB, HFC hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The variable motor A6VE is not suitable for operation with HFA hydraulic fluid. If HFB, HFC, or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.

Selection diagram

$t_{min} =$ -40 °C   Hydraulic fluid temperature range $t_{max} =$ +115 °C
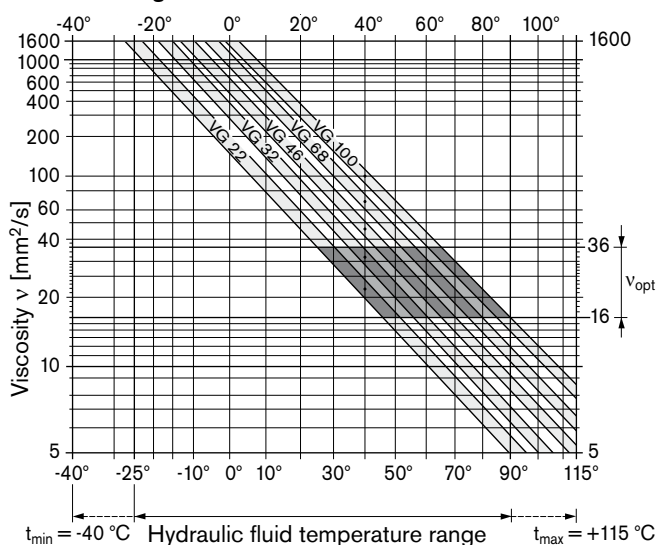
Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit, the circuit temperature, in an open circuit, the reservoir temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (v_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum viscosity range (v_{opt}, shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the circuit temperature or reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case with a flushing and boost pressure valve (see page 29).

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq$ -50 °C $T_{opt} =$ +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	$v_{max} =$ 1600	$T_{St} \geq$ -40 °C	$t \leq$ 3 min, without load (p $\leq$ 50 bar), n $\leq$ 1000 rpm (sizes 28 to 160), n $\leq$ 0.25 • n_{nom} (size 250)
Permissible temperature difference		$\Delta T \leq$ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	$v <$ 1600 to 400	T = -40 °C to -25 °C	At p $\leq$ 0.7 • p_{nom}, n $\leq$ 0.5 • n_{nom} and t $\leq$ 15 min
Operating phase			
Temperature difference		$\Delta T =$ approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	$v =$ 400 to 10 $v_{opt} =$ 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$v_{min} \geq$ 7	$T_{max} =$ +103 °C	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T $\leq$ +115 °C	see page 5

[1] At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

[2] Size 250, please contact us.

Technical data

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes (t < 0.1 s) of up to 10 bar are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or higher than the ambient pressure.
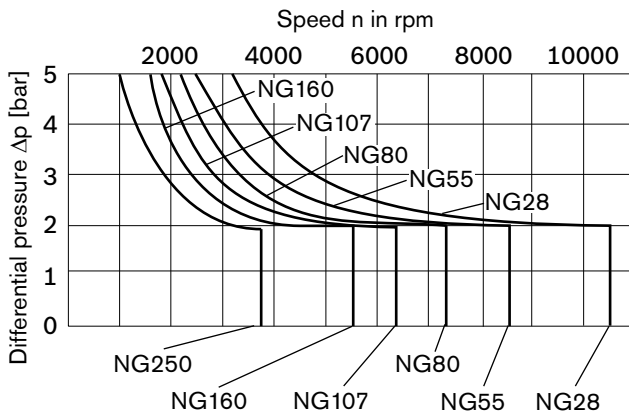
The values are valid for an ambient pressure $p_{abs} = 1$ bar.

Temperature range

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note

For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal in plain text when ordering. Please contact us.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HD, HA.T (sizes 28 to 160) _____ increase
HD, EP, HA, HA.T (size 250) _____ increase
DA _____ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
EP, HA (sizes 28 to 160)

The factory settings for the beginning of control are made at $p_{abs} = 2$ bar (sizes 28 to 160) or $p_{abs} = 1$ bar (size 250) case pressure.

Direction of flow

Direction of rotation, viewed on drive shaft	
cw	**ccw**
A to **B**	**B** to **A**

Technical data

Operating pressure range
(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 160

Nominal pressure p_{nom} _____ 400 bar absolute

Maximum pressure p_{max} _____ 450 bar absolute
Single operating period_____ 10 s
Total operating period _____ 300 h

Size 250

Nominal pressure p_{nom} _____ 350 bar absolute

Maximum pressure p_{max} _____ 400 bar absolute
Single operating period_____ 10 s
Total operating period _____ 300 h

Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve_____ 9000 bar/s
without pressure-relief valve _____ 16000 bar/s

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operation mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).
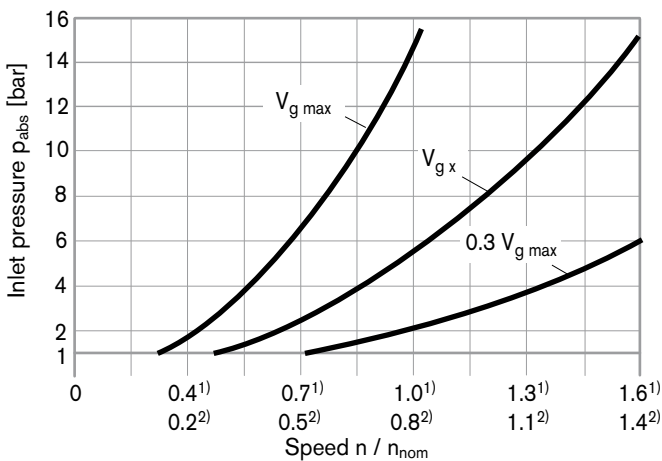
[1] For sizes 28 to 160
[2] For size 250

This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

Rate of pressure change R_A
Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
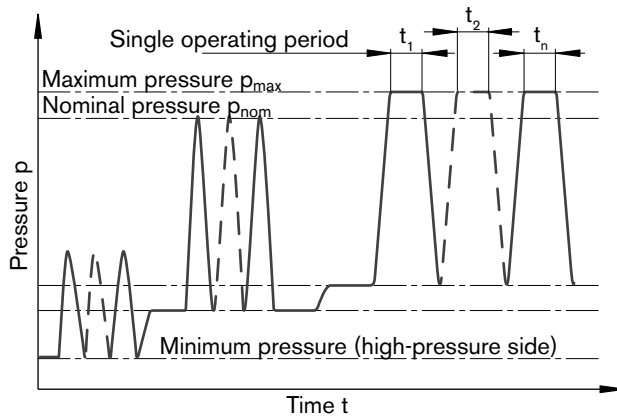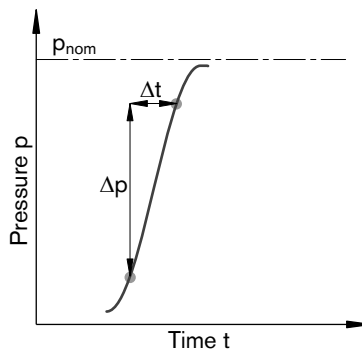
Total operating period $= t_1 + t_{2 + \ldots} + t_n$

Technical data

Table of values (theoretical values, without efficiency and tolerances; values rounded)
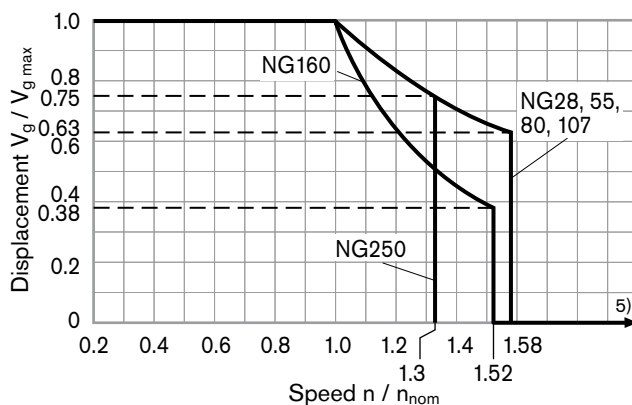
Size	NG		28	55	80	107	160	250
Displacement geometric[1],	$V_{g\,max}$	cm³	28.1	54.8	80	107	160	250
per revolution	$V_{g\,min}$	cm³	0	0	0	0	0	0
	$V_{g\,x}$	cm³	18	35	51	68	61	188
Speed maximum[2] (while adhering to the maximum permissible input flow)								
at $V_{g\,max}$	n_{nom}	rpm	5550	4450	3900	3550	3100	2700
At $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	8750	7000	6150	5600	4900	3600
at $V_{g\,0}$	n_{max}	rpm	10450	8350	7350	6300	5500	3600
Input flow[3]								
at n_{nom} and $V_{g\,max}$	$q_{V\,max}$	L/min	156	244	312	380	496	675
Torque[4]								
At $V_{g\,max}$ and $\Delta p = 400$ bar	T	Nm	179	349	509	681	1019	–
At $V_{g\,max}$ and $\Delta p = 350$ bar	T	Nm	157	305	446	596	891	1391
Rotary stiffness								
$V_{g\,max}$ to $V_{g/2}$	c_{min}	KNm/rad	6	10	16	21	35	60
$V_{g/2}$ to 0 (interpolated)	c_{max}	KNm/rad	18	32	48	65	105	181
Moment of inertia for rotary group	J_{GR}	kgm²	0.0014	0.0042	0.008	0.0127	0.0253	0.061
Maximum angular acceleration	α	rad/s²	47000	31500	24000	19000	11000	10000
Case volume	V	L	0.5	0.75	1.2	1.5	2.4	3.0
Mass (approx.)								
Port plate 02, 37, 38	m	kg	16	26	34	47	64	90
Port plate 22	m	kg	–	35	43	53	72	–

[1] The minimum and maximum displacement are infinitely adjustable, see ordering code, page 2.
(standard setting for size 250 if not specified in the order: $V_{g\,min} = 0.2 \cdot V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).
[2] The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s
- with hydraulic fluid based on mineral oils
[3] Restriction of input flow with counterbalance valve, see page 32
[4] Torque without radial force, with radial force see page 8

Note

Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.
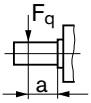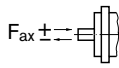
Permissible displacement in relation to speed

[5] Values in this range on request

Technical data

Permissible radial and axial forces of the drive shafts

Size		NG		28	55	80	107	160	250
Drive shaft		ø	mm	30	30	40	40	50	50
Maximum radial force[1] at distance a (from shaft collar)		$F_{q\ max}$	N	4838	7581	10283	13758	16435	1200[3]
		a	mm	17.5	17.5	22.5	22.5	27.5	41
with permissible torque		T_{max}	Nm	179	281	509	681	1019	[4]
≙ Permissible pressure Δp at $V_{g\ max}$		$p_{nom\ perm.}$	bar	400	322	400	400	400	[4]
Maximum axial force[2]		$+F_{ax\ max}$	N	315	500	710	900	1120	1200
		$-F_{ax\ max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure		$F_{ax\ perm./bar}$	N/bar	4.6	7.5	9.6	11.3	15.1	[4]

1) With intermittent operation.
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.
4) Please contact us.

Note
Influence of the direction of the permissible axial force:

$+F_{ax\ max}$ = Increase in service life of bearings

$-F_{ax\ max}$ = Reduction in service life of bearings (avoid)

Effect of radial force F_q on the service life of bearings

By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

Toothed gear drive

$\varphi_{opt} = 45°$ $\varphi_{opt} = 45°$ Alternating direction of rotation

"Counter-clockwise" direction of rotation

Pressure at port **B**

"Clockwise" direction of rotation

Pressure at port **A**

V-belt drive

Alternating direction of rotation

$\varphi_{opt} = 70°$ $\varphi_{opt} = 70°$

"Counter-clockwise" direction of rotation

Pressure at port **B**
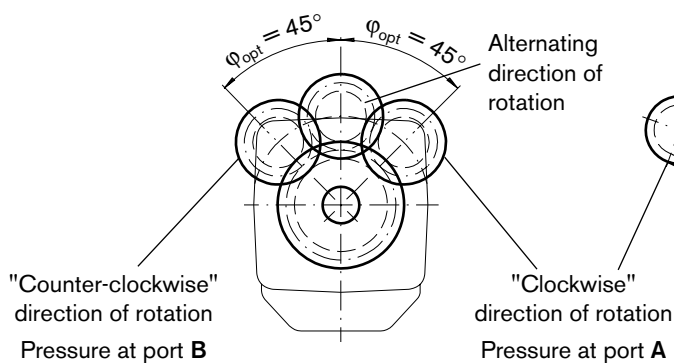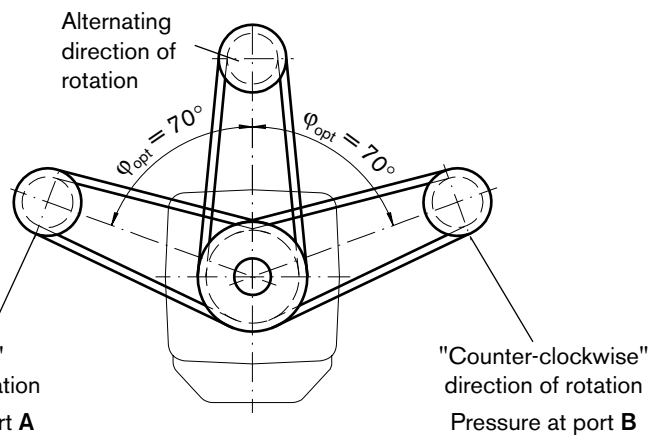
Determining the operating characteristics

Input flow $q_v = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [min⁻¹]

Torque $T = \dfrac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$ [Nm]

Power $P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [kW]

V_g = Displacement per revolution in cm³

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

HD – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

– Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)

– End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note
– Maximum permissible pilot pressure: $p_{St} = 100$ bar

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.

