Rexroth
Bosch Group
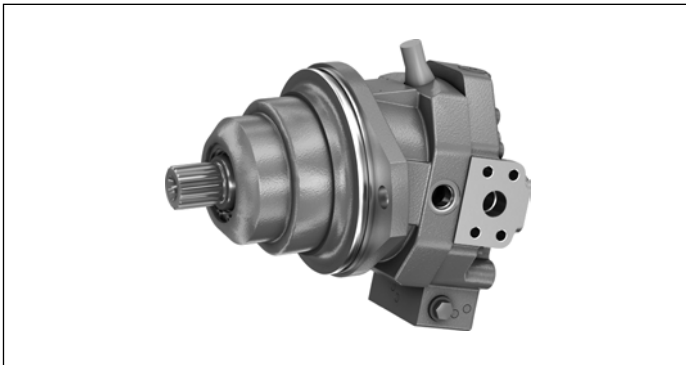
Variable plug-in motor
A6VE Series 65

RE 91615
Edition: 05.2016
Replaces: 08.2015

▶ High pressure motor for integration in mechanical gearbox
▶ Sizes 55 to 200
▶ Nominal pressure 400 bar
▶ Maximum pressure 450 bar
▶ Open and closed circuits

Features

▶ Space-saving construction due to recessed mounting flange
▶ Easy to install. Simply plug into the mechanical gearbox.
▶ Wide control range (can be swiveled to zero)
▶ Approved for very high rotational speeds
▶ High torque
▶ Optional with flushing and boost-pressure valve mounted
▶ Optional with integrated or mounted counterbalance valve
▶ Bent-axis design

Contents

Type code

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	E					0	0			/	65	M	W	V	0						–	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 400 bar, maximum pressure 450 bar					**A6V**

Operating mode

02	Plug-in motor	**E**

Size (NG)

			055	080	107	160	200	
03	Geometric displacement, see "Technical data" on page 8		**055**	**080**	**107**	**160**	**200**	

Control device

					055	080	107	160	200	
04	Proportional control Hydraulic	positive control	Δp_{St} = 10 bar		●	●	●	●	●	**HP1**
			Δp_{St} = 25 bar		●	●	●	●	●	**HP2**
		negative control	Δp_{St} = 10 bar		●	●	●	●	●	**HP5**
			Δp_{St} = 25 bar		●	●	●	●	●	**HP6**
	Proportional control electrical	positive control	U = 12 V		●	●	●	●	●	**EP1**
			U = 24 V		●	●	●	●	●	**EP2**
		negative control	U = 12 V		●	●	●	●	●	**EP5**
			U = 24 V		●	●	●	●	●	**EP6**
	Two-point control Hydraulic	negative control			–	–	–	●	●	**HZ5**
					●	●	●	●[1]	–	**HZ7**
	Two-point control electrical	negative control	U = 12 V		–	–	–	●	●	**EZ5**
			U = 24 V		–	–	–	●	●	**EZ6**
			U = 12 V		●	●	●	–	–	**EZ7**
			U = 24 V		●	●	●	–	–	**EZ8**
	Automatic control High pressure dependent, positive control	with minimum pressure increase	Δp ≤ approx. 10 bar		●	●	●	●	●	**HA1**
		with pressure increase	Δp = 100 bar		●	●	●	●	●	**HA2**
		with minimum pressure increase	Δp ≤ approx. 10 bar		○	○	●	●	–	**HA3**[1]

Pressure control/override

		055	080	107	160	200	
05	Without pressure control/override	●	●	●	●	●	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6	●	●	●	●	●	**D1**
	Override of the HA1, HA2, and HA3 controls, hydraulic remote controlled, proportional	●	●	●	●	●	**T3**

Connector for solenoids[2] (see page 24)

06	Without connector (without solenoid, only for hydraulic control)	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	**P**

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**0**

● = Available   ○ = On request   – = Not available

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[1] Only possible in conjunction with port plate 6 (integrated counterbalance valve)

[2] Connectors for other electric components may deviate

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20	21
A6V	E					0	0			/	65	M	W	V	0					–	

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		**0**
	Damping	HP, EP, HP5,6D. and EP5,6D., HZ, EZ, HA with BVD/BVE counterbalance valves	**1**
		One-sided in inlet to large stroking chamber (HA)	**4**

Setting range for displacement[3]

10	$V_{g\,max}$-setting screw	$V_{g\,min}$-setting screw	**055**	**080**	**107**	**160**	**200**	
	No setting screw	short (0-adjustable)	●	●	●	●	●	**A**
		medium	●	●	●	●	●	**B**
		long	●	●	●	●	●	**C**
		extra long	–	–	●	●	●	**D**
	short	short (0-adjustable)	●	●	●	●	●	**E**
		medium	●	●	●	●	●	**F**
		long	●	●	●	●	●	**G**
		extra long	–	–	●	●	●	**H**
	medium	short (0-adjustable)	●	●	●	●	●	**J**
		medium	●	●	●	●	●	**K**
		long	●	●	●	●	●	**L**
		extra long	–	–	●	●	●	**M**

Series

11	Series 6, index 5	**65**

Version of port and fastening threads

12	Metric, port thread with O-ring seal according to ISO 6149	**M**

Direction of rotation

13	Viewed on drive shaft, bidirectional	**W**

Sealing material

14	FKM (fluoroelastomer)	**V**

Drive shaft bearing

15	Standard bearing	**0**

Mounting flange

16	ISO 3019-2		**055**	**080**	**107**	**160**	**200**	
		160-2	●	–	–	–	–	**P2**
		190-2	–	●	–	–	–	**Y2**
		200-2	–	–	●	●	–	**S2**
		260-4	–	–	–	–	●	**Z2**

Drive shaft

17	Splined shaft DIN 5480		**055**	**080**	**107**	**160**	**200**	
		W30×2×14×9g	●	–	–	–	–	**Z6**
		W35×2×16×9g	●	●	–	–	–	**Z8**
		W40×2×18×9g	–	●	●	–	–	**Z9**
		W45×2×21×9g	–	–	●	●	–	**A1**
		W50×2×24×9g	–	–	–	●	●	**A2**

● = Available   ○ = On request   – = Not available

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[3] The adjustment values for the setting screws can be found in the table (page 36).

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	E					0	0			/	65	M	W	V	0						−	

Working port

			055	080	107	160	200	
18	SAE working ports **A** and **B** at rear		●	●	●	●	●	1
	SAE working ports **A** and **B** lateral, opposite		●	●	●	●	●	2
	SAE working ports **A** and **B** at bottom only with integrated BVI counterbalance valve[4]		○	○	●	●	−	6
	Port plate with 1-level pressure relief valves for mounting a counterbalance valve[5]	BVD20	●	●	●	−	−	7
		BVD25, BVE25	−	−	●	●	●	8

Valve (see page 25 to 34)

			055	080	107	160	200	
19	Without valve		●	●	●	●	●	0
	With BVD/BVE counterbalance valves mounted[6]		●	●	●	●	●	W
	Integrated brake release valve (only with port plate 6)	For external piping	○	○	●	●	−	Y
		for internal ducting	○	○	●	●	−	Z
	With flushing and boost-pressure valve mounted, flushing on both sides. Flushing flow when: $\Delta p = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [l/min]**						
		3.5	●	●	●	−	−	A
		5	●	●	●	−	−	B
		8	●	●	●	●	●	C
		10	●	●	●	●	●	D
		14	●	●	●	−	−	F
		15	−	−	−	●[7]	●[7]	G
		18	−	−	●[7]	●[7]	●[7]	I
		21	−	−	●[7]	●[7]	●[7]	J
		27	−	−	●[7]	●[7]	●[7]	K
		31	−	−	●[7]	●[7]	●[7]	L
		37	−	−	−	●[7]	●[7]	M

Speed sensor (see page 35)

		055	080	107	160	200	
20	Without speed sensor	●	●	●	●	●	0
	Prepared with DSA speed sensor	●	●	●	●	●	U
	With DSA speed sensor mounted[8]	●	●	●	●	●	V

Standard / special version

21	Standard version	0
	Standard version with installation variants, e.g. **T** ports open and closed contrary to standard	Y
	Special version	S

● = Available   ○ = On request   − = Not available

Notice
▶ Note the project planning notes on page 40.

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4) Only for HZ7 and HA3. Supplement specification for integrated BVI counterbalance valve, see separate type code on page 30. Note the restrictions described on page 31.

5) Possible only in combination with HP, EP and HA control Note the restrictions described on page 27.

6) Type code for counterbalance valve to be quoted separately in accordance with data sheet 95522 – BVD or 95525 – BVE). Note the restrictions described on pages 27 and 30.

7) Not for EZ7, EZ8, HZ7 and HA3

8) Specify the type code separately for sensor in accordance with data sheet 95133 – DSA and observe the requirements for the electronics.

Hydraulic fluids

The A6VE variable motor is designed for operation with HLP mineral oil according to DIN 51524. Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

▶ 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
▶ 90221: Environmentally acceptable hydraulic fluids
▶ 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
▶ 90223: Fire-resistant, water-containing hydraulic fluids (HFC, HFB)
▶ 90225: Axial piston units for operation with water-free and water-containing fire-resistant hydraulic fluids (HFDR, HFDU, HFB, HFC).

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

Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (v_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be met due to extreme operating parameters,
we recommend the use of a flushing and boost-pressure valve (see page 25).

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start[1]	$v_{max} \leq 1600$ mm²/s	$\theta_{St} \geq$ -40 °C	$t \leq 3$ min, $n \leq 1000$ min⁻¹, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$v =$ 1600 to 400 mm²/s	θ = -40 °C to -25 °C	At $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	$v =$ 400 to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = -25 °C to +103 °C	measured at port **T** Observe the permissible temperature range of the shaft seal (ΔT = approx. 12 K between bearing/shaft seal and port **T**)
	$v_{opt} =$ 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} \geq$ 7 mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

1) For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range -40 °C to +90 °C).

▼ **Selection diagram**
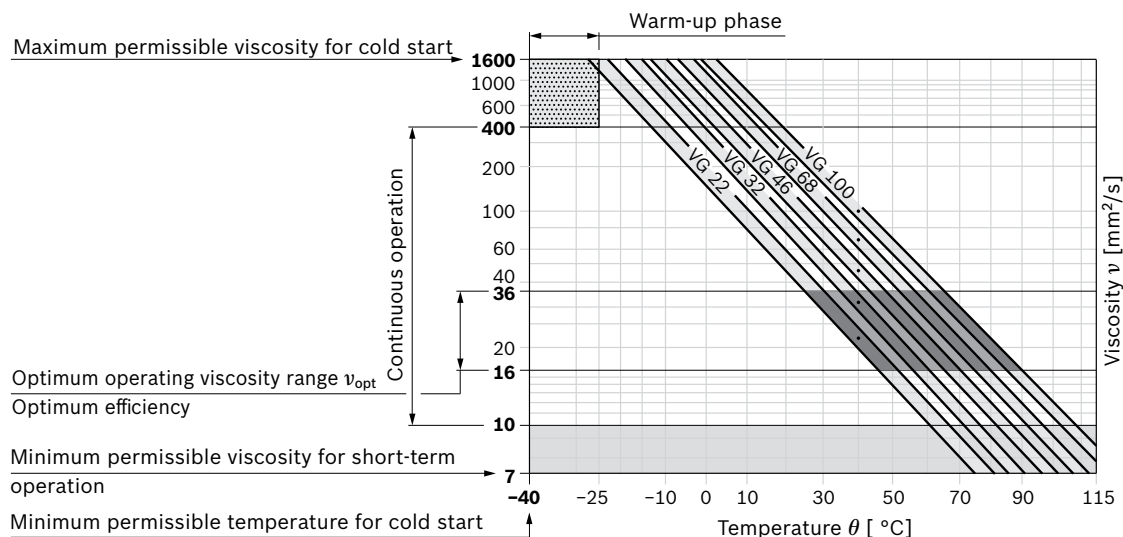
Filtration of the hydraulic fluid

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

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Effect of case pressure on beginning of control

An increase in the case pressure leads to an increase in the beginning of control for the HP and HA.T3 controls.

For EP and HA control, an increase in case pressure has no effect on the beginning of control.

The factory setting for the beginning of control is made at p_{abs} = 2 bar case pressure.

Flow direction

Direction of rotation, viewed on drive shaft	
clockwise	counter-clockwise
A to **B**	**B** to **A**

Shaft seal
Permissible pressure loading

The service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary (t < 0.1 s) pressure peaks of up to 10 bar are permitted. The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure. The case pressure must be equal to or higher than the ambient pressure.
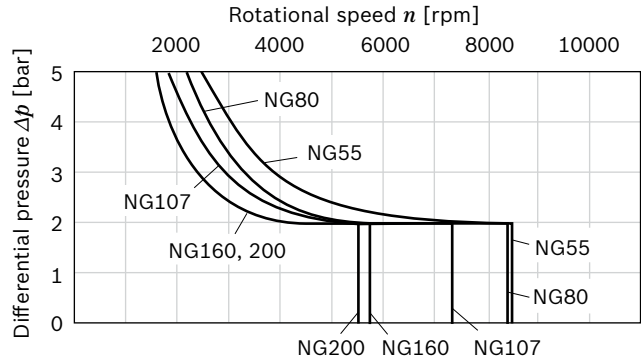

The FKM shaft seal ring may be used for leakage temperatures from -25 °C to +115 °C. For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).
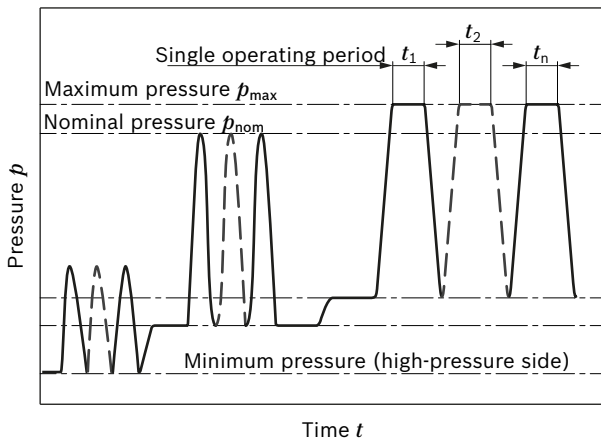
Working pressure range

| Pressure at working port A or B		Definition
Nominal pressure p_{nom}	400 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** or **B**) required to prevent damage to the axial piston unit.
Minimum pressure – operation as a pump (inlet)	See diagram below	To avoid damage to the axial piston motor during operation as a pump (change of the high-pressure side at constant direction of rotation, e.g. during braking processes) a minimum pressure has to be ensured at the working port (inlet). The minimum required pressure is dependent on the rotational speed and displacement of the axial piston unit (see characteristic curve).
Summation pressure p_{Su} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at the working ports (**A** and **B**).
Rate of pressure change $R_{A\ max}$		Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
with built-in pressure relief valve	9000 bar/s	
without pressure relief valve	16000 bar/s	

▼ **Rate of pressure change** $R_{A\ max}$
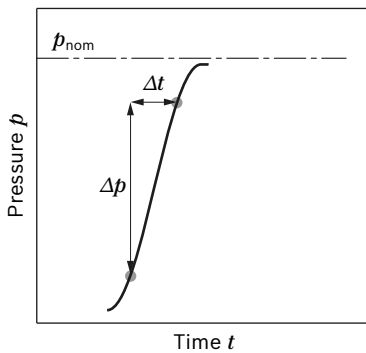
▼ **Pressure definition**

Total operating period = $t_1 + t_2 + ... + t_n$

▼ **Minimum pressure – operation as a pump (inlet)**
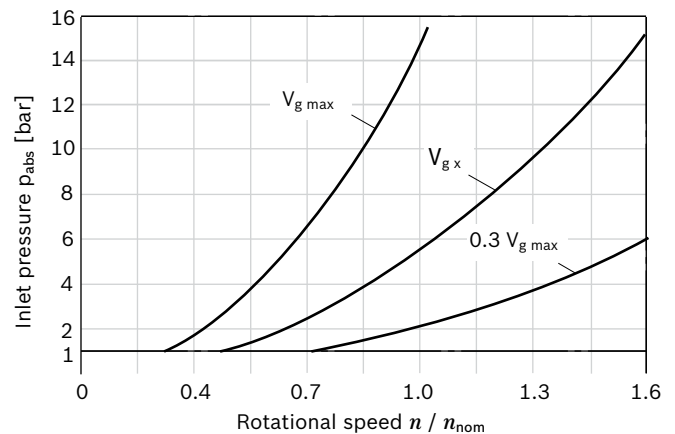
This diagram is only valid for the optimum viscosity range of n_{opt} = 36 to 16 mm²/s.
If the above mentioned conditions cannot be ensured please contact us.

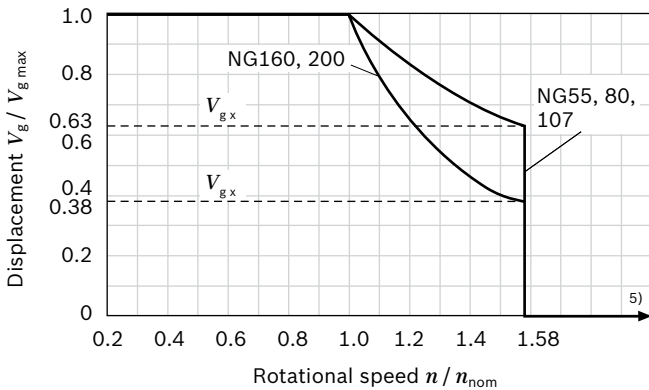**Notice**

Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		55	80	107	160	200
Displacement geometric, per revolution		$V_{g\,max}$	cm^3	54.8	80	107	160	200
		$V_{g\,min}$	cm^3	0	0	0	0	0
		$V_{g\,x}$	cm^3	35	51	68	61	76
Maximum rotational speed[1] (observing the maximum permissible inlet flow)	at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3100	2900
	where $V_g < V_{g\,x}$ (see diagram)	n_{max}	rpm	7000	6150	5600	4900	4600
	where $V_{g\,0}$	n_{max}	rpm	8350	7350	6300	5500	5100
Inlet flow[2]	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	l/min	244	312	380	496	580
Torque[3]	at $V_{g\,max}$ and Δp = 400 bar	T	Nm	349	509	681	1019	1273
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	10	16	21	35	44
	$V_g/2$ to 0 (interpolated)	c_{min}	kNm/rad	32	48	65	105	130
Moment of inertia for rotary group		J_{TW}	kgm^2	0.0042	0.008	0.0127	0.0253	0.0353
Maximum angular acceleration		α	rad/s^2	31500	24000	19000	11000	11000
Case volume		V	l	0.75	1.2	1.5	2.4	3.0
Weight approx.	Port plate 1, 2, 7, and 8	m	kg	28	36	46	62	78
	Port plate 6	m	kg	37	45	52	70	–

▼ **Permissible displacement in relation to rotational speed**

Notice

▶ Theoretical values, without efficiency and tolerances; values rounded

▶ 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, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

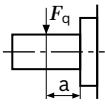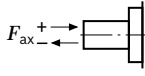| **Determining the operating characteristics**			
Inlet flow	q_v	$= \dfrac{V_g \times n}{1000 \times \eta_v}$	[l/min]
Rotational speed	n	$= \dfrac{q_v \times 1000 \times \eta_v}{V_g}$	[rpm]
Torque	T	$= \dfrac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p \times \eta_t}{600}$	[kW]

Key

V_g Displacement per revolution [cm^3]

Δp Differential pressure [bar]

n Rotational speed [rpm]

η_v Volumetric efficiency

η_{hm} Hydraulic-mechanical efficiency

η_t Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

[1] The values are applicable:
– for the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
– with hydraulic fluid based on mineral oils

[2] Observe limitation of input flow due to counterbalance valve (page 27).

[3] Torque without radial force, with radial force see page 9.

[4] Values in this range on request

Permissible radial and axial forces of the drive shafts

Size		NG		55	80		107		160		200
Drive shaft				W30	W35	W35	W40	W40	W45	W45	W50	W50
Maximum radial force[1] at distance a (from shaft collar)		$F_{q\,max}$	N	7581	8069	10867	10283	13758	12215	18278	16435	20532
		a	mm	17.5	20.0	20.0	22.5	22.5	25.0	25.0	27.5	27.5
Maximum torque at $F_{q\,max}$		$T_{q\,max}$	Nm	281	349	470	509	681	681	1019	1019	1273
Maximum differential pressure at V_{gmax} and $F_{q\,max}$		$\Delta p_{q\,max}$	bar	322	400	369	400	400	400	400	400	400
Maximum axial force, at standstill or depressurized operation		$+\,F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
		$-\,F_{ax\,max}$	N	500	500	710	710	900	900	1120	1120	1250
Permissible axial force per bar working pressure		$+\,F_{ax\,perm/bar}$	N/bar	7.5	7.5	9.6	9.6	11.3	11.3	15.1	15.1	17.0

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 output drive**
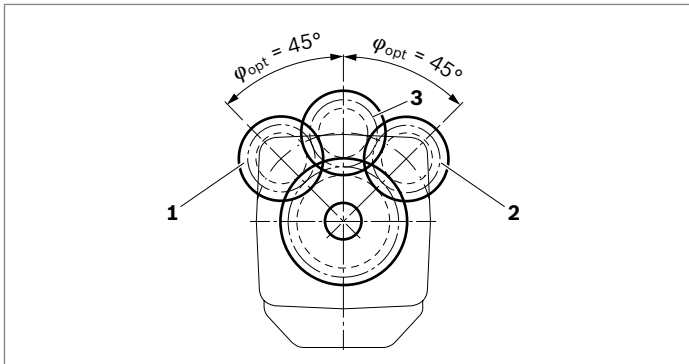
1 "Counter-clockwise" rotation, pressure at port **B**
2 "Clockwise" rotation, pressure at port **A**
3 Bidirectional direction of rotation

Notice
▶ The values given are maximum values and do not apply to continuous operation.
▶ The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
▶ Special requirements apply in the case of belt drives. Please contact us.

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[1] With intermittent operation

HP – Proportional hydraulic control

The proportional hydraulic control provides infinite adjustment of the displacement. The control is proportional to the pilot pressure at port **X**.

HP1, HP2 positive control

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

▶ End of control at $V_{g\,max}$ (maximum torque, minimum rotational speed at maximum pilot pressure)

HP5, HP6 negative control

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

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

Notice

▶ 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, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us.
Bear in mind that pressures up to 450 bar can occur at port **G**.

▶ Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 10 bar.

▶ The beginning of control and the HP characteristic curve are influenced by the case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel displacement of the characteristic curve.

▶ A leakage flow of maximum 0.3 l/min can occur at port **X** due to internal leakage (working pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

Response time damping

The response time damping impacts the pivot behavior of the motor and consequently the machine response speed.

Standard for sizes 55 to 200

HP without damping.