– The beginning of control and the HD characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

– A leakage flow of maximum 0.3 L/min can escape at port X due to internal leakage (operating pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

HD1
Pilot pressure increase $\Delta p_{St} = 10$ bar

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\,max}$ to 0 cm^3 (sizes 28 to 160) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).

Beginning of control, setting range _____ 2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

HD1 characteristic

HD2
Pilot pressure increase $\Delta p_{St} = 25$ bar

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\,max}$ to 0 cm^3 (sizes 28 to 160) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).

Beginning of control, setting range _____ 5 to 35 bar

Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

HD2 characteristic
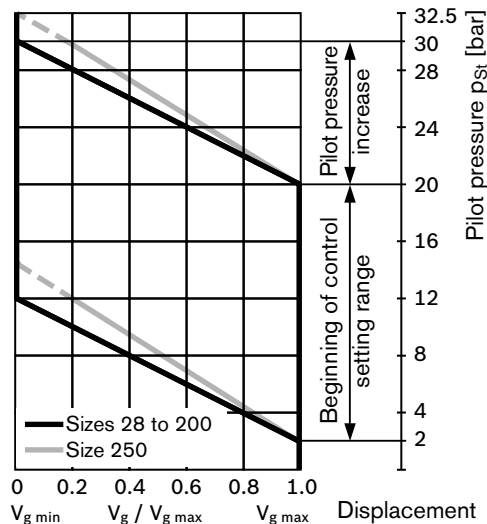
HD – Proportional control hydraulic

Schematic HD1, HD2
Sizes 28 to 160
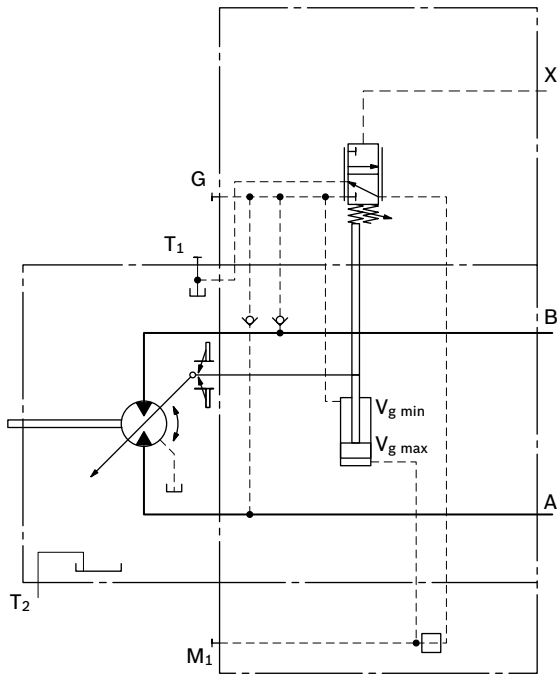
Schematic HD1, HD2
Size 250
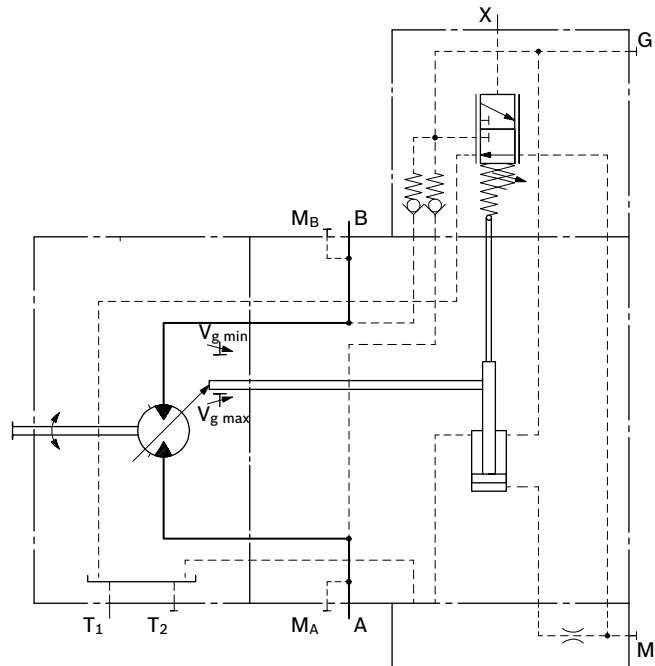
Note

The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

HD – Proportional control hydraulic

HD.D
Pressure control, fixed setting

The pressure control overrides the HD control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve
Sizes 28 to 160 _____ 80 to 400 bar
Size 250 _____ 80 to 350 to bar

Schematic HD.D
Sizes 28 to 160
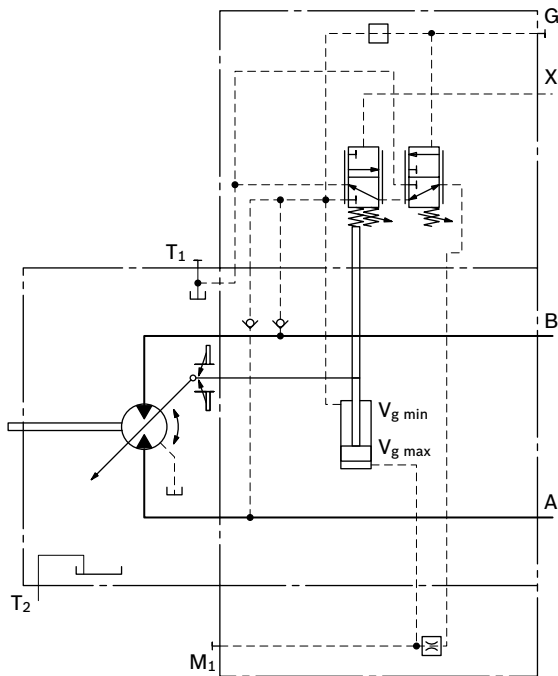
Schematic HD.D
Size 250
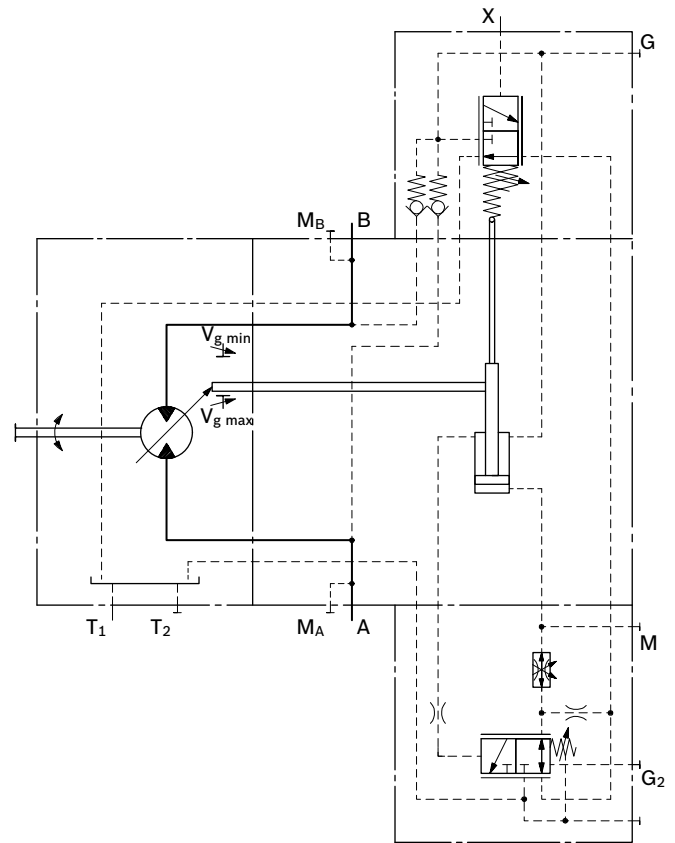
EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid (sizes 28 to 200) or proportional valve (sizes 250).

For size 250, the pilot oil supply at port P requires an external pressure of $p_{min} = 30$ bar ($p_{max} = 100$ bar).

– Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)

– End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic
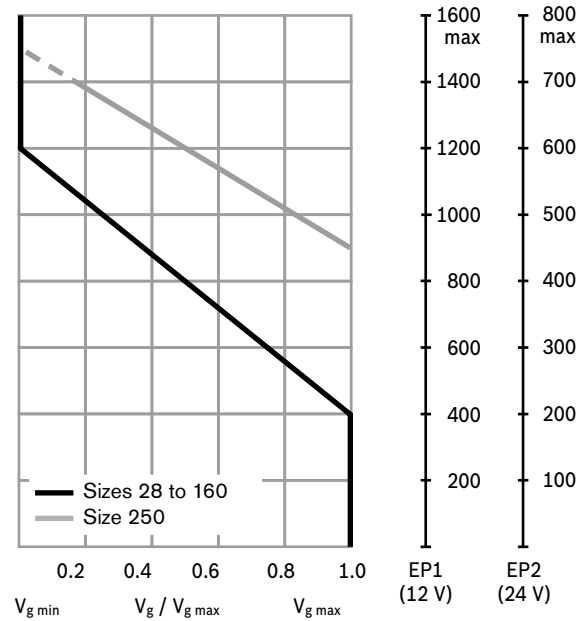
Sizes 28 to 160
Size 250

$V_{g\,min}$ $V_g / V_{g\,max}$ $V_{g\,max}$ EP1 (12 V)   EP2 (24 V)

Note
The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure $<$ 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

The following only needs to be noted for size 250:

– The beginning of control and the EP characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

Technical data, solenoid
Sizes 28 to 160

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

– BODAS controller RC
  Series 20 _____ RE 95200
  Series 21_____ RE 95201
  Series 22 _____ RE 95202
  Series 30 _____ RE 95203, RE 95204
  and application software

– Analog amplifier RA _____ RE 95230

– Electric amplifier VT 2000, series 5X (see RE 29904)
  (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Technical data, proportional valve
Size 250

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Beginning of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Limiting current	2.2 A	1.0 A
Nominal resistance (at 20 °C)	2.4 Ω	12 Ω
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

See also proportional pressure-reducing valve DRE 4K (RE 29181).

Note

The spring return feature in the control part is not a safety device

The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2
Sizes 28 to 160

Schematic EP1, EP2
Size 250

Proportional
pressure-reducing
valve DRE 4K
(see RE 29181)
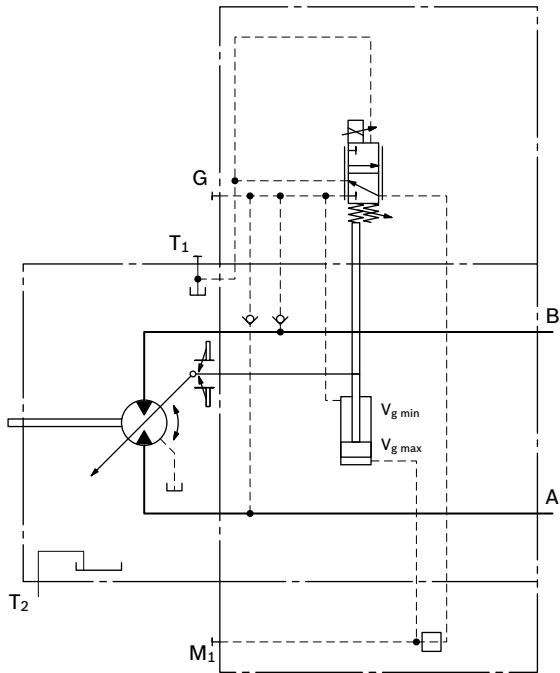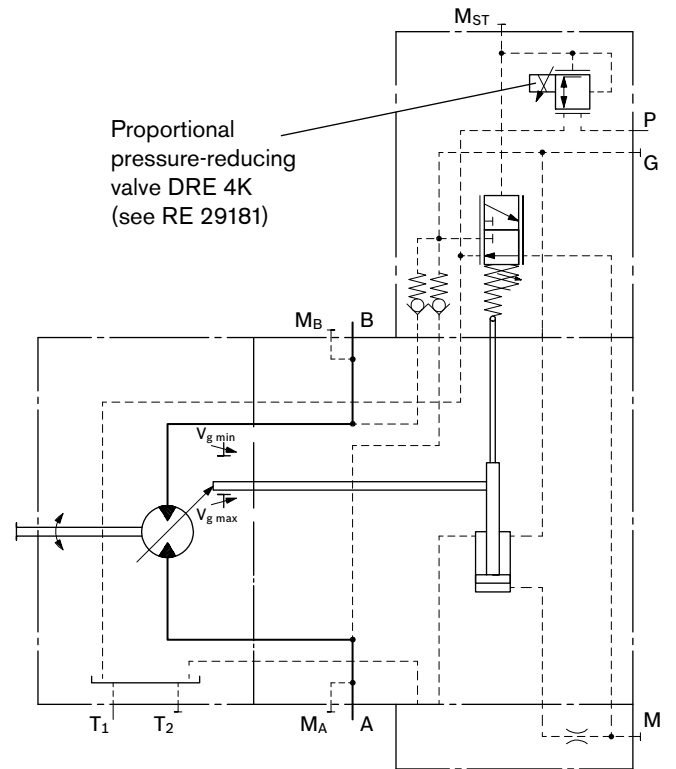
EP – Proportional control electric

EP.D
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve
Sizes 28 to 160 _____ 80 to 400 bar
Size 250 _____ 80 to 350 to bar