HP.D with throttle pin on both sides, symmetrical (see table)

Optional for sizes 55 to 200

HP with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Size	55	80	107	160	200
Groove size [mm]	0.45	0.45	0.55	0.55	0.65

HP1, HP5 – pilot pressure increase Δp_{St} = 10 bar

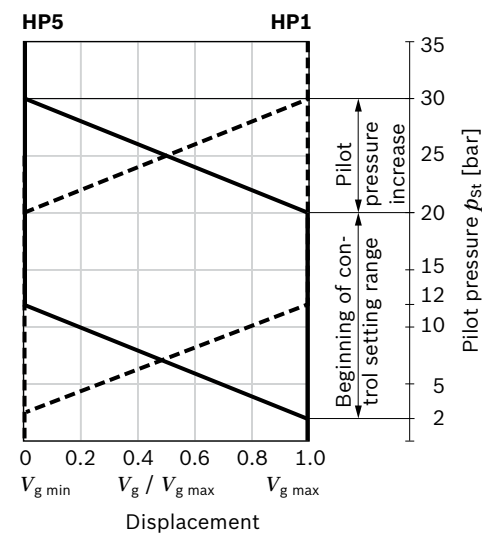**HP1 positive control**

A pilot pressure increase of 10 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 10 bar at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range 2 to 20 bar

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

▼ **Characteristic curve**

HP2, HP6 pilot pressure increase Δp_{St} = 25 bar
HP2 positive control

A pilot pressure increase of 25 bar at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.
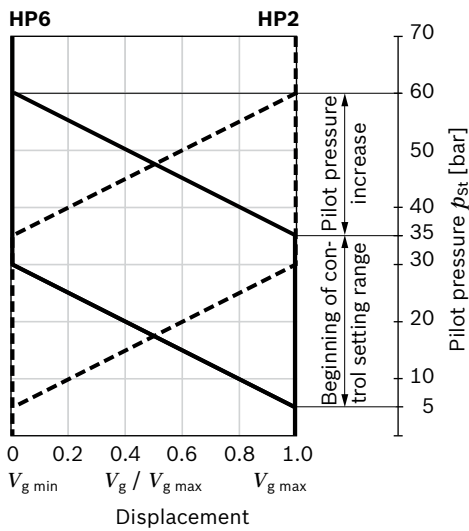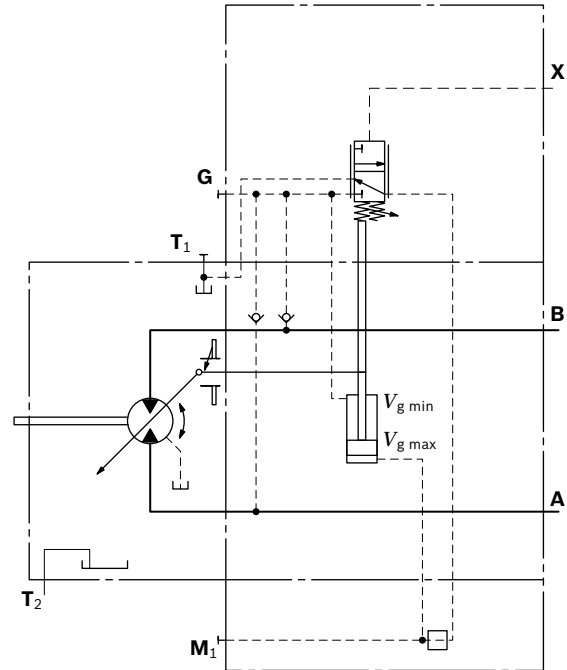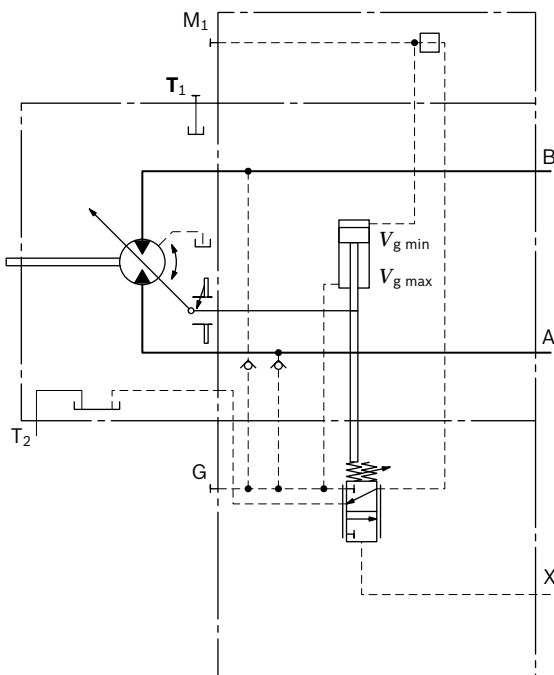
HP6 negative control

A pilot pressure increase of 25 bar at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range 5 to 35 bar
Standard setting:
beginning of control at 10 bar (end of control at 35 bar)

▼ **Characteristic curve**

▼ **Circuit diagram HP1, HP2 (positive control)**

▼ **Circuit diagram HP5, HP6 (negative control)**

HP5D1, HP6D1 Pressure control, fixed setting

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

The increase in 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 80 to 400 bar

▼ **Circuit diagram HP5D1, HP6D1 (negative control)**
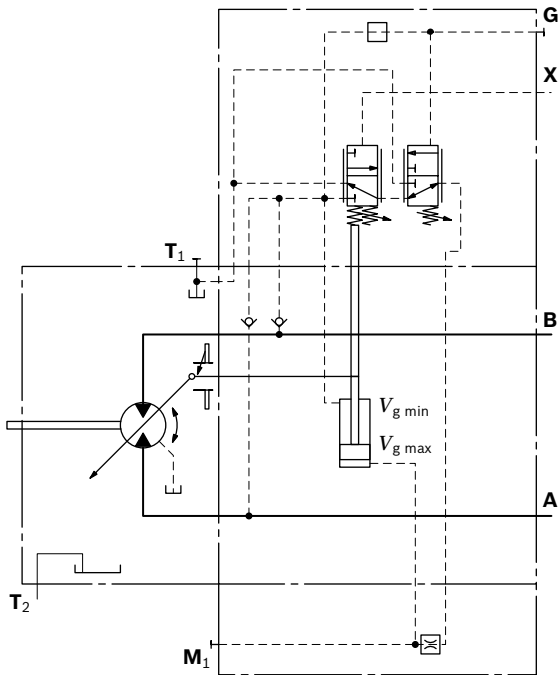
EP – Proportional control, electric

The proportional electric control provides infinite adjustment of the displacement. Control is proportional to the electric control current applied to the solenoid.

EP1, EP2 positive control

▶ Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible rotational speed at minimum control current)

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

EP5, EP6 negative control

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

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

▼ **Characteristic curve**
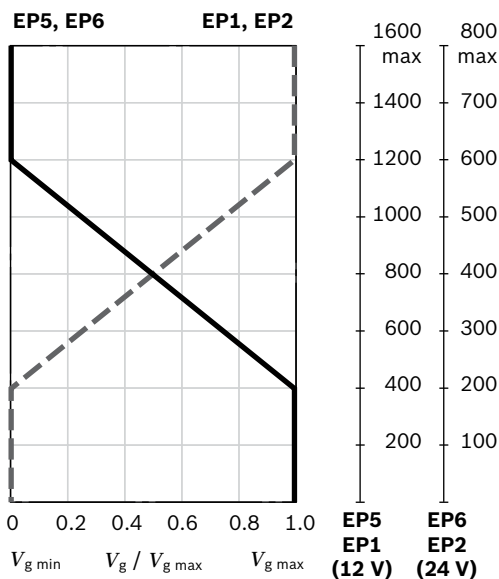
Notice

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

Bear in mind that pressures up to 450 bar can occur at port **G**.

Response time damping

The response time damping impacts the pivot behavior of the motor and consequently the machine response speed.

Standard for sizes 55 to 200

EP without damping.

EP.D with throttle pin on both sides, symmetrical (see table)

Optional for sizes 55 to 200

EP with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Size	55	80	107	160	200
Groove size [mm]	0.45	0.45	0.55	0.55	0.65

Technical data, solenoid	EP1, EP5	EP2, EP6
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
Minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 24		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.
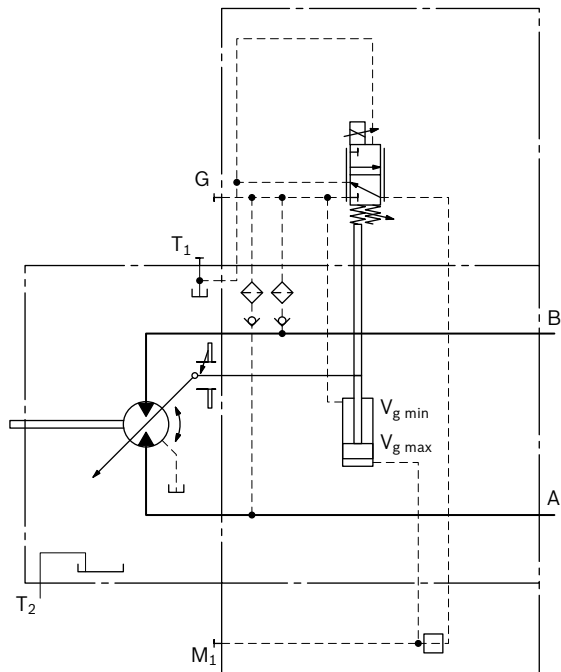
Further information can also be found on the internet at www.boschrexroth.de/mobilelektronik.

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[1] Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

▼ **Circuit diagram EP1, EP2 (positive control)**
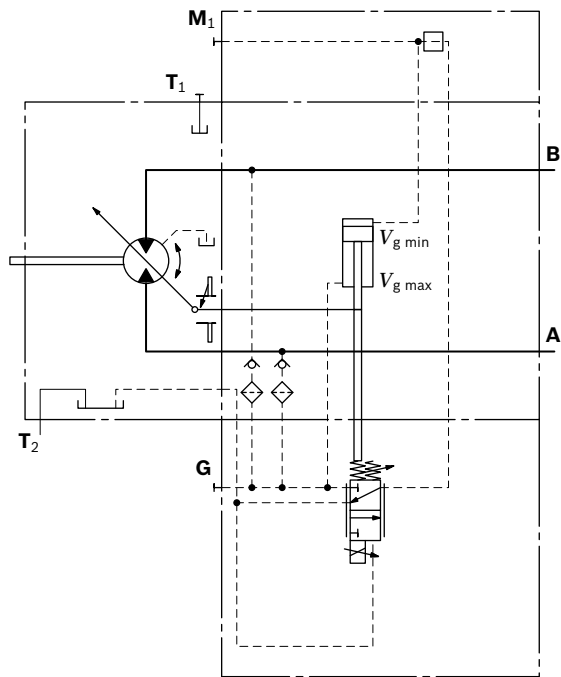
▼ **Circuit diagram EP5, EP6 (negative control)**

EP5D1, EP6D1 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 value of the pressure control, the motor will swivel towards a larger angle.

The increase in 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 80 to 400 bar

▼ **Circuit diagram EP5D1, EP6D1 (negative control)**
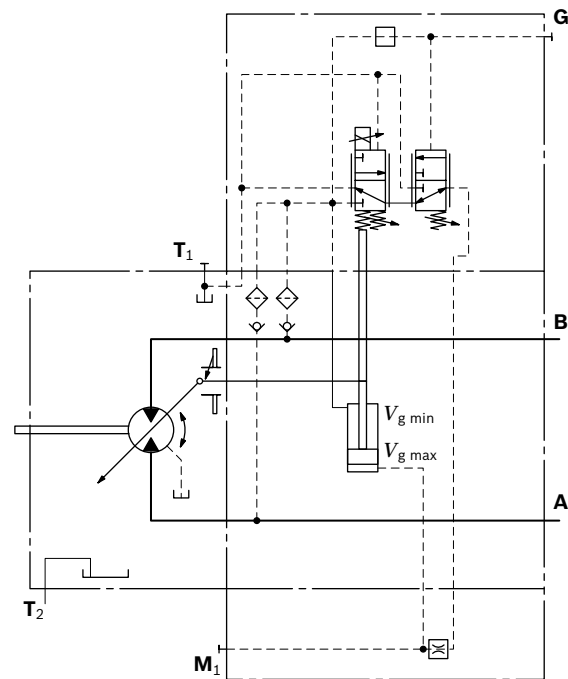
HZ – Two-point control, hydraulic

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.

HZ5, HZ7 negative control

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum rotational speed)
- Position at V_g min (with pilot pressure > 15 bar activated, minimum torque, maximum permissible rotational speed)

▼ **Characteristic curve HZ5, HZ7**
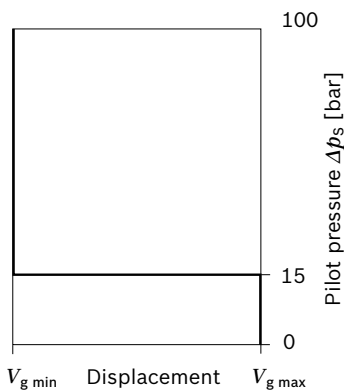
Notice

- 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, a working pressure of at least 30 bar required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Bear in mind that pressures up to 450 bar can occur at port **G**.
- A leakage flow of maximum 0.3 l/min occurs at port **X** (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure must be relieved from port **X** to the reservoir.

Response time damping

The response time damping impacts the pivot behavior of the motor and consequently the machine response speed.

Standard for sizes 160 and 200

HZ5 with throttle pin on both sides, symmetrical (see table)

Standard for sizes 107 and 160 with BVI
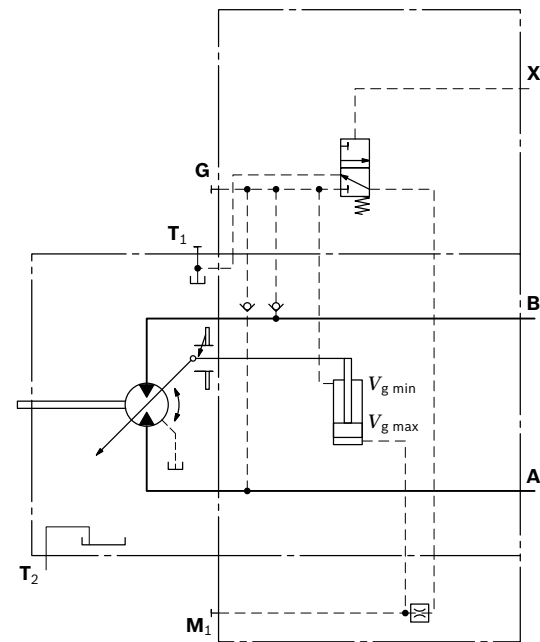
HZ7 with throttle pin on both sides 0.30, symmetrical

Standard for sizes 55 to 107

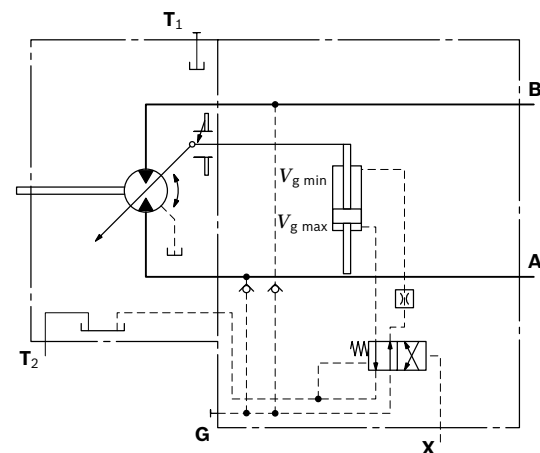**HZ7** (synchronous piston) with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Size	55	80	107	160	200
Groove size [mm]	0.30	0.30	0.30	0.55	0.65

▼ **Circuit diagram HZ5 (negative control) sizes 160 and 200**

▼ **Circuit diagram HZ7 (negative control) size 55 to 107**

EZ – Two-point control, electric

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

Notice

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

Bear in mind that pressures up to 450 bar can occur at port **G**.

Response time damping

The response time damping impacts the pivot behavior of the motor and consequently the machine response speed.
Standard for sizes 160 and 200
EZ5, EZ6 with throttle pin on both sides, symmetrical (see table)
Standard for sizes 55 to 107
EZ7, EZ8 (synchronous piston) with throttle pin on both sides, symmetrical (see table)

▼ **Throttle pin overview**

Size	55	80	107	160	200
Groove size [mm]	0.30	0.30	0.30	0.55	0.65

Sizes 160 and 200

Technical data, solenoid with Ø37	EZ5	EZ6
Voltage	12 V (±20%)	24 V (±20%)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	Current Switched on	Current Switched on
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 24		

▼ **Circuit diagram EZ5, EZ6 (negative control)**
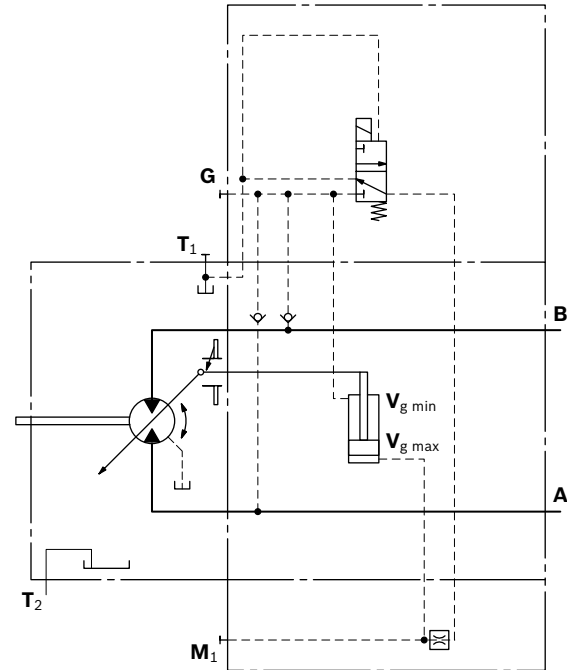
Sizes 55 to 107

Technical data, solenoid with Ø45	EZ7	EZ8
Voltage	12 V (±20%)	24 V (±20%)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum active current required	1.5 A	0.75 A
Duty cycle	100%	100%
Type of protection: see connector version page 24		

▼ **Circuit diagram EZ7, EZ8 (negative control)**
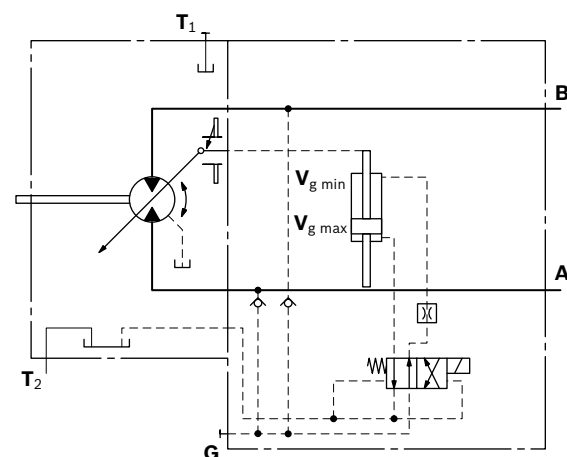
HA – Automatic high-pressure related control

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

The beginning of control of the A6VE motor with HA control is $V_{g\,min}$ (maximum rotational speed and minimum torque). The control device measures internally the working 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 $V_{g\,max}$. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$ depending on the load.

HA1, HA2, HA3 positive control

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

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

Notice

▶ 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, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us.
Bear in mind that pressures up to 450 bar can occur at port **G**.

▶ The beginning of control and the HA.T3 characteristic curve are influenced by case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel displacement of the characteristic curve.

▶ A leakage flow of maximum 0.3 l/min occurs at port **X** (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure must be relieved from port **X** to the reservoir. Only for HA.T control.

Response time damping

The response time damping impacts the pivot behavior of the motor and consequently the machine response speed.

Standard for sizes 55 to 200

HA1,2 with one-sided throttle pin, throttling occurs from $V_{g\,min}$ to $V_{g\,max}$. (see table) HA3 and HA3T3 with BVI and throttle pin on both sides, 0.30, symmetrical

▼ **Throttle pin overview**

Size	55	80	107	160	200
Groove size [mm]	0.45	0.45	0.55	0.55	0.65

Standard for sizes 55 to 200

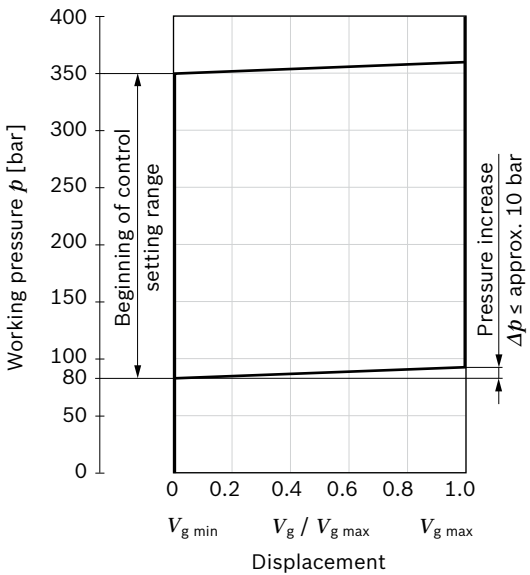HA with BVD or BVE counterbalance valves with throttle screw (see table)

▼ **Throttle screw**

Size	55	80	107	160	200
Diameter [mm]	0.80	0.80	0.80	0.80	0.80

HA1, HA3 with minimum pressure increase, positive control

A working pressure increase of $\Delta p \leq$ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.
Beginning of control, setting range 80 to 350 bar
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 300 bar.

HA2 with pressure increase, positive control

A working pressure increase of $\Delta p \leq$ approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.
Beginning of control, setting range 80 to 350 bar
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 200 bar.
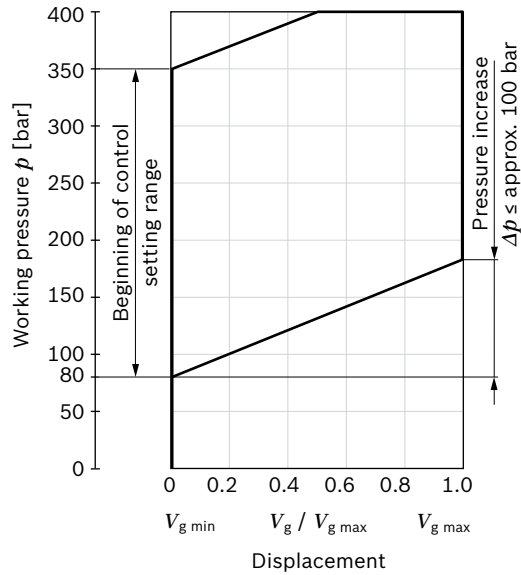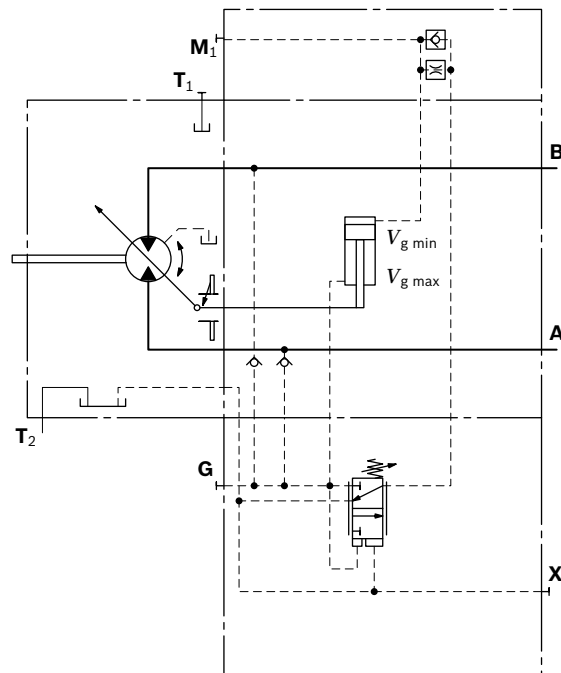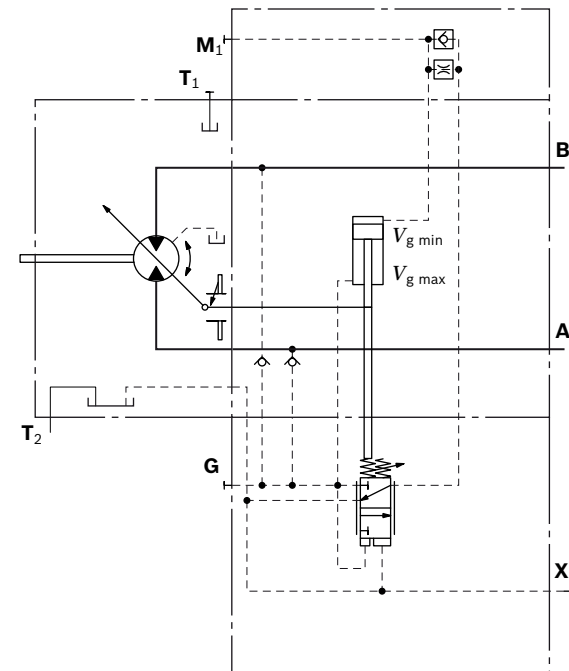
▼ **Characteristic curve HA1, HA3**

▼ **Characteristic curve HA2**

▼ **Circuit diagram HA1**

▼ **Circuit diagram HA2**

▼ **Circuit diagram HA3**

With integrated BVI counterbalance valve, see page 32

HA.T3 override, hydraulic, remote controlled, proportional

With the HA.T3 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.