Schematic EP.D
Sizes 28 to 160

Schematic EP.D
Size 250

Proportional
pressure-reducing
valve DRE 4K
(see RE 29181)
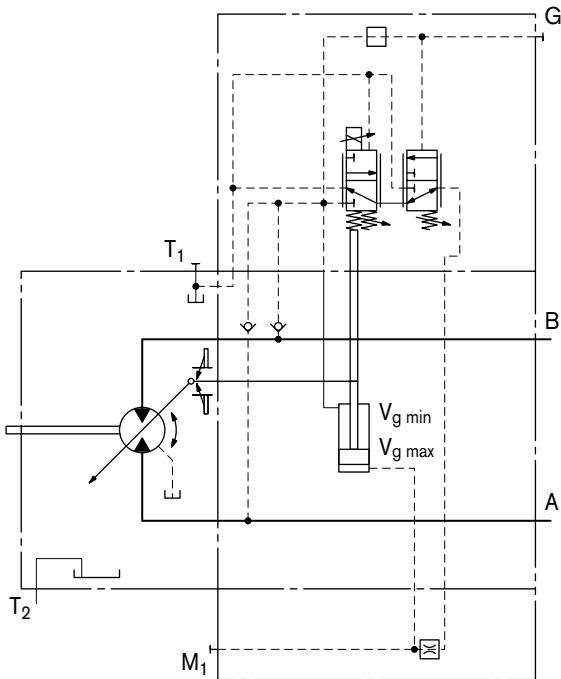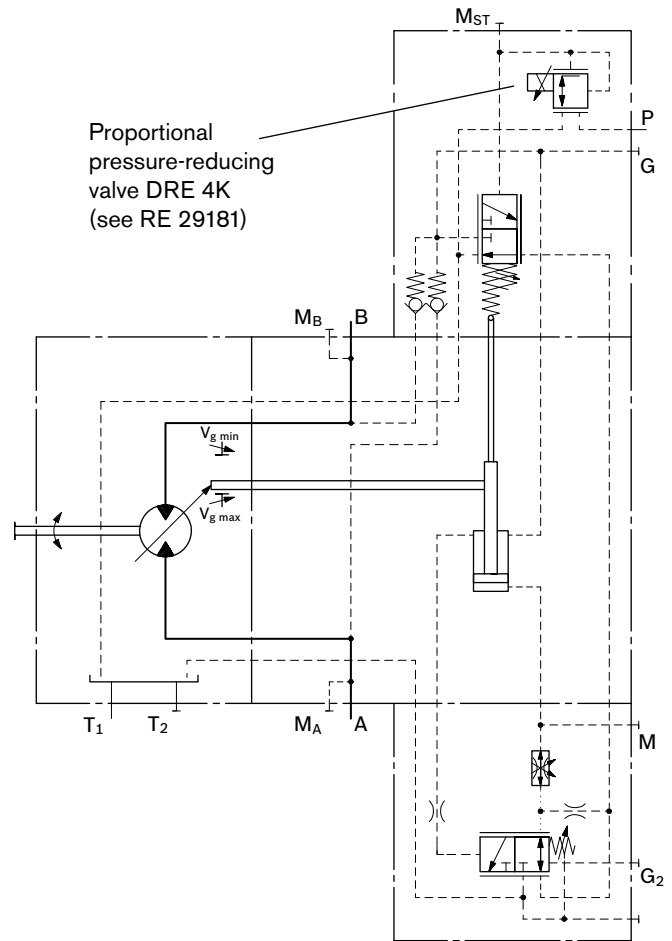
HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

– Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)

– Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

Characteristic HZ
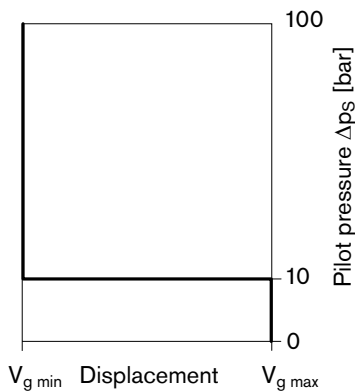
Note
– Maximum permissible pilot pressure: 100 bar

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir.

Schematic HZ3
Sizes 55 to 107
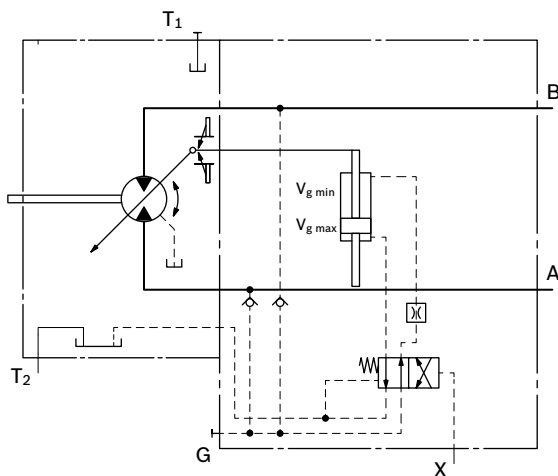
Size 160
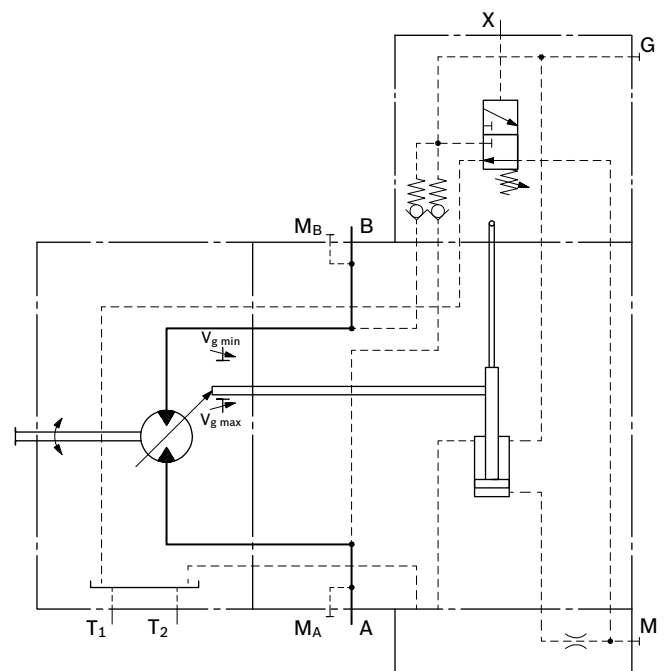With integrated counterbalance valve BVI, see page 37

Schematic HZ1
Sizes 28, 160
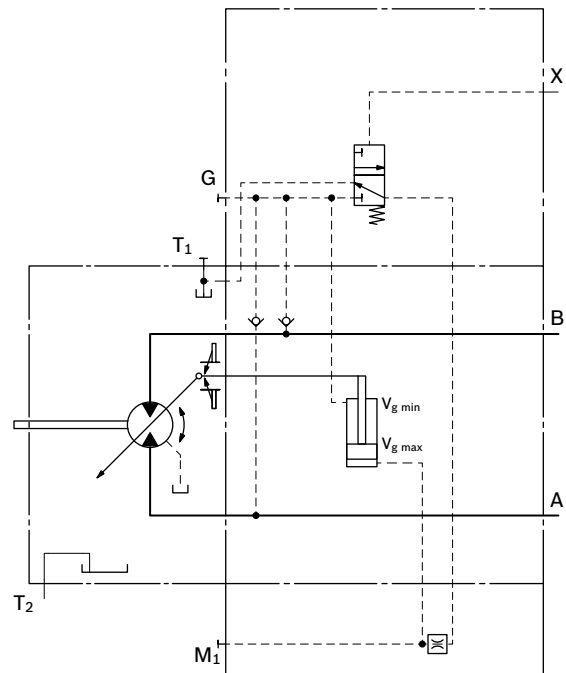
Schematic HZ
Size 250

EZ – Two-point control electric

The two-point electric control with switching solenoid (sizes 28 to 160) or control valve (size 250) allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current at the switching solenoid or control valve on or off.

Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure $<$ 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.

Please note that pressures up to 450 bar can occur at port G.

Technical data, solenoid with Ø37
Sizes 28, 160

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

Technical data, solenoid with Ø45
Sizes 55 to 107

	EZ3	EZ4
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

Technical data, control valve
Size 250

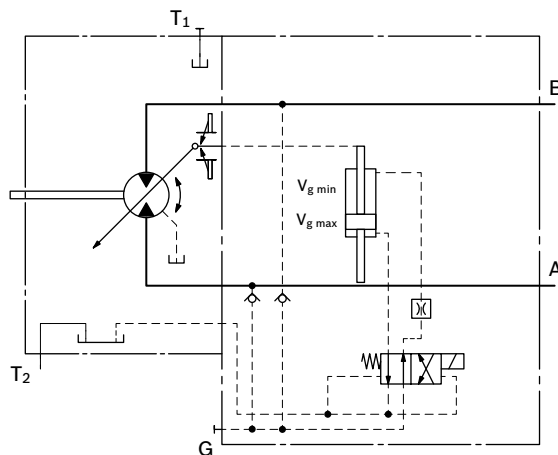|	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	6 Ω	23 Ω
Nominal power	26 W	26W
Minimum required current	2 A	1.04 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

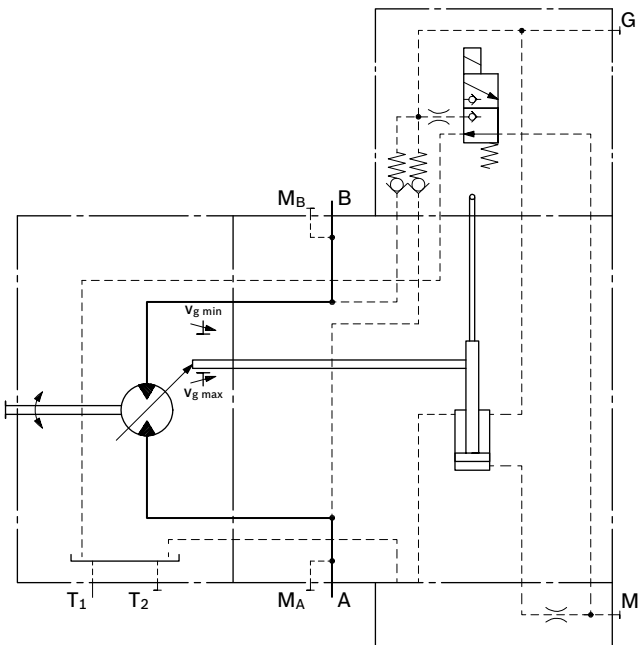**Schematic EZ1, EZ2**
Sizes 28, 160
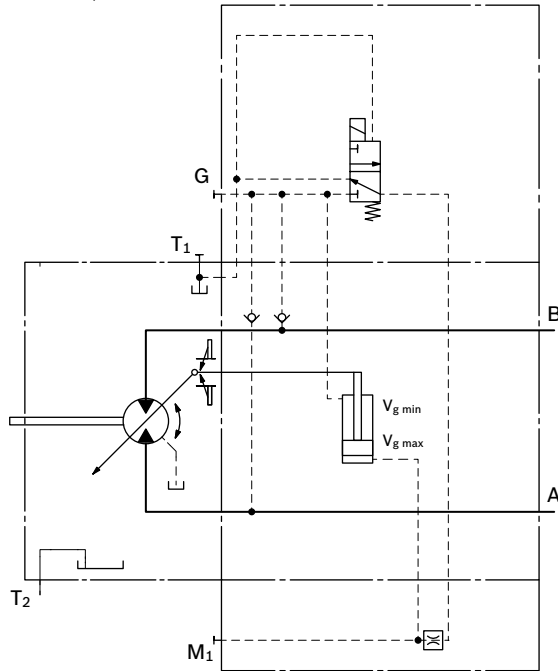
Schematic EZ3, EZ4
Sizes 55 to 107

Schematic EZ1, EZ2
Size 250

HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VE motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

– Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)

– End of control at $V_{g\,max}$ (maximum torque, minimum speed)

Note
– For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure $<$ 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– The beginning of control and the HA characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic. Only for HA1T (sizes 28 to 160) and HA1, HA2, HA3, HA.T, (size 250).

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure $>$ pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir. **Only for control HA.T**.