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

Notice

Maximum permissible pilot pressure 100 bar.

▼ **Circuit diagram HA1T3**
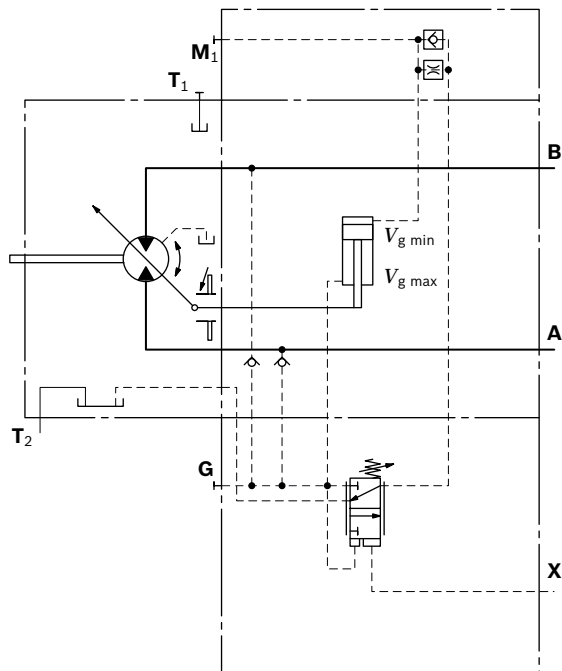
▼ **Circuit diagram HA2T3**
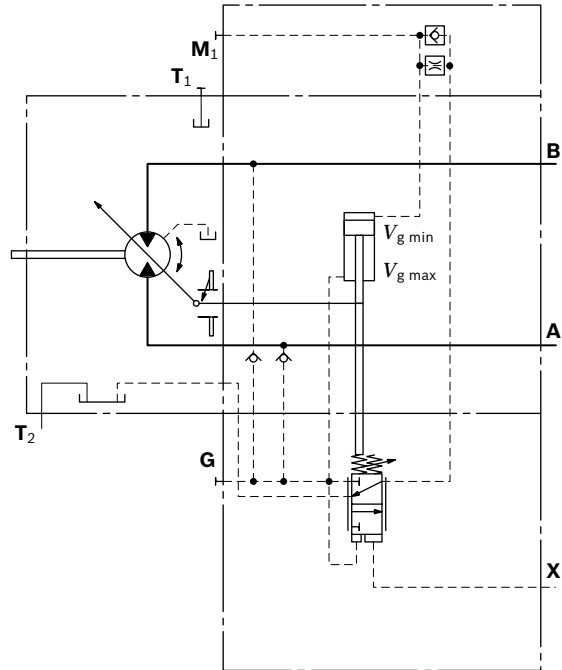
▼ **Circuit diagram HA3T3**

With integrated BVI counterbalance valve, see page 32

Dimensions

Sizes 55 to 160

HZ7 – Two-point control, hydraulic

Port plate 2 — SAE working ports **A** and **B** lateral, opposing
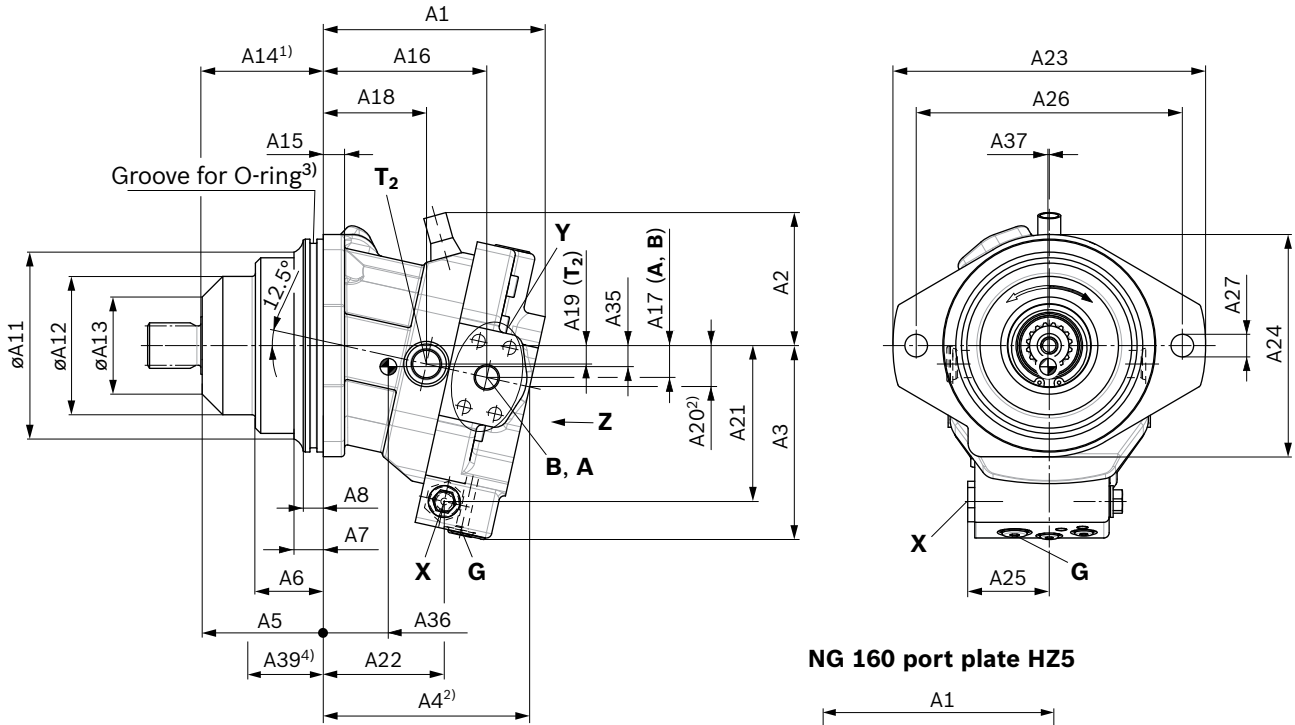
NG 160 port plate HZ5

View Y
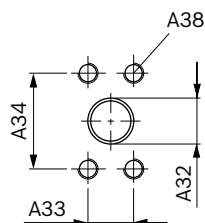
⊕ Center of gravity

1) To shaft collar
2) Port plate 1 — SAE working ports **A** and **B** at rear
3) The O-ring is not included in the scope of delivery
4) Difference in dimension of mounting flange A6VM to A6VE

Notice

Dimensions of the control devices, see data sheet RD 91610.

NG	A1	A2	A3	A4	A5	A6	A7	A8	øA9	øA10	øA11	øA12	øA13	A14	A15	A16
55	167	100	146	153	91	51	22	15	160	132	140.5	104	73	92	16	123
80	176	114	161	164	109.5	65	30	15	190	143	151	116	88	110.5	18	129
107	187	121	172	175	121.8	73	35	15	200	160	168	132	90	122.8	18	137
160	243	133	197	212	122	67	29	15	200	180	188	146	100	123	20	171

NG	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32
55	24	77	14	30	117	91	235	166	57	200	17	76	76	73	73	19
80	28	78	16	35	132	93	260	198	57	224	21	82	82	78.5	78.5	25
107	30	82	17	38	143	99	286	210	61	250	21	90	90	86.5	86.5	25
160	34	109	20	43	107	208	286	210	40.5	250	21	102	102	98.5	98.5	32

NG	A33	A34	A35	A36	A37	A38	A39	O-ring
55	23.8	50.8	15.8	48.8	1	M10 x 1.5; 17 deep	60	150 × 4
80	27.8	57.2	15.9	44.2	0.6	M12 × 1.75; 17 deep	78.5	182 × 4
107	27.8	57.2	15.2	42.9	0.5	M12 × 1.75; 17 deep	83	192 × 4
160	31.8	66.7	14.3	69.9	0.5	M14 x 2; 19 deep	83	192 × 4

▼ **Drive shaft**
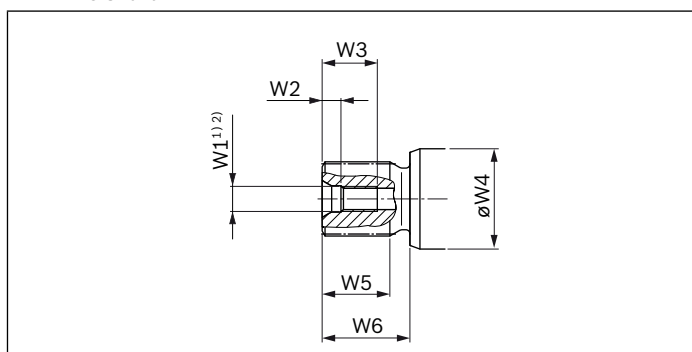
NG	Splined shaft DIN 5480	W1	W2	W3	øW4	W5	W6
55	**Z6 –** W30×2×14×9g	M12×1.75	9.5	28	45	27	35
55	**Z8 –** W35×2×16×9g	M12×1.75	9.5	28	45	32	40
80	**Z8 –** W35×2×16×9g	M12×1.75	9.5	28	50	32	40
80	**Z9 –** W40×2×18×9g	M16×2	12	36	50	37	45
107	**Z9 –** W40×2×18×9g	M12×1.75	9.5	28	60	37	45
107	**A1 –** W45×2×21×9g	M16×2	12	36	60	42	50
160	**A1 –** W45×2×21×9g	M16×2	12	36	70	42	50
160	**A2 –** W50×2×24×9g	M16×2	12	36	70	44	55
200	**A2 –** W50×2×24×9g	M16×2	12	36	70	44	55

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1) For notes on tightening torques, see the instruction manual.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions
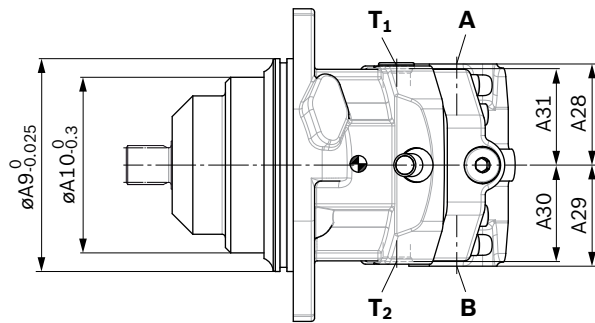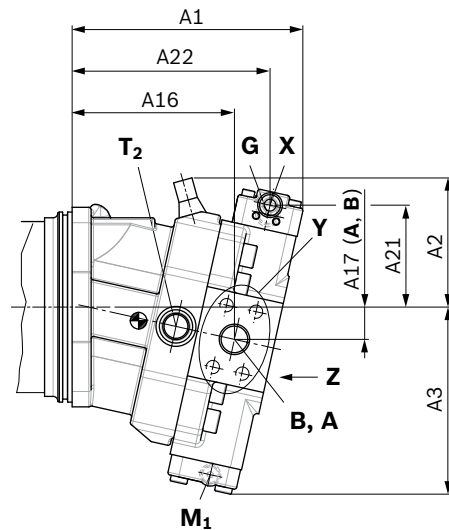
Sizes 200

HZ5 – Two-point control, hydraulic
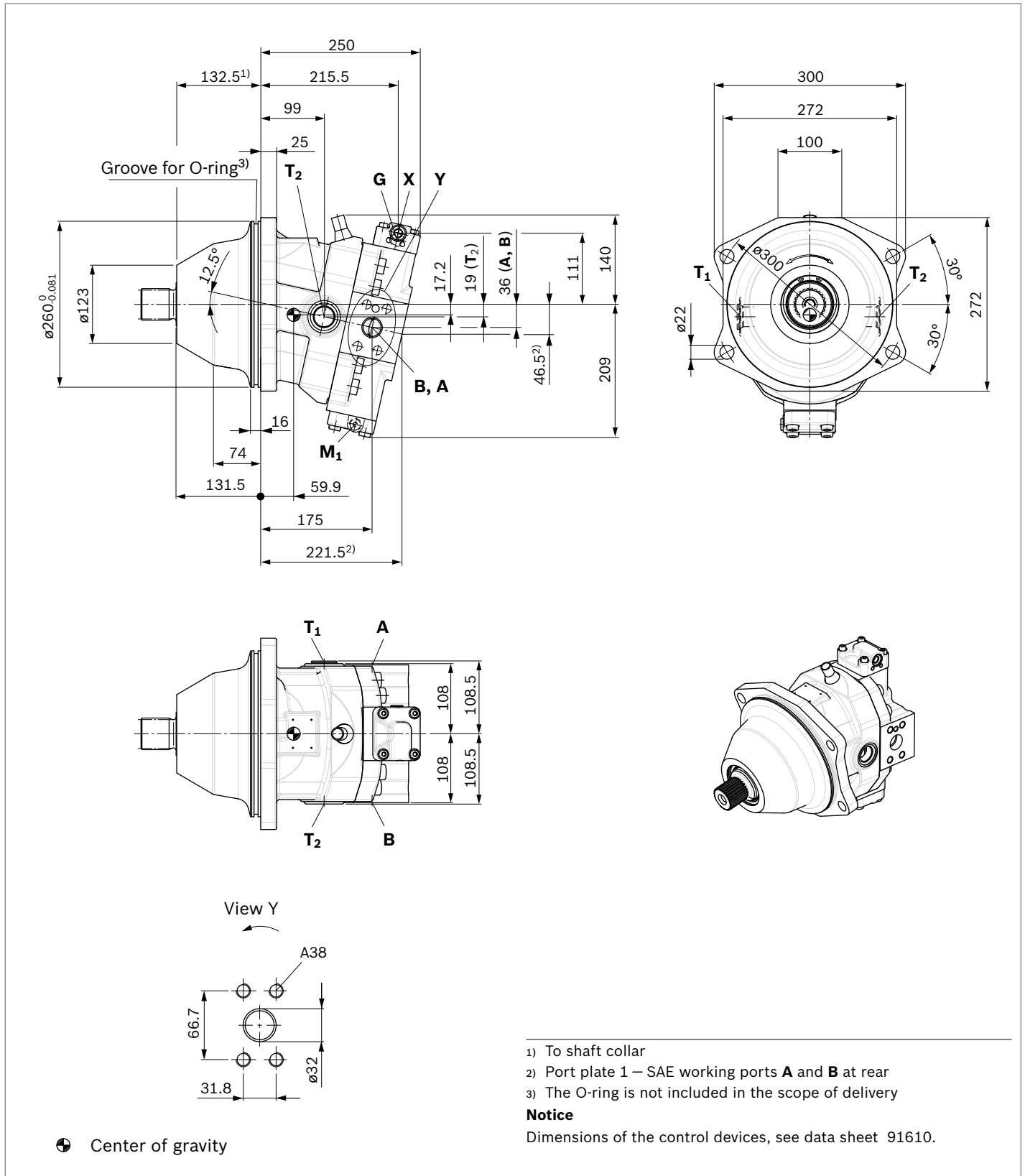
Port plate 2 — SAE working ports **A** and **B** lateral, opposing

View Y

⊕ Center of gravity

1) To shaft collar
2) Port plate 1 — SAE working ports **A** and **B** at rear
3) The O-ring is not included in the scope of delivery
Notice
Dimensions of the control devices, see data sheet 91610.

▼ **Location of the working ports on the port plates** (view **Z**)

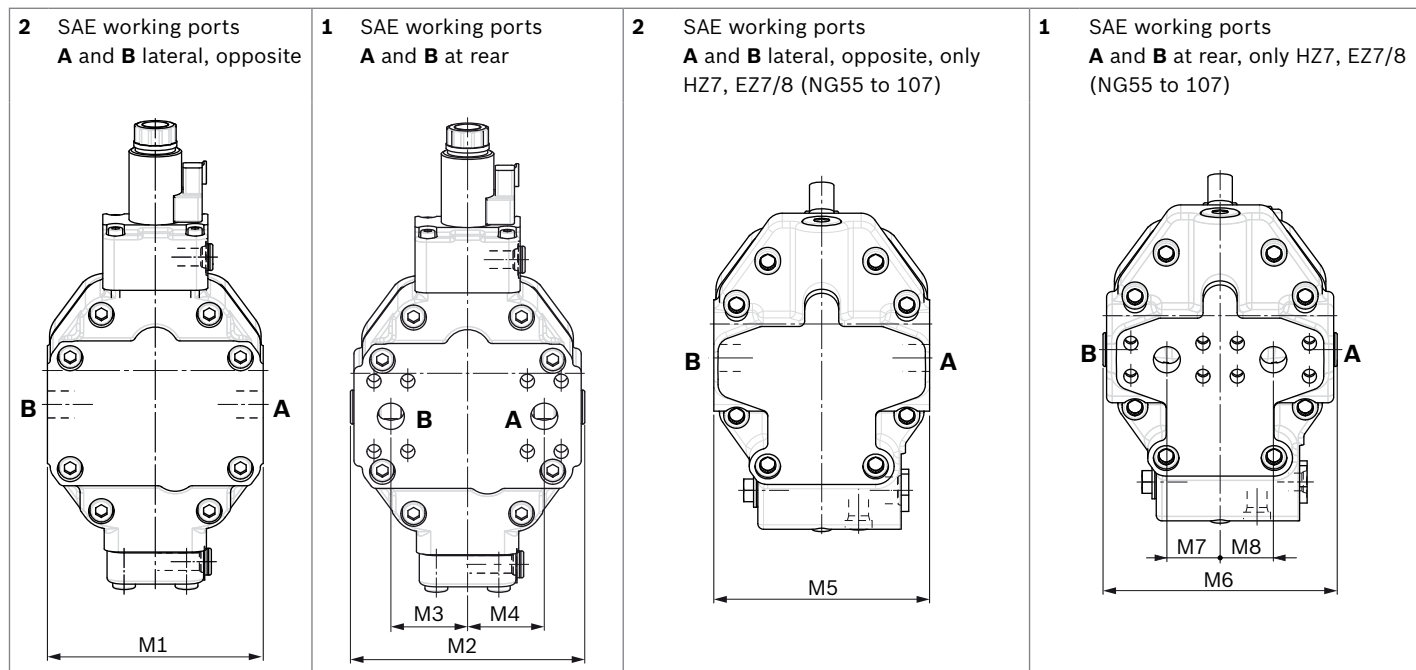| **2** SAE working ports **A** and **B** lateral, opposite	**1** SAE working ports **A** and **B** at rear	**2** SAE working ports **A** and **B** lateral, opposite, only HZ7, EZ7/8 (NG55 to 107)	**1** SAE working ports **A** and **B** at rear, only HZ7, EZ7/8 (NG55 to 107)

NG	M1	M2	M3	M4	M5	M6	M7	M8
55	152	165	54	54	152	165	37.5	37.5
80	164	177	54	54	164	177	42	42
107	180	193	65	65	180	193	42	42
160	204	226	76	76	–	–	–	–
200	216	235	82	82	–	–	–	–

NG	Ports A, B		T_1, T_2	G	X (HA1, HA2)	X (HP, HZ, HA1T/2T)	M_1
55	3/4 in	M10 x 1.5; 17 deep	M22 × 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	–
80	1 in	M12 × 1.75; 17 deep	M22 × 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	–
107	1 in	M12 × 1.75; 17 deep	M22 × 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	–
160	1 1/4 in	M14 x 2; 19 deep	M27 x 2; 19 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 × 1.5; 11.5 deep
200	1 1/4 in	M14 x 2; 19 deep	M33 × 2; 19 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep

Ports		Standard	p_{max} [bar][1]	State[5]
A, B	Working port fastening thread	SAE J518 DIN 13[2]	450	O
T_1, T_2	Drain port	ISO 6149[4]	3	X/O (T_2)[3]
G	Synchronous control	ISO 6149[4]	450	X
X (HA1, HA2)	Pilot signal	ISO 6149[4]	3	X
X (HP, HZ, HA1T/2T)	Pilot signal	ISO 6149[4]	100	O
M_1	Stroking chamber measurement	ISO 6149[4]	450	X

1) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard
3) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 38).
4) The countersink can be deeper than as specified in the standard.
5) O = Must be connected (plugged when delivered)
   X = Plugged (in normal operation)
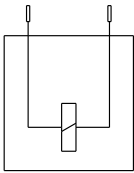
Connector for solenoids

DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

The following type of protection results with the installed mating connector:

▶ IP67 (DIN/EN 60529) and
▶ IP69K (DIN 40050-9)

▼ **Circuit symbol**

▼ **Mating connector DEUTSCH DT06-2S-EP04**

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 scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

▶ If necessary, you can change the position of the connector by turning the solenoid.
▶ The procedure is defined in the instruction manual.

Flushing and boost-pressure valve

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

In a closed circuit, it is used for flushing the case and safeguarding the minimum boost pressure.

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

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

Cracking pressure of pressure retaining valve

(observe when setting the primary valve)

▶ Size 55 to 200, fixed setting 16 bar

Switching pressure of flushing spool Δp

▶ Size 55 to 107 (small flushing valve) 8 ± 1 bar
▶ Size 107 to 200 (medium and large flushing valve) 17.5 ± 1.5 bar

Flushing flow q_v

Orifices can be used to adjust the flushing flows as required. The following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $v = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 55 to 107

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909651766	1.2	3.5	A
R909419695	1.4	5	B
R909419696	1.8	8	C
R909419697	2.0	10	D
R909444361	2.4	14	F

Medium flushing valve for size 107

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909431310	2.8	18	I
R902138235	3.1	21	J
R909435172	3.5	27	K
R909449967	5.0	31	L

Large flushing valve for sizes 160 and 200

| Material number of orifice	ø [mm]	q_v [l/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	15	G
R909431310	2.8	18	I
R902138235	3.1	21	J
R909435172	3.5	27	K
R909436622	4.0	31	L
R909449967	5.0	37	M

▼ **Circuit diagram EP**
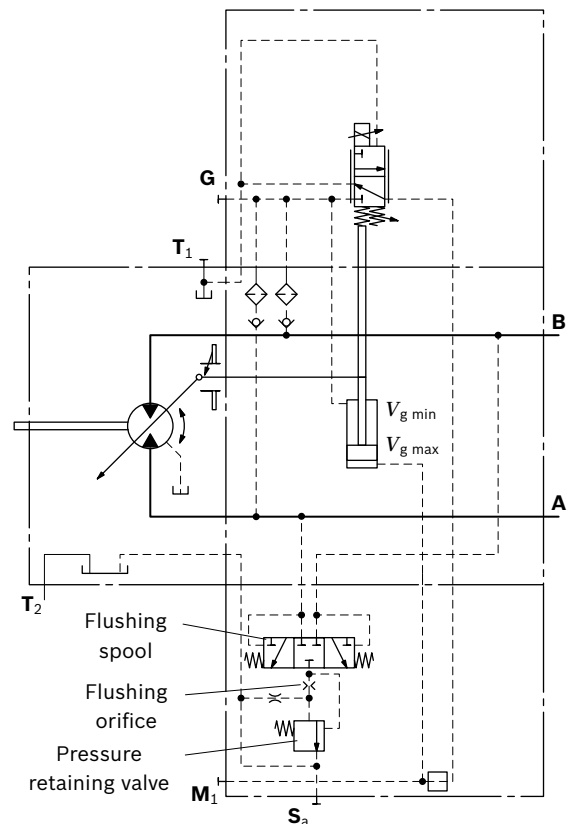
Notice

▶ Port **S**$_a$ only for sizes 160 and 200
▶ For a flushing flow of 35 l/min, it is recommended that port **S**$_a$ be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