HA – Automatic control high-pressure related

HA1, HA3
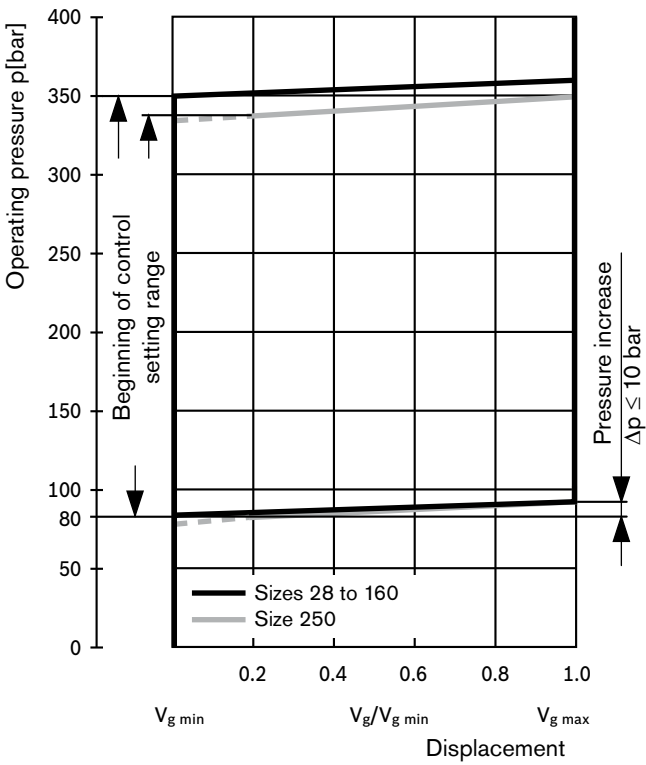## With minimum pressure increase

An operating pressure increase of $\Delta p \leq$ approx. 10 bar results in an increase in displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 160) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).
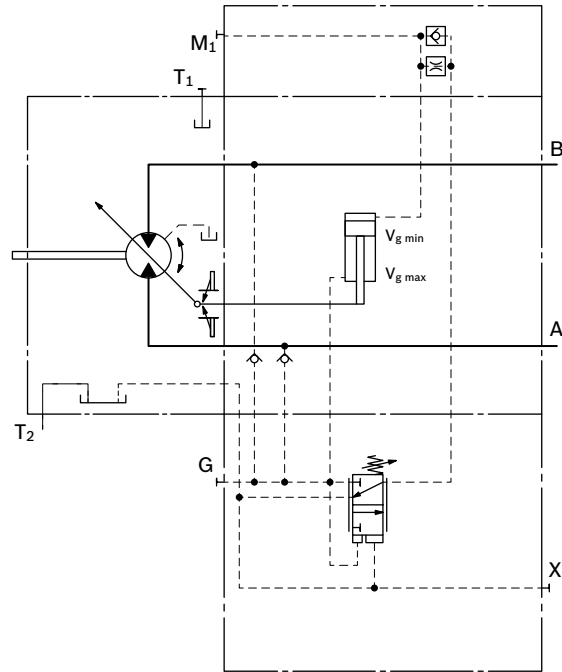
Beginning of control, setting range
Sizes 28 to 160 _____ 80 to 350 bar
Size 250 _____ 80 to 340 bar

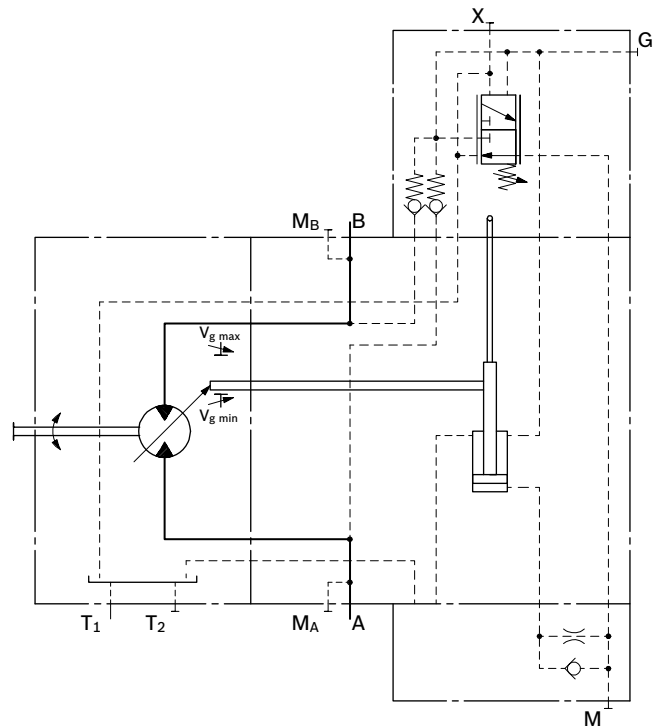Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

Characteristic HA1, HA3

Schematic HA1
Sizes 28 to 160

Size 250

Schematic HA3
Sizes 55 to 160
With integrated counterbalance valve BVI, see page 37

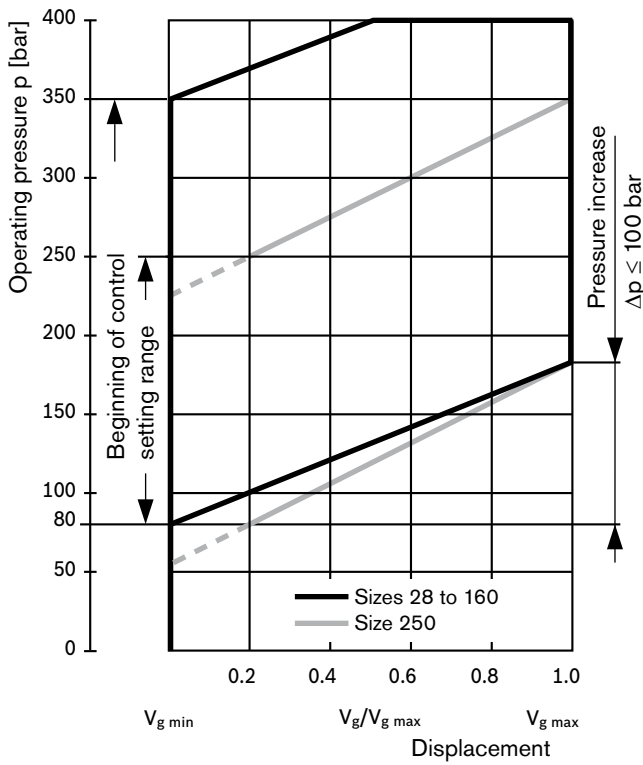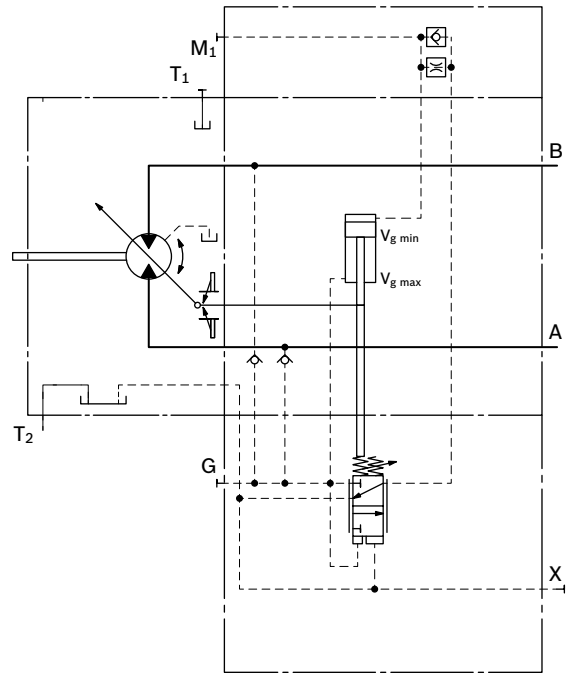# HA – Automatic control high-pressure related

HA2
With pressure increase

An operating pressure increase of $\Delta p =$ approx. 100 bar results in an increase in displacement from 0 cm³ to $V_{g\,max}$ (sizes 28 to 160) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).

Beginning of control, setting range
Sizes 28 to 160 _____ 80 to 350 bar
Size 250 _____ 80 to 250 bar

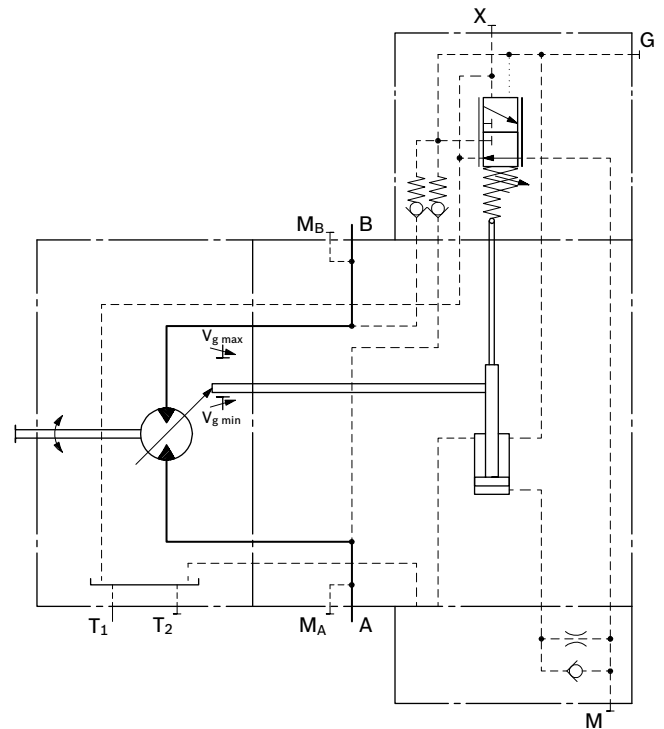Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

Characteristic HA2

Schematic HA2
Sizes 28 to 160

Size 250

HA – Automatic control high-pressure related

HA.T
Override hydraulic remove control, proportional

With the HA.T control, the beginning of control can be influenced by applying a pilot pressure to port X.
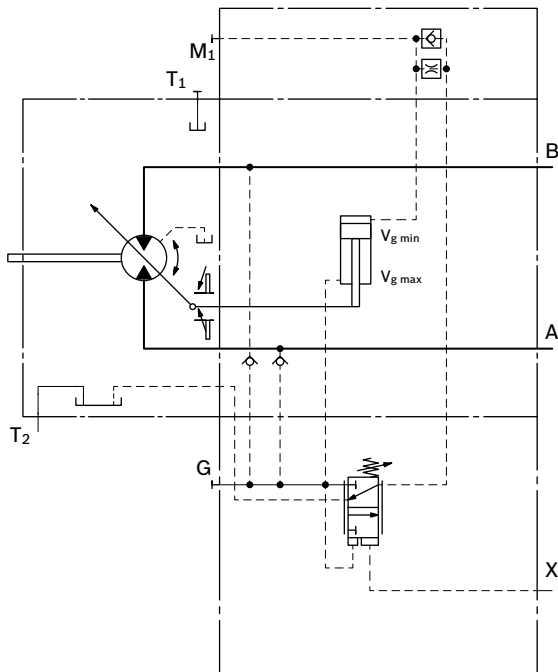
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar (sizes 28 to 160) or 8 bar (size 250).
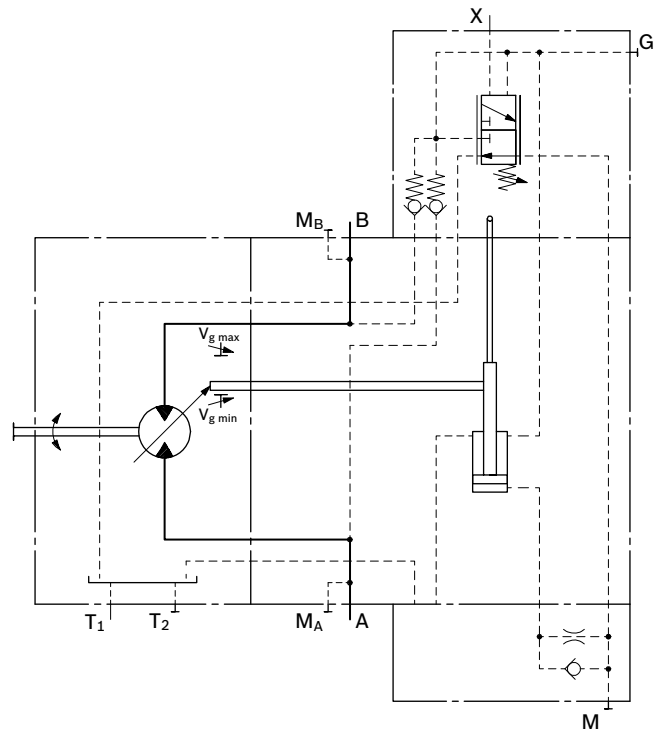
Example (sizes 28 to 160):

Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
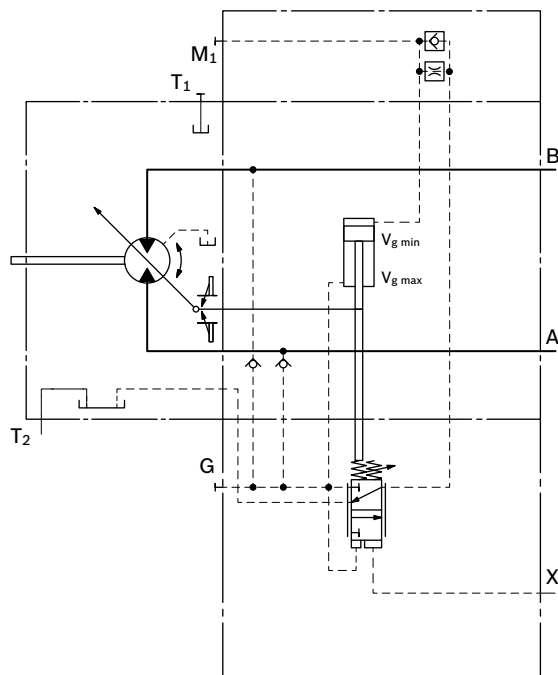Maximum permissible pilot pressure 100 bar.

Schematic HA1.T
Sizes 28 to 160

Schematic HA1.T
Size 250

Schematic HA2.T
Sizes 28 to 160

DA – Automatic control speed-related

The variable motor A6VE with automatic speed-related control, is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD}: 3/100, 5/100

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 5) and thus a parallel shift of the characteristic.
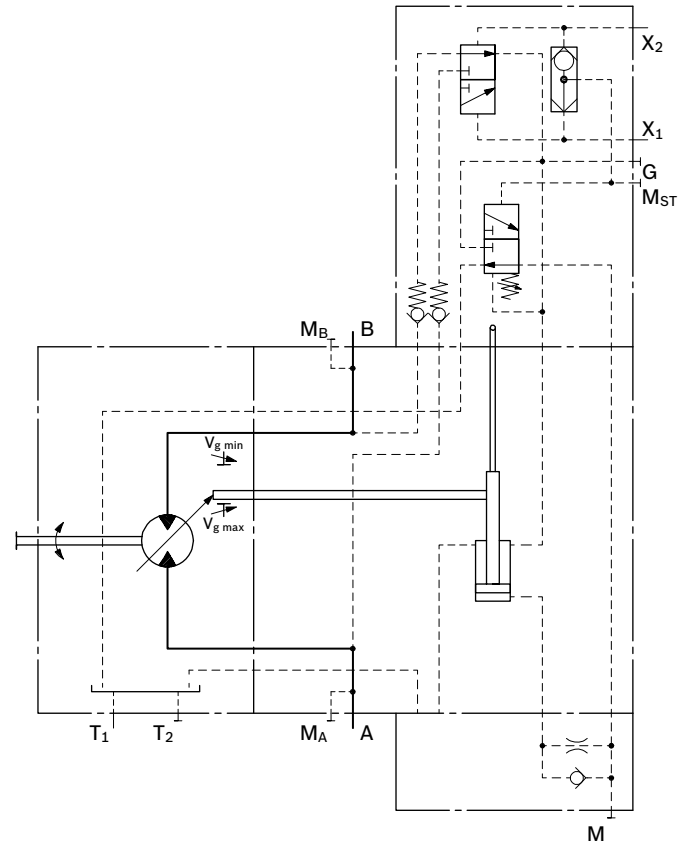
DA
Hydraulic travel direction valve
Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA
Size 250

DA – Automatic control speed-related

DA3
Electric travel direction valve +
electric $V_{g\,max}$-circuit

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\,max}$-circuit).

Technical data, solenoid a with Ø37
(travel direction valve)

		DA3
Voltage		24 V (±20 %)
Direction of rotation	Operating pressure in	
ccw	B	de-energized
cw	A	energized
Nominal resistance (at 20 °C)		21.7 Ω
Nominal power		26.5 W
Minimum required current		0.67 A
Duty cycle		100 %
Type of protection see connector design page 28		

Technical data, solenoid b with Ø37
(electric override)

	DA3,
Voltage	24 V (±20 %)
No override	de-energized
Displacement $V_{g\,max}$	energized
Nominal resistance (at 20 °C)	21.7 Ω
Nominal power	26.5 W
Minimum required current	0.67 A
Duty cycle	100 %
Type of protection see connector design page 28	

Schematic DA3
Sizes 28 to 160
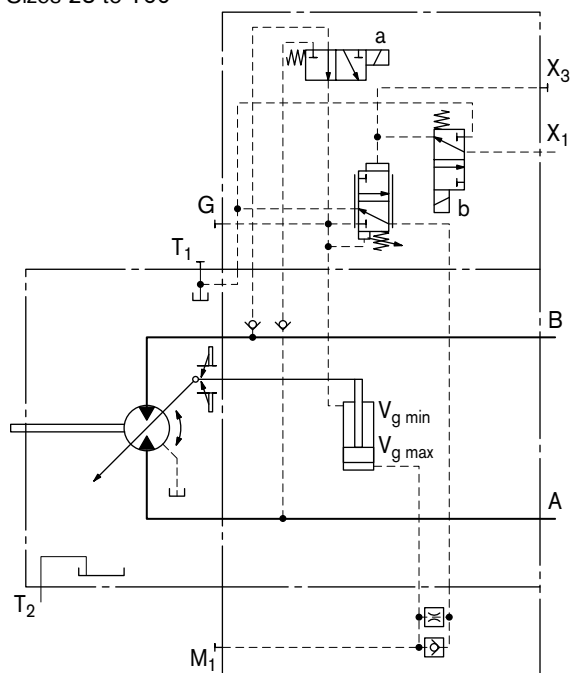
Electric travel direction valve (for DA)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

– the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.

– reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

As a result, jerky deceleration or braking is prevented in both cases.

DA3 control (see page 22)
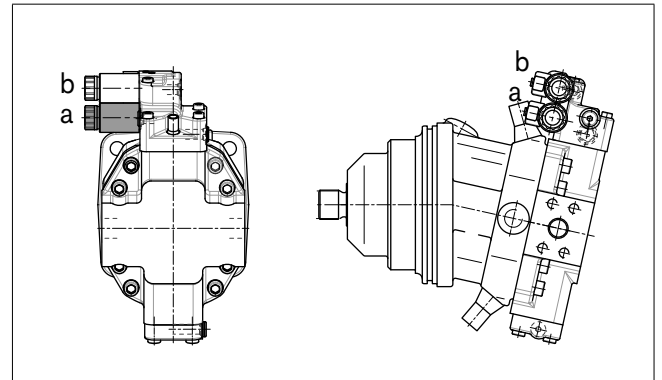
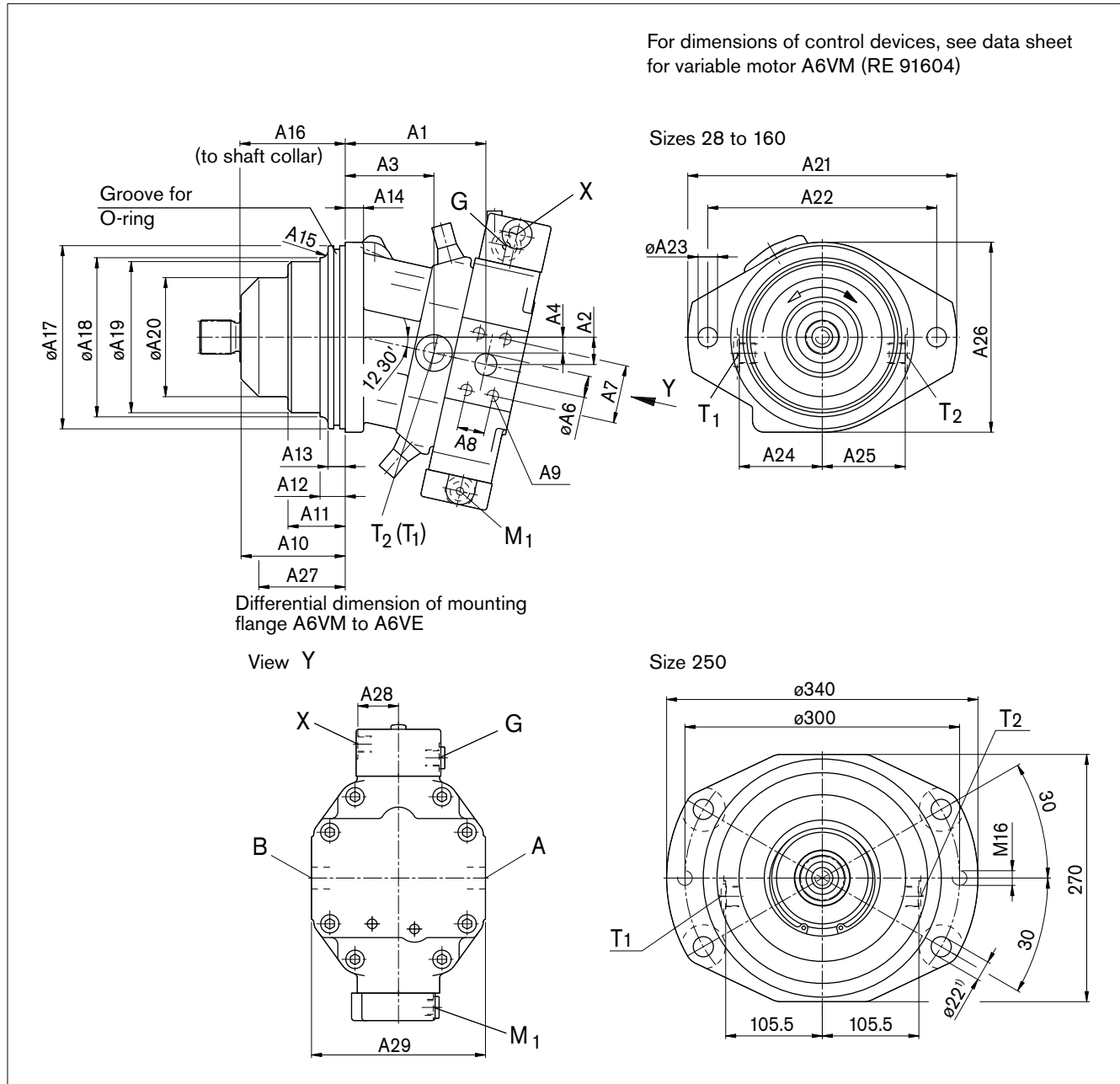**Schematic - electric travel direction valve**
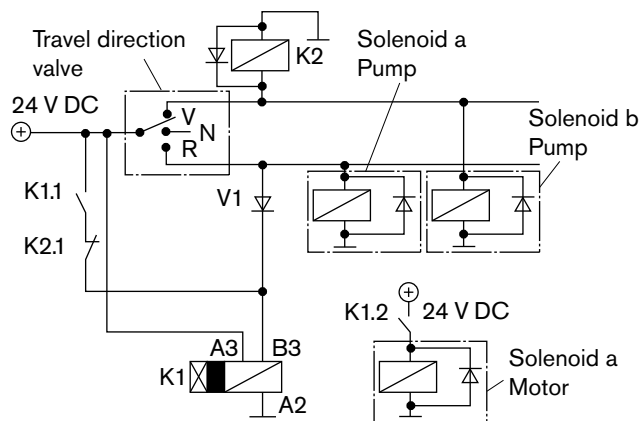
Note
The shown diodes and relays are not included in the delivery of the motor.

Dimensions

HD1, HD2 – Proportional control hydraulic
Port plate 02 – SAE flange port A and B at side, opposite

For dimensions of control devices, see data sheet
for variable motor A6VM (RE 91604)

Sizes 28 to 160

Differential dimension of mounting
flange A6VM to A6VE

View Y

Size 250

Ports

Size	Service line port A, B SAE J518	Drain port T_1; T_2[2] DIN 3852[3]
28	3/4 in	M18 x 1.5; 12 deep
55	3/4 in	M18 x 1.5; 12 deep
80	1 in	M18 x 1.5; 12 deep
107	1 in	M18 x 1.5; 12 deep
160	1 1/4 in	M26 x 1.5; 16 deep
250	1 1/4 in	M22 x 1.5; 14 deep

[1] Hole ø22 with spot face ø48; 2 deep

[2] 1x plugged

[3] Observe the general instructions on page 40 for the maximum tightening torques.

For further ports, see variable motor A6VM (RE 91604)!

Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Standard flange L (sizes 28 to 160), **M** (size 250)

NG	A1	A2	A3	A4	øA6	A7	A8	A9 (DIN 13)[2]	A10	A11	A12	A13	A14	A15
28	91	20	47	10	ø19	50.8	23.8	M10 x 1.5; 17 deep	88	54	–	15	14	R10
55	123	24	77	14	ø19	50.8	23.8	M10 x 1.5; 17 deep	91	50	22	15	16	R6
80	129	28	78	16	ø25	57.2	27.8	M12 x 1.75; 17 deep	109.5	65	30	15	18	R10
107	137	30	84	18	ø25	57.2	27.8	M12 x 1.75; 17 deep	121.8	72	35	15	18	R12
160	171	34	109	20	ø32	66.7	31.8	M14 x 2; 19 deep	122	67	29	15	20	R5
250	204	44	103	20	ø32	66.7	31.8	M14 x 2; 19 deep	131.5	–	–	14	25[1]	–

NG	A16[3]	A17	A18	A19	A20	A21	A22	øA23	A24	A25	A26	A27	A28	A29	O-ring[4]
28	89	135$_{-0.025}$	110	–	86	188	160	ø13.5	62.5	62.5	142	64	35.5	132	126x4
55	92	160$_{-0.025}$	139	132	104	235	200	ø17	72.5	72.5	166	59	35.5	152	150x4
80	110.5	190$_{-0.029}$	151	143	116	260	224	ø21	78.5	78.5	198	79	35.5	164	182x4
107	122.8	200$_{-0.029}$	168	160	132	286	250	ø21	86.5	86.5	210	82	40.5	180	192x4
160	123	200$_{-0.029}$	188	180	146	286	250	ø21	98.5	98.5	210	83	40.5	204	192x4
250	133.5	260$_{-0.081}$	230	–	–	–	–	–	–	–	–	83.5	48.5	224	250x5

Adapter flange U (size 107)

NG	A1	A2	A3	A4	A5	A6	A7	A8	A9 (DIN 13)[2]	A10	A11	A12	A13	A14
107	150	30	96	18	15.5	25	57.2	27.8	M12 x 1.75; 17 deep	109.5	59.7	22.7	18	15

NG	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	O-ring[4]
107	R8	110.5	190$_{-0.025}$	168	160	132	260	224	22	86.5	86.5	198	91.5	13.8	70	182x4

Drive shafts
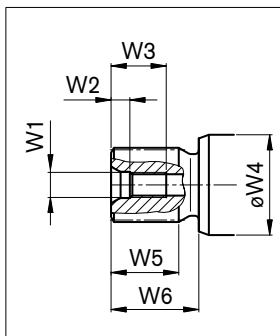
NG	Splined shaft DIN 5480	W1[2)5]	W2	W3	øW4	W5	W6
28	**A** (W30x2x14x9g)	M10 x 1.5	7.5	22	ø35	27	35
55	**Z** (W30x2x14x9g)	M12 x 1.75	9.5	28	ø45	27	35
80	**A** (W40x2x18x9g)	M16 x 2	12	36	ø50	37	45
107	**Z** (W40x2x18x9g)	M12 x 1.75	9.5	28	ø60	37	45
160	**A** (W50x2x24x9g)	M16 x 2	12	36	ø70	44	55
250	**Z** (W50x2x24x9g)	M16 x 2	12	36	ø60	49	58