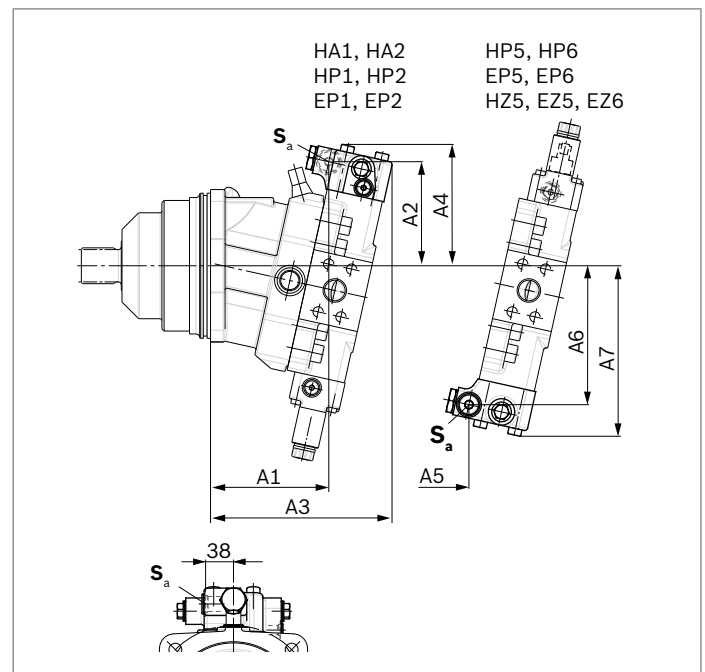▼ **Dimensions of sizes 55 to 107 (small flushing valve)**

HA1, HA2   HP5, HP6   HZ7
HP1, HP2   EP5, EP6   EZ7, EZ8
EP1, EP2
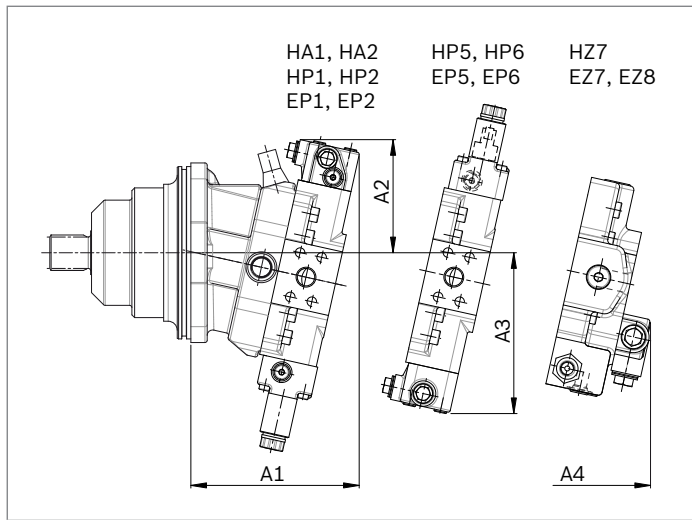
NG	A1	A2	A3	A4
55	183	137	183	176
80	195	142	194	176
107	204	143	202	186

▼ **Dimensions of size 107 (medium flushing valve)**

HA1, HA2   HP5, HP6
HP1, HP2   EP5, EP6
EP1, EP2
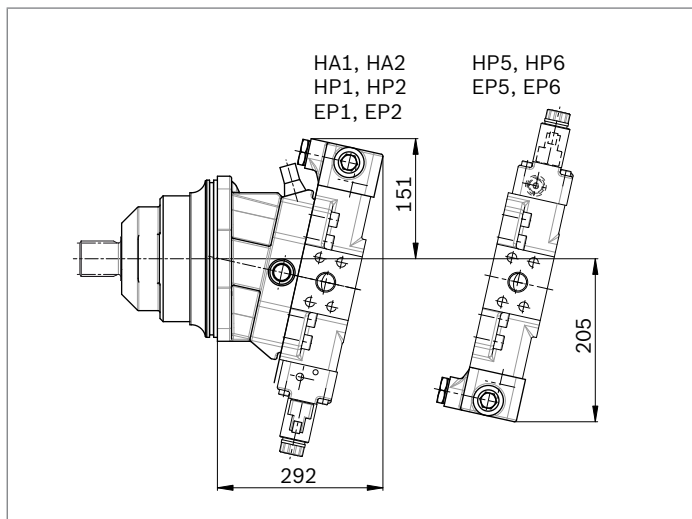
▼ **Dimensions of sizes 160 and 200 (large flushing valve)**

HA1, HA2   HP5, HP6
HP1, HP2   EP5, EP6
EP1, EP2   HZ5, EZ5, EZ6

NG	A1	A2	A3	A4	A5	A6	A7	S_a [1]
160	163	142	249	165	89	190	233	M22 × 1.5; 15.5 deep
200	170	148	256	172	93	201	244	M22 × 1.5; 15.5 deep

[1] ISO 6149, ports plugged (in normal operation). For notes on tightening torques, see instruction manual.
The countersink can be deeper than as specified in the standard.

BVD and BVE counterbalance valves

Function

Counterbalance valves for travel drives and winches should reduce the danger of overspeed and cavitation in open circuits of axial piston motors. Cavitation occurs if, during braking, when going downhill or during the load-lowering process, the motor speed is greater than it should be for the given inlet flow and thus the supply pressure collapses. If the supply pressure falls below the value specified for the relevant counterbalance valve, the counterbalance spool moves into the closed position. The cross-sectional area of the counterbalance valve return duct is then reduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor reaches the specified value for the given inlet flow.

Notice

▶ BVD available for sizes 55 to 200 and BVE available for sizes 107 to 200.

▶ The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
Order example: A6VE080HA1T30004A/65MWV0Y2Z 97W0-0 + BVD20F27S/41B–V03K16D0400S12

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

▶ Counterbalance valves must be optimized during prototype commissioning to prevent unacceptable operating conditions and compliance with the specification must be verified.

▶ The counterbalance valve does not replace the mechanical service brake and holding 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 require the following data for the mechanical holding brake:
– the cracking pressure
– 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)

Permissible inlet flow or pressure when using pressure relief valve and BVD/BVE

Motor NG	Without valve		Limited values when using pressure relief valve and BVD/BVE								
			DBV[1]				BVD[2]/BVE[3]				
	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	276	22	350 /420	240	7	20(BVD)	350 /420	220	7W
80		332								
107		410	32		400					
107		410				8	25 (BVD/ BVE)		320	8W
160		533								
200		628	On request							

Mounting of the counterbalance valve

When delivered, the counterbalance valve is fastened to the motor with two tacking screws (transport lock). The tacking screws may not be removed while mounting the working lines! If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be fastened to the motor port plate using the provided tacking screws.

The counterbalance valve is finally mounted to the motor by fitting the SAE flange
The screws to be used and the instructions for mounting can be found in the instruction manual.

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1) Pressure relief valve
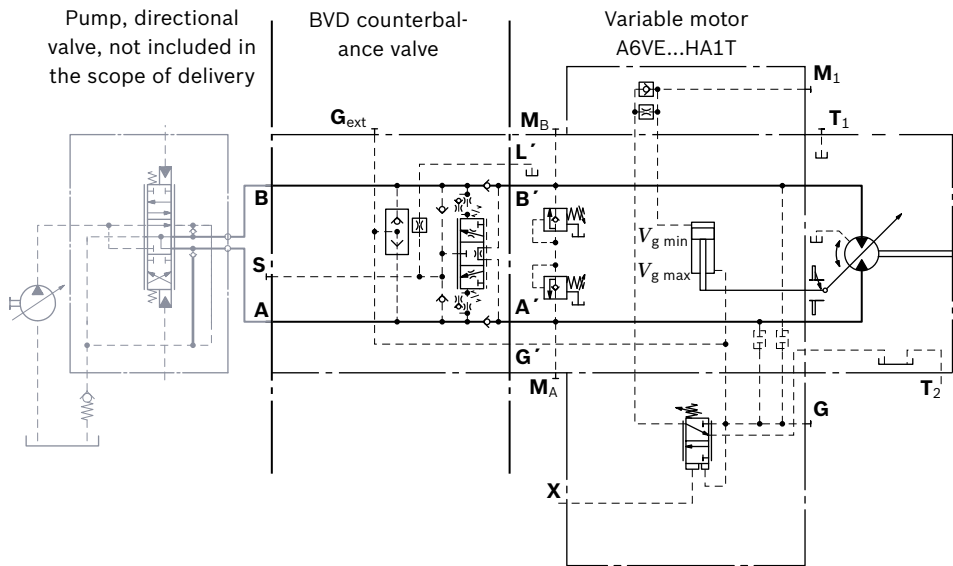2) Counterbalance valve, dual action
3) Counterbalance valve, single action

Counterbalance valve for travel drive BVD...F

Application option

▶ Travel drives for wheeled excavators (BVD and BVE)

▼ **Example circuit diagram for travel drive on wheeled excavators**

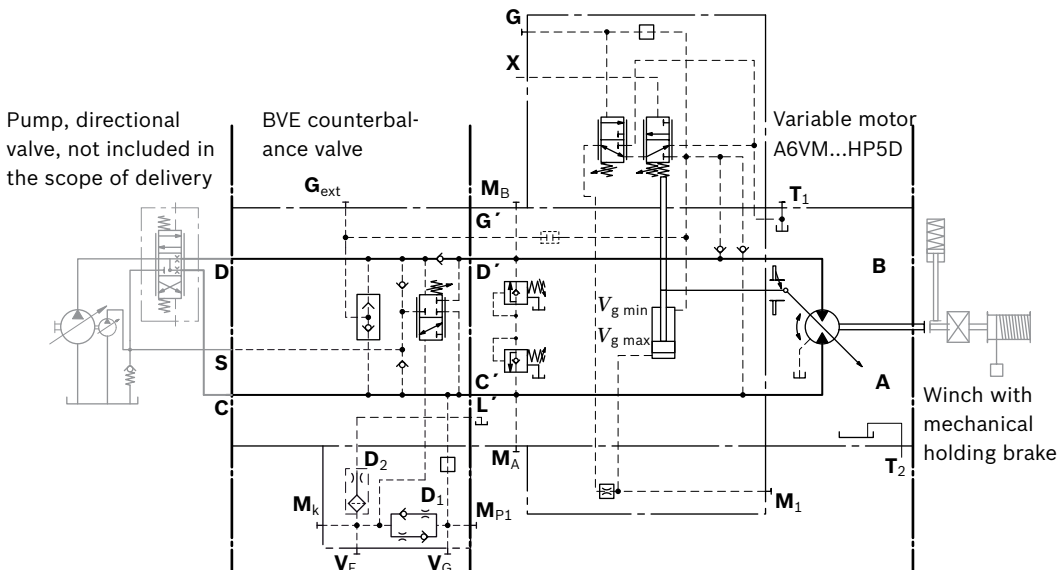A6VE080HA1T30004A/65MWV0Y2Z97W0-0 + BVD20F27S/41B–V03K16D0400S12