1) Hole ø22 with spot face ø48; 2 deep
2) Observe the general instructions on page 40 for the maximum tightening torques.
3) To shaft collar
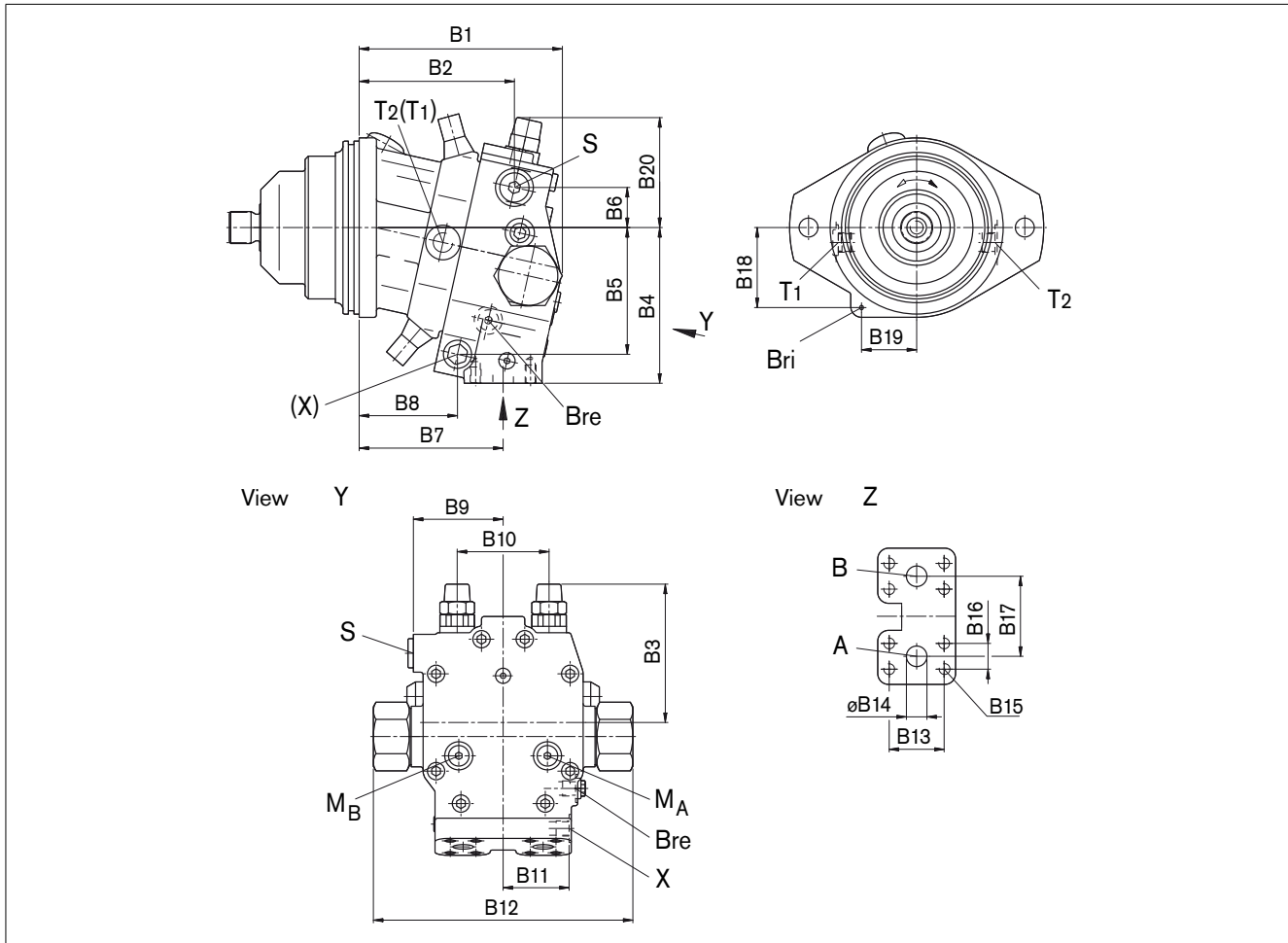4) The O-ring is not included in the delivery contents
5) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions

HA3 – Automatic control high-pressure related
Port plate 22 – SAE flange port A and B at bottom, with integrated counterbalance valve

View Y

View Z

Ports

NG	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15 (DIN 13)[2]	B16	B17
55	192	144	127	144	117	37	133	91	83	85	64	259	50.8	19	M10 x 1.5; 17 deep	23.8	80
80	198	150	136	162	132	40	138	93	83	90	69	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
107	202	161	139	171.5	143	40	144	99	85	96	72	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
160	240	195	152	197	162	47	177	128	102	108	78	259	66.7	32	M14 x 2; 19 deep	31.8	94

NG	B18	B19	B20	Service line port A, B SAE J518	Drain port T_1; T_2[1] DIN 3852[2]	Infeed S DIN 3852[2]
55	74	51	102	3/4 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
80	90	53	114	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
107	96	58	122	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
160	94	65	136	1 1/4 in	M26 x 1.5; 16 deep	M27 x 2; 16 deep

[1] 1x plugged

[2] Observe the general instructions on page 40 for the maximum tightening torques.

Note:
Port plate HZ3 and HA3 are not identical!

Dimensions

Ports

Designation	Port for	Standard[5]	Size[1]	Maximum pressure [bar][2]	State[8]
X	Pilot signal (open with HZ and HA3T, plugged with HA3)	ISO 6149	M14 x 1.5; 11.5 deep	100	O
M_A, M_B	Measuring stroking chamber	DIN 3852	M14 x 1.5; 11.5 deep	420	X
Bre	Brake release, external	DIN 3852	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal (not provided on versions with flange U)	–	ø4	30	X/O[7]

[1] Observe the general instructions on page 40 for the maximum tightening torques.

[2] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

[4] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 39).

[5] The spot face can be deeper than specified in the appropriate standard.

[6] Must be connected for external piping. Is plugged with internal ducting.

[7] Is plugged with external ducting. Must be connected with internal piping.

[8] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

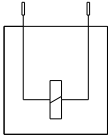## DEUTSCH DT04-2P-EP04

Sizes 28 to 160

Molded, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

IP67 _____ DIN/EN 60529

and IP69K _____ DIN 40050-9

Circuit symbol

Mating connector

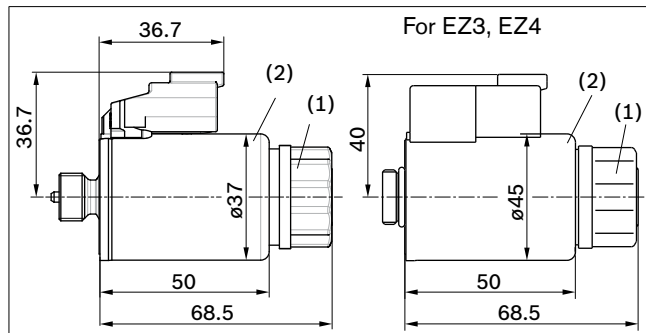DEUTSCH DT06-2S-EP04
Bosch Rexroth Mat. No. R902601804

Consisting of:	DT designation
– 1 housing	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.

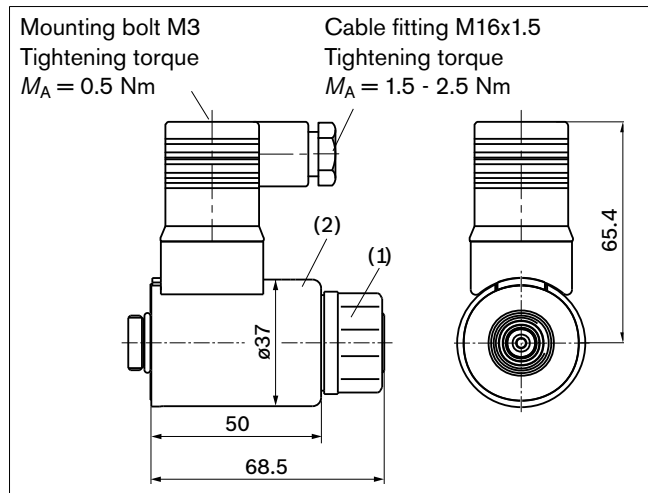## HIRSCHMANN DIN EN 175 301-803-A/ISO 4400

Size 250

Without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

IP65 _____DIN/EN 60529

The seal ring in the cable fitting is suitable for line diameters of 4.5 mm to 10 mm.

The HIRSCHMANN connector is included in the delivery contents of the motor.

Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one turn counter-clockwise.

2. Turn the solenoid body (2) to the desired orientation.

3. Retighten the mounting nut. Tightening torque: 5+1 Nm. (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting _____ 16 bar

Switching pressure of flushing piston Δp _____ 8±1 bar

Flushing flow q_v

Orifices can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm^2/s
(p_{ND} = low pressure, p_G = case pressure)

Size	Flushing flow q_V [L/min]	Mat. No. of orifice
28, 55	3.5	R909651766
80	5	R909419695
107	8	R909419696
160	10	R909419697
250	10	R909419697

With sizes 28 to 160, orifices can be supplied for flushing flows from 3.5 to - 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.
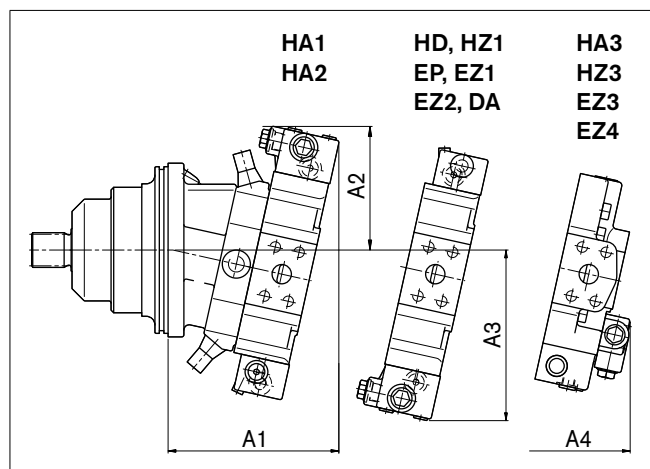
Schematic EP
Sizes 28 to 160
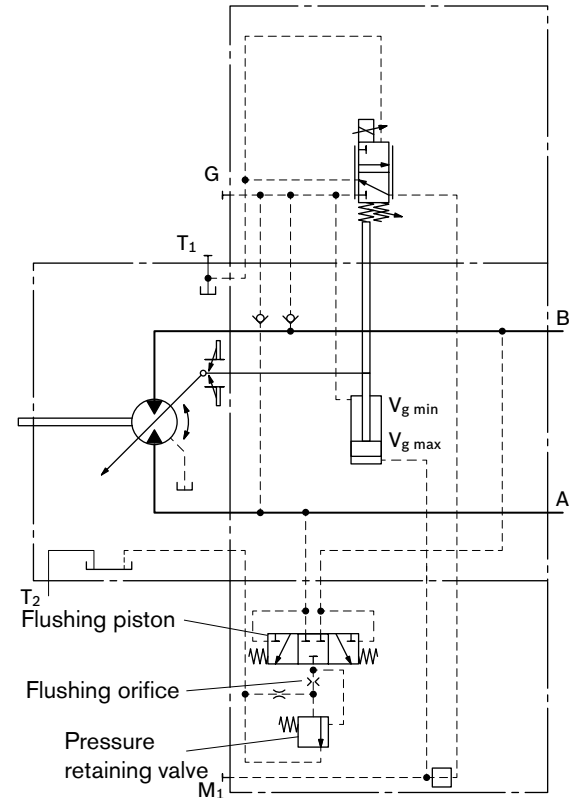
Schematic
Size 250
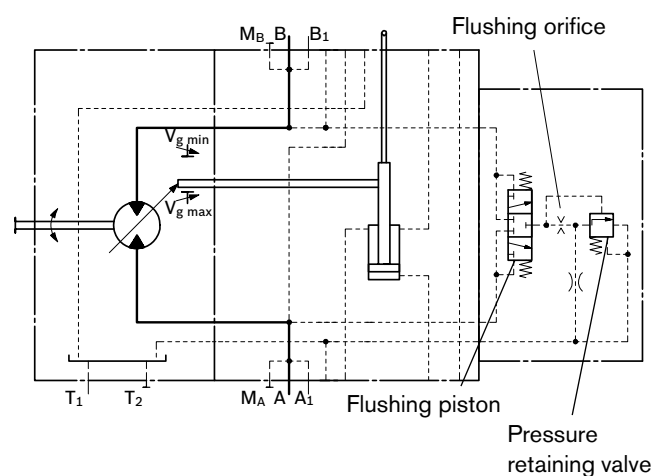
Flushing and boost pressure valve

Dimensions

Sizes 28 to 160

NG	A1	A2	A3	A4
28	152	125	161	–
55	182	133	176	176
80	194	141	192	176
107 (L flange)	204	143	202	186
107 (U flange)	217	143	202	199
160	245	154	220	–

Size 250
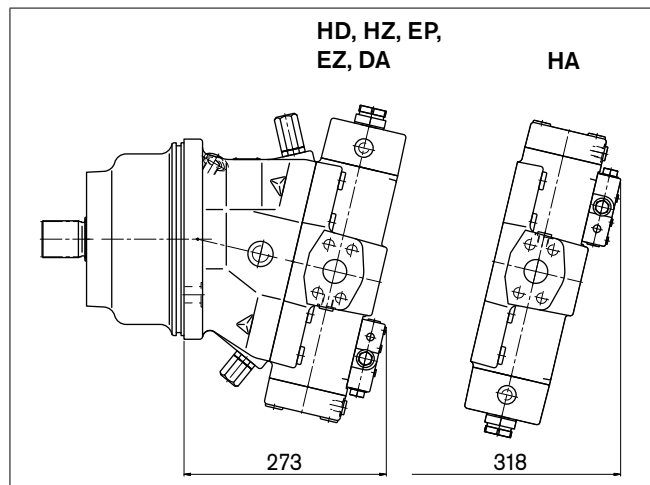
Counterbalance valve BVD and BVE

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

– BVD available for sizes 55 to 160 and BVE available for sizes 107 and 160.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12

– For safety reasons, controls with beginning of control at $V_{g\,min}$ (e. g. HA) are not permissible for winch drives!

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening

  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)

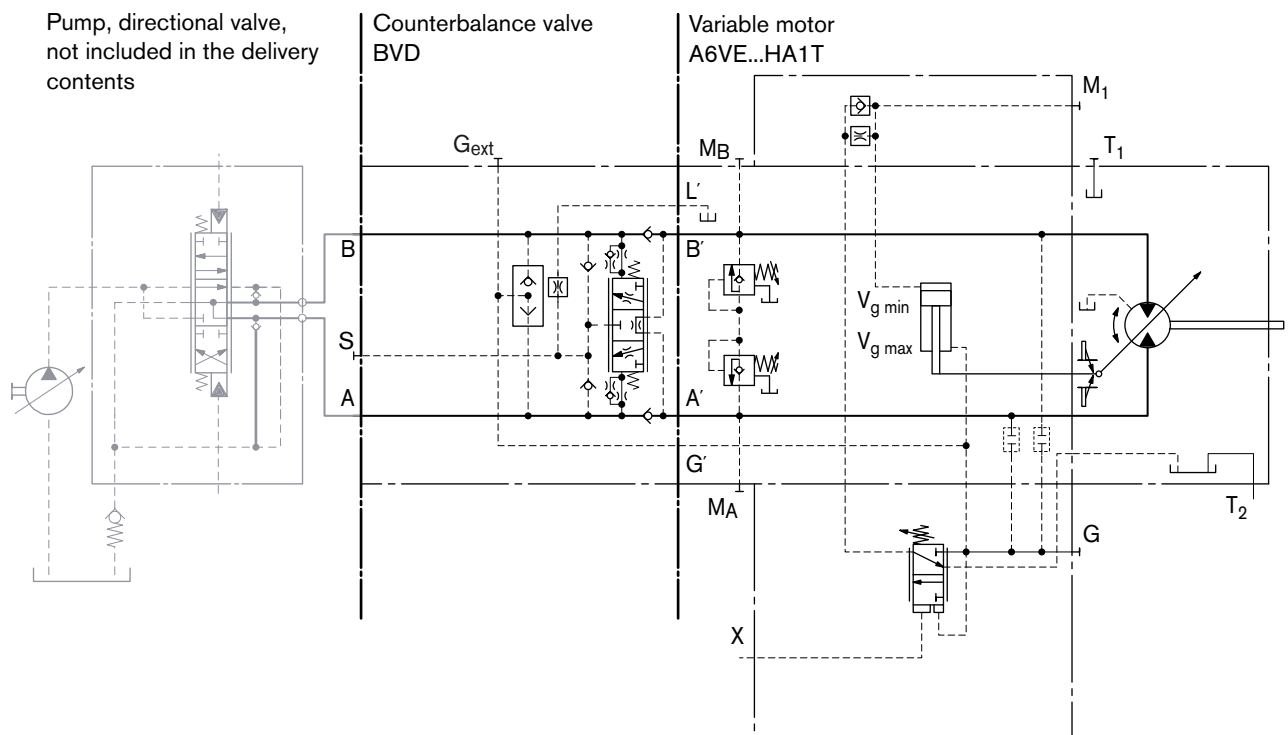 - the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive for wheeled excavators
A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding installation drawing. Dimensions in mm.
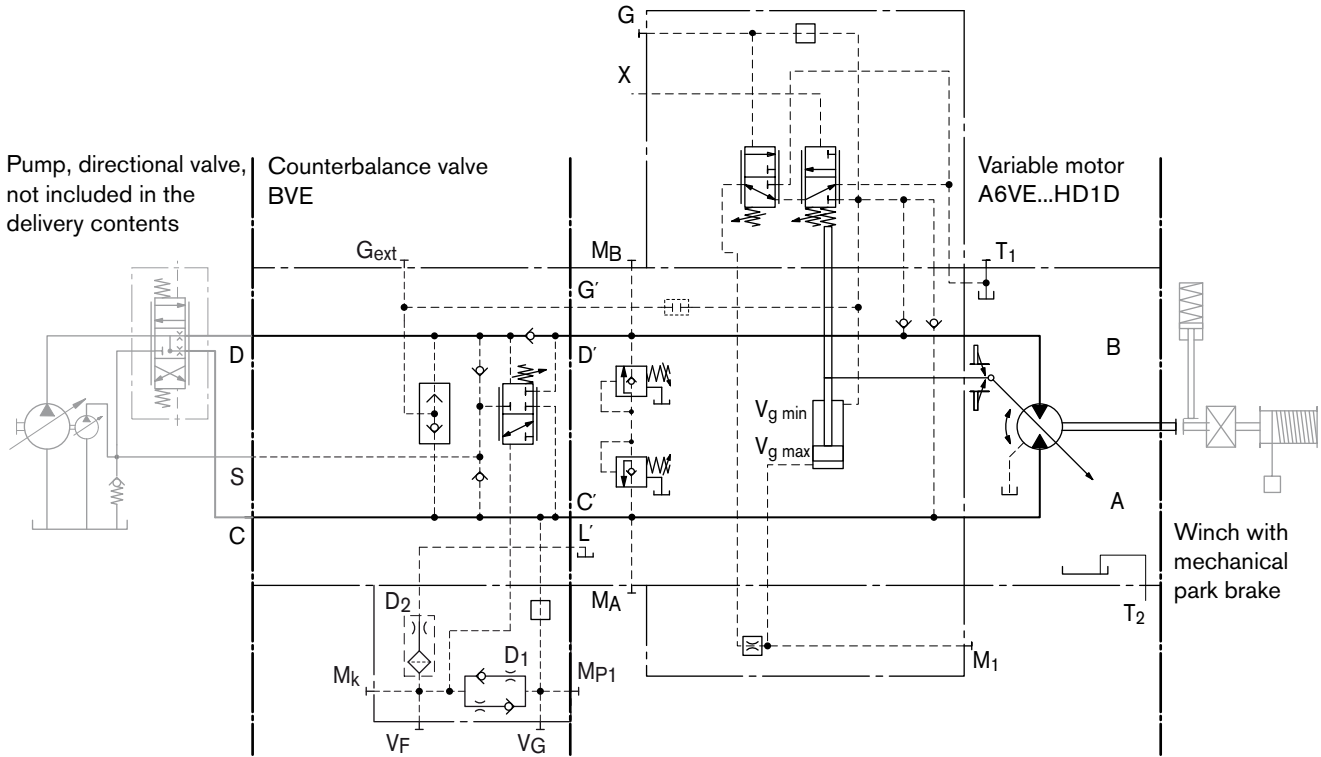
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VE80HD1D/63W–VAL38800B + BVE25W38S/51ND-V100K00D4599T30S00-0

Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve		Restricted values in operation with DBV and BVD/BVE								
			DBV				BVD/BVE				
	p_{nom}/p_{max} [bar]	$q_{V\,max}$ [L/min]	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
55	400/450	244	22	350/420	240	380	20 (BVD)	350/420	220	388
80		312								
107		380	32		400	370				378
107		380				380	25 (BVD/BVE)		320	388
160		496								
250	350/400	675	On request							

DBV _____ pressure-relief valve

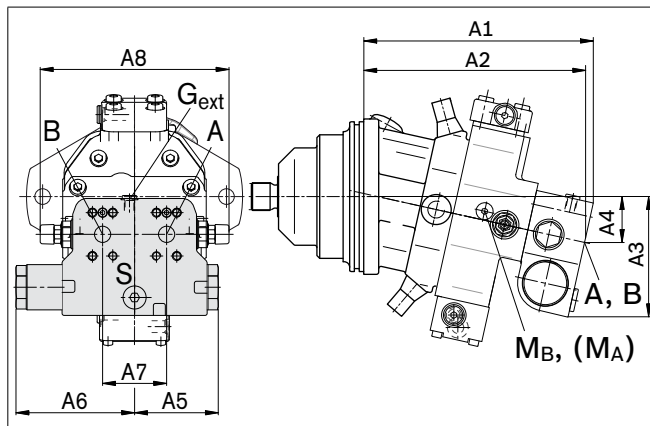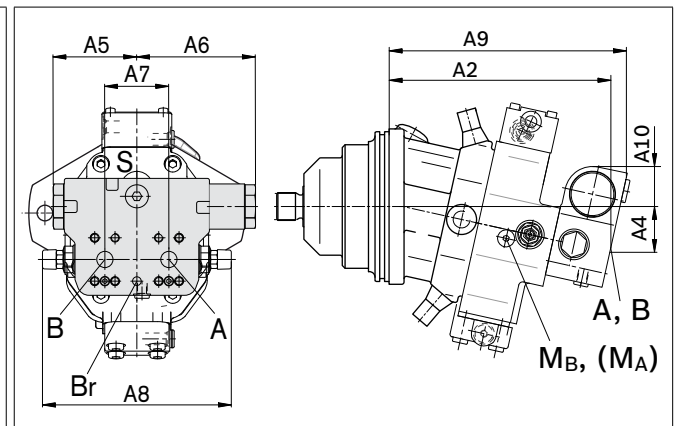BVD _____counterbalance valve, double-acting

BVE _____counterbalance valve, one-sided

Counterbalance valve BVD and BVE

Before finalizing your design, request a binding
installation drawing. Dimensions in mm.

Dimensions

A6VE...HA1/2   **A6VE...HD or EP[1]**

A6VE	Counterbalance valve											
NG...plate	Type	Ports	Dimensions									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...38	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
80...38	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
107...37	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
107...38	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
160...38	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
107...38	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
160...38	BVE25...38	1 1/4 in	334	324	176	68	137	214	84	238	349	59

Ports

Designation	Port for	Version	A6VE Plate	Standard	Size[2]	Maximum pressure [bar][3]	State[5]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4]	M12 x 1.5; 12 deep	30	O
G$_{ext}$	Brake release, high-pressure	S		DIN 3852[4]	M12 x 1.5; 12.5 deep	420	X
M$_A$, M$_B$	Measuring pressure A and B			ISO 6149[4]	M18 x 1.5; 14.5 deep	420	X

[1] At the mounting version for the controls HD and EP, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!

[2] Observe the general instructions on page 40 for the maximum tightening torques.

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] The spot face can be deeper than specified in the appropriate standard.

[5] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

# Counterbalance valve BVD and BVE

Mounting the counterbalance valve

When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) _____ length B1+B2+B3
2 screws (**6, 7**) _____ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10 x 1.5	10.9	75
M12 x 1.75	10.9	130
M14 x 2	10.9	205
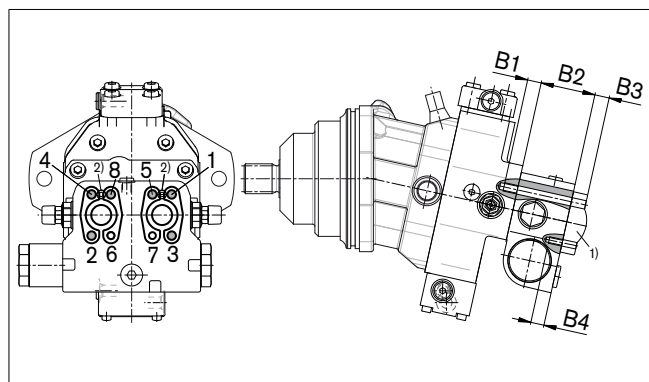
1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG…plate	55…38	80…38, 107…37	107…38, 160…38
B1[3)]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Counterbalance valve integrated BVI

Function

The integrated counterbalance valve is designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking or traveling downhill.

Note

– The integrated counterbalance valve must be ordered additionally, see ordering code below.

– The counterbalance valve does not replace the mechanical service brake and park brake.

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening

  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)

  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Application options

– Track drive in excavator crawlers

Ordering code

BVI			00		–	
01	02	03	04	05		06

Counterbalance valve

01	Counterbalance valve integrated			**BVI**

Brake piston version

	Brake piston version	qv [L/min]	Material number	
02	Volume preselected	≤ 150	R902038832	**51**
		= 150 – 210	R902038936	**52**
		= 210 – 270	R902038833	**53**
		= 270 – 330	R902038834	**54**
		= 330 – 400	R902038835	**55**
		≥ 400	R902038836	**56**

Throttle mounting

	Throttle mounting	Material number	
03	Constant throttle	R909432302	**0008**
	Throttle pin	R909651165	**0603**

Check valve

04	Without residual opening	**00**

Brake release valve

	Brake release valve		
05	With brake release valve (standard with HZ)	Without disable function	**1**
	With brake release valve (standard with HA)	With disable function	**2**

Standard / special version

	Standard / special version	
06	Standard version	**0**
	Special version	**S**

Counterbalance valve integrated BVI

Table of values

Operating pressure	nominal pressure	p	bar	350
	peak pressure	p	bar	420
Flow, maximum		$q_{v\ max}$	L/min	400
Counterbalance spool	start of opening	p	bar	12
	fully open	p	bar	26
Pressure-reducing valve for brake release (fixed setting)	control pressure	p	bar	21^{+4}
	beginning of control	p	bar	10^{+4}

Comparison between port plates 02 and 22

Maximum permissible input flow with restricted nominal pressure 350 bar, maximum pressure 420 bar

Motor NG	Without restrictions standard plate (02)		Restricted values plate with integrated counterbalance valve (22)		with BVI + DBV
	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Code	p_{nom}/p_{max} [bar]	q_V [L/min]
55	400/450	276	22	350/420	240
80		332			
107		410			
160		533			400

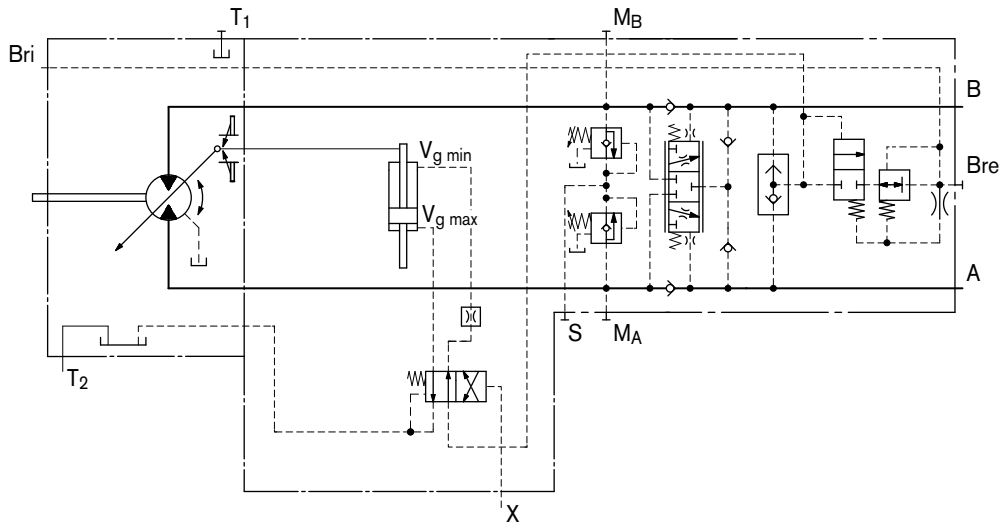**Infeed characteristic M22 x 1.5**

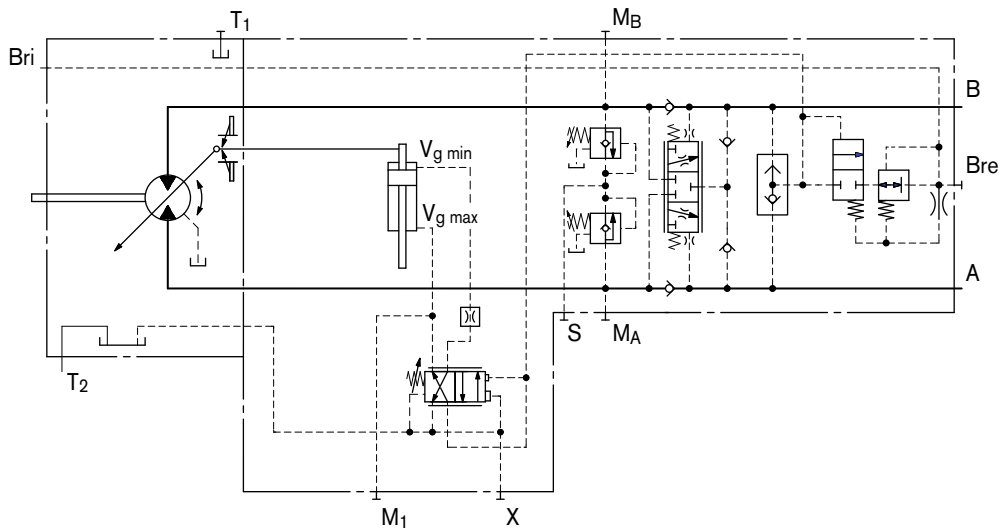**Infeed characteristic M27 x 2**
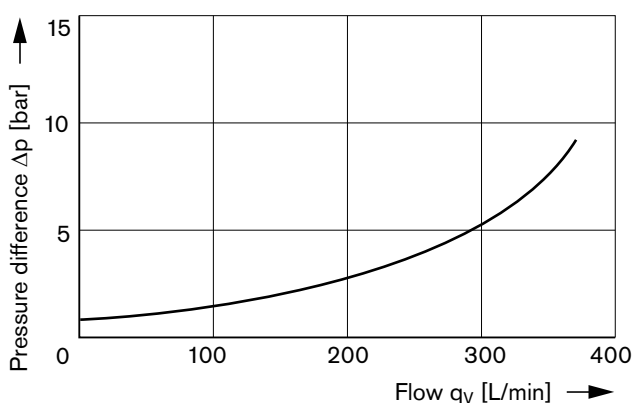
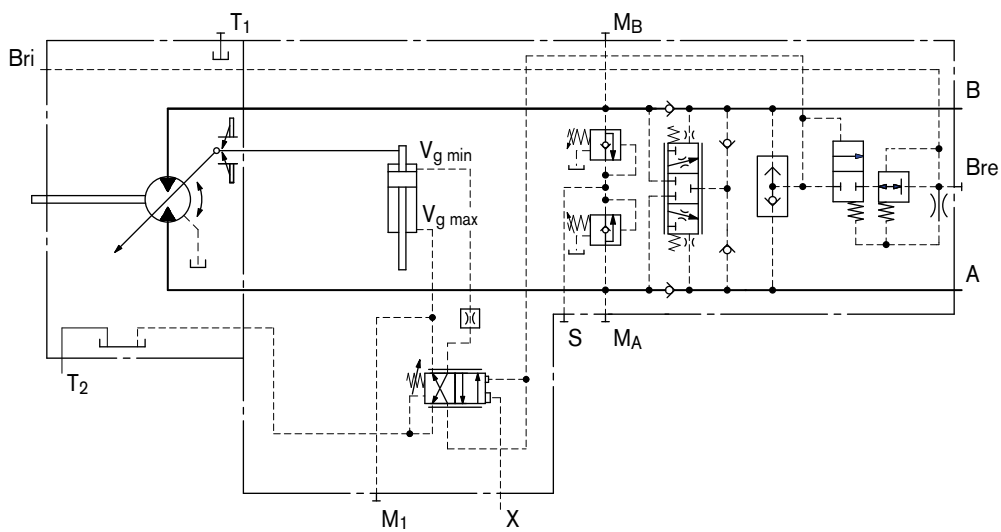# Counterbalance valve integrated BVI

Schematic HZ3

Schematic HA3

Schematic HA3.T

Speed sensor

Version A6VE...U ("prepared for speed spensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the speed sensor DSA mounted, a signal proportional to motor speed can be generated. The sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (DSA – RE 95133).

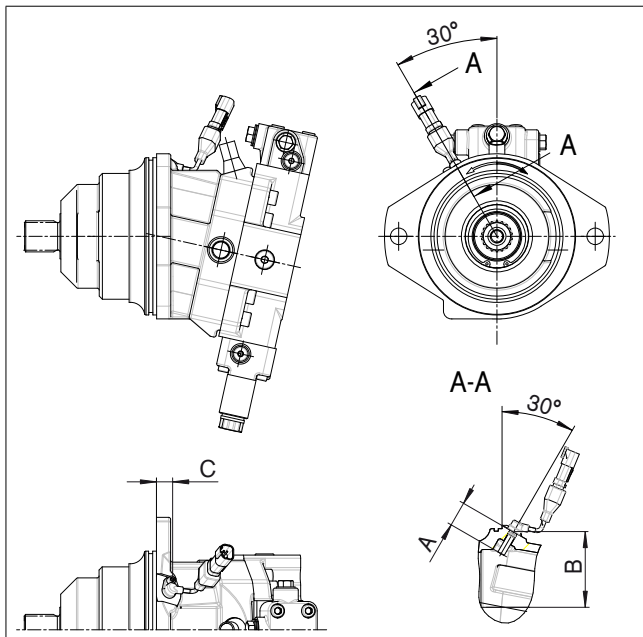The sensor is mounted on the port provided for this purpose with a mounting bolt.

We recommend ordering the A6VE variable motor complete with installed sensor.

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Schematic
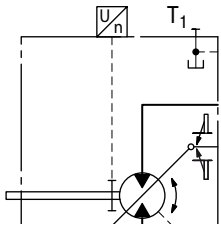
Dimensions
Version "V" with mounted speed sensor

NG	55	80	107	160	250
Number of teeth	54	58	67	75	86
A	32	32	32	32	on request
B	83.3	87.3	96.3	104.3	on request
C	26	16.5	14.2	28.5	on request

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

The case drain fluid in the motor housing must be directed to the reservoir via the highest available drain port (T_1, T_2).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 6.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

Note
In certain installation conditions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Installation position	Air bleed	Filling
1	–	T_2, T_1
2	–	T_2, T_1
3	–	T_2, T_1
4	L_1	T_2, T_1 (L_1)
5	L_1	T_2, T_1 (L_1)
6	L_1	T_2, T_1 (L_1)

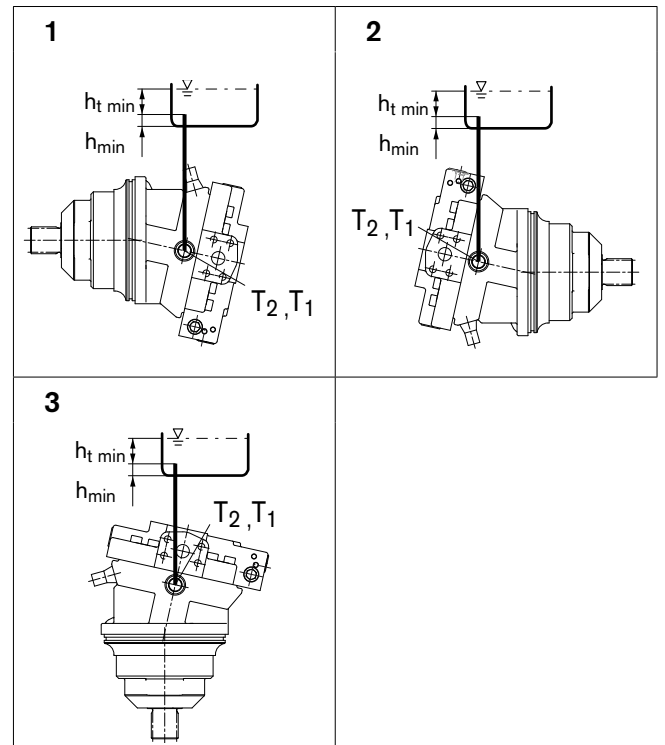L_1 Filling / air bleed

T_1, T_2 Drain port

$h_{t\,min}$ Minimum required immersion depth (200 mm)

h_{min} Minimum required spacing to reservoir bottom (100 mm)
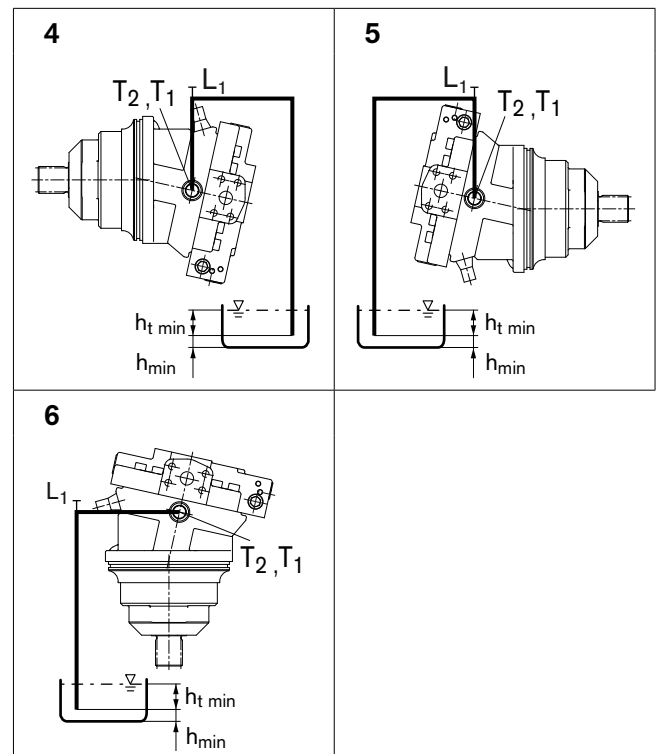
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

General instructions

– The motor A6VE is designed to be used in open and closed circuits.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

- The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

- The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– The product is not approved as a component for the safety concept of a general machine according to ISO 13849.

– The following tightening torques apply:

- Fittings:
  Observe the manufacturer's instruction regarding tightening torques for the fittings used.

- Mounting bolts:
  For mounting bolts with metric ISO threads according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

- Female threads in the axial piston unit:
  The maximum permissible tightening torques $M_{G\,max}$ are maximum values for the female threads and must not be exceeded. For values, see the following table.

- Threaded plugs:
  For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports		Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs M_V[1]	WAF hexagon socket of the threaded plugs
Standard	Size of thread			
DIN 3852	M12 x 1.5	50 Nm	25 Nm[2]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm

[1] The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.

[2] In the "lightly oiled" state, the M_V is reduced to 17 Nm for M12 x 1.5.