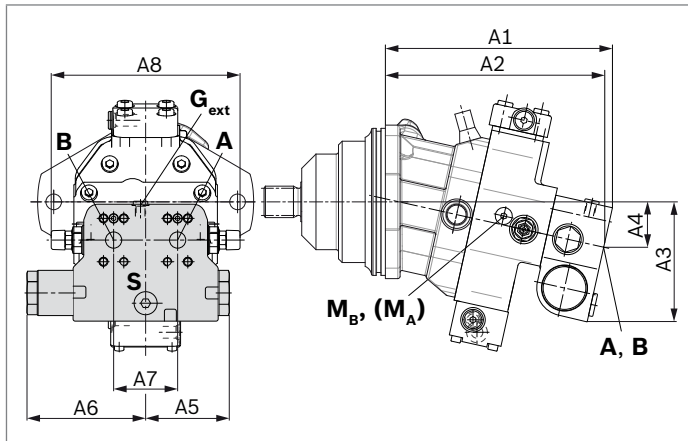## Counterbalance valve for winches and track drives BVD...W and BVE

Application option

▶ Winch drives for cranes (BVD and BVE)
▶ Track drives for tracked excavators (BVD)

▼ **Example circuit diagram for winch drive in cranes**

A6VE080HP5D10001A/65MWV0Y2Z97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0

Counterbalance valve dimensions

▼ **A6VE...HA, HP1, HP2 and EP1, EP2**

▼ **A6VE...HP5, HP6 and EP5, EP6**[1]
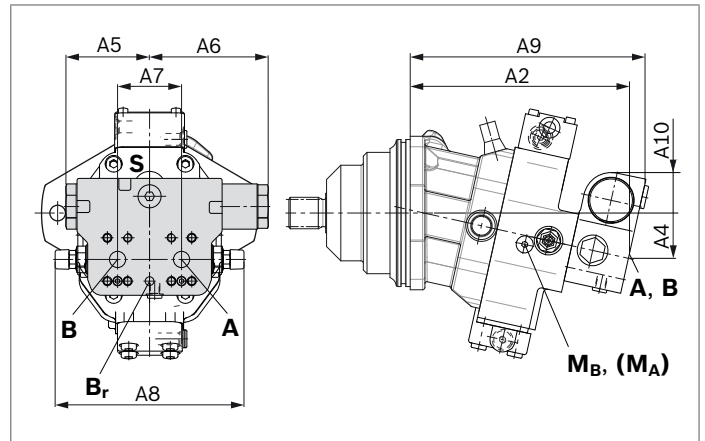
A6VE	Counterbalance valve											
NG...plate	Type	Ports	Dimensions									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...7	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
80...7	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
107...7	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
107...8	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
160...8	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
107...8	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
160...8	BVE25...38	1 1/4 in	334	325	176	68	137	214	84	238	349	59
200...8	BVD25...38	1 1/4 in	356	346	176	74	120.5	175	84	299	370	46
200...8	BVE25...38	1 1/4 in	356	346	182	74	137	214	84	299	370	52

Ports		Version	A6VM plate	Standard	Size	P_{max} [bar][2]	State[4]
A, B	Working line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[3]	M22 × 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[3]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	7	DIN 3852[3]	M12 × 1.5; 12.5 deep	30	O
			8	DIN 3852[3]	M12 × 1.5; 12 deep	30	O
G_ext	Brake release, high pressure	S		DIN 3852[3]	M12 × 1.5; 12.5 deep	420	X
M_A, M_B	Pressure measurement A and B			ISO 6149[3]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designation **A** and **B** on the BVD/BVE counterbalance valve do not correspond with the connection designation of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!

2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

3) The countersink can be deeper than as specified in the standard.

4) O = Must be connected (plugged on delivery)
   X = Plugged (in normal operation)

Integrated BVI counterbalance valve

Function

The integrated counterbalance valves for track drives in excavator crawlers should reduce the danger of overspeed and cavitation of axial piston motors in open circuits. Cavitation occurs if, during braking or driving downhill, the rotational speed of the motor is greater than it should be for the given inlet flow, causing the supply pressure to fall sharply.

If the supply pressure falls below the value specified for the relevant counterbalance valve, the counterbalance spool moves into the closed position. The cross-sectional area of the counterbalance valve return duct is then reduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor reaches the specified value for the given inlet flow.

Notice

▶ BVI available for sizes 107 and 160.
▶ The counterbalance valve must be ordered additionally. Order example: A6VE107HA3T30004A/65MWV0S2Z 96Y0-0 + BVI510008001-0
▶ Counterbalance valves must be optimized during prototype commissioning to prevent unacceptable operating conditions and compliance with the specification must be verified.
▶ The counterbalance valve does not replace the mechanical service brake and holding brake.
▶ For the design of the brake release valve, we require the following data for the mechanical holding brake:
  – the cracking pressure
  – 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)

Type code

01	02	03	04	05		06
BVI					**–**	

Counterbalance valve

01	Counterbalance valve integrated		**BVI**

Brake piston version

02	Volume preselection	q_v [l/min]	Material number	
		≤ 150	R902038832	**51**
		= 150 – 210	R902038936	**52**
		= 210 – 270	R902038833	**53**
		= 270 – 330	R902038834	**54**
		= 330 – 400	R902038835	**55**
		≥ 400	R902038836	**56**

Throttle mounting

03	Constant throttle	R909432302	**0008**
	Throttle pin	R909651165	**0603**

Check valve

04	Without residual opening	**00**

Brake release valve

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

Standard / special version

06	Standard version	**0**
	Special version	**S**

Technical data

| Working pressure		Nominal pressure	p	350 bar
		Maximum pressure	p	420 bar
Volume flow, maximum			$q_{v\,max}$	400 l/min
Counterbalance spool		Start of opening	p	12 bar
		Fully open	p	26 bar
Pressure reducing valve for brake release (fixed setting)		Control pressure	p	21^{+4} bar
		Beginning of control	p	10^{+4} bar

Permissible inlet flow or pressure when using pressure relief valve and BVI

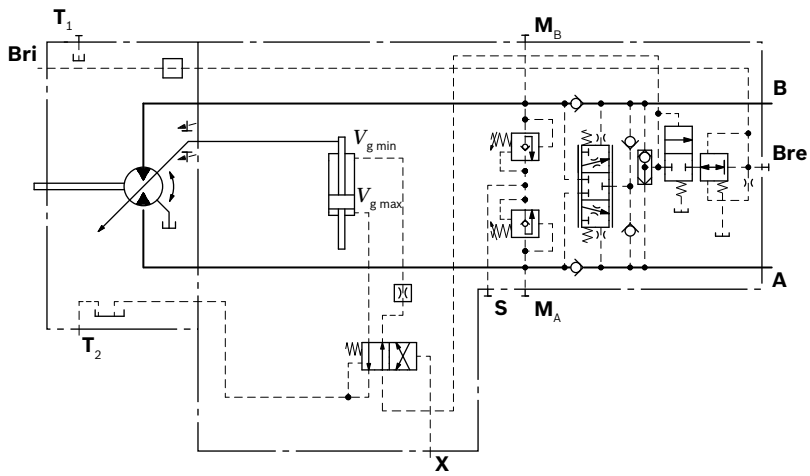| Motor	No restriction Standard plate (1 + 2)		Limited values Plate with integrated counterbalance valve (6)	
			BVI + DBV	
NG	p_{nom}/p_{max} [bar]	$q_{V\,max}$ [l/min]	p_{nom}/p_{max} [bar]	q_V [l/min]
107	400 /450	410	350 /420	240
160		533		400

▼ **Infeed characteristic curve M22 × 1.5**
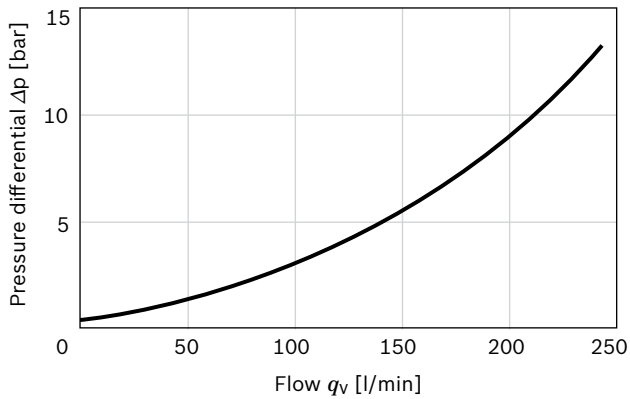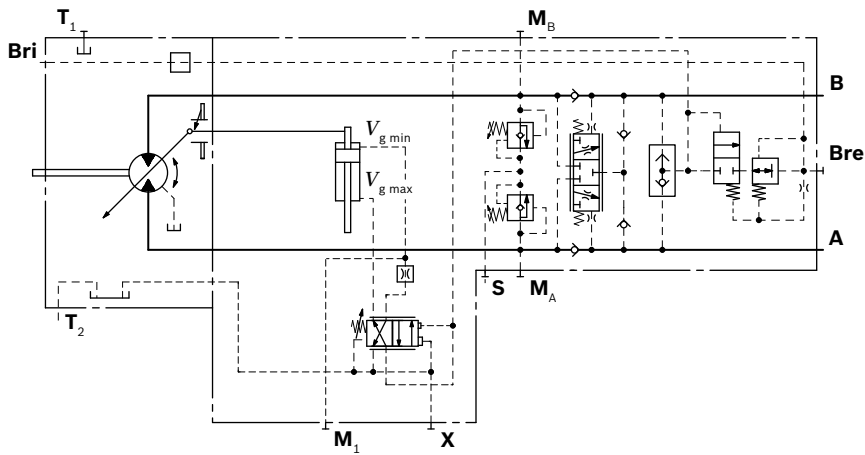

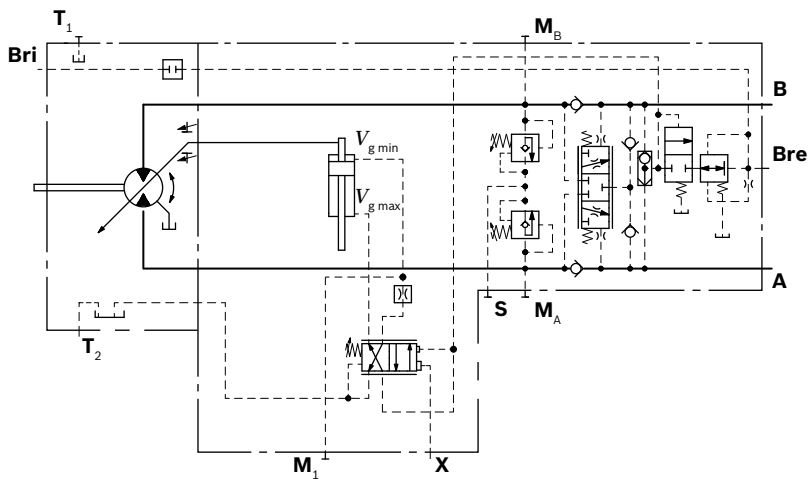▼ **Infeed characteristic curve M27 × 2**
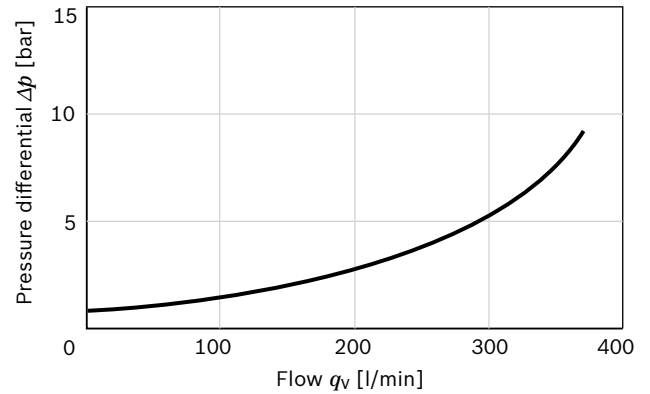
▼ **Circuit diagram HZ7**

▼ **Circuit diagram HA3**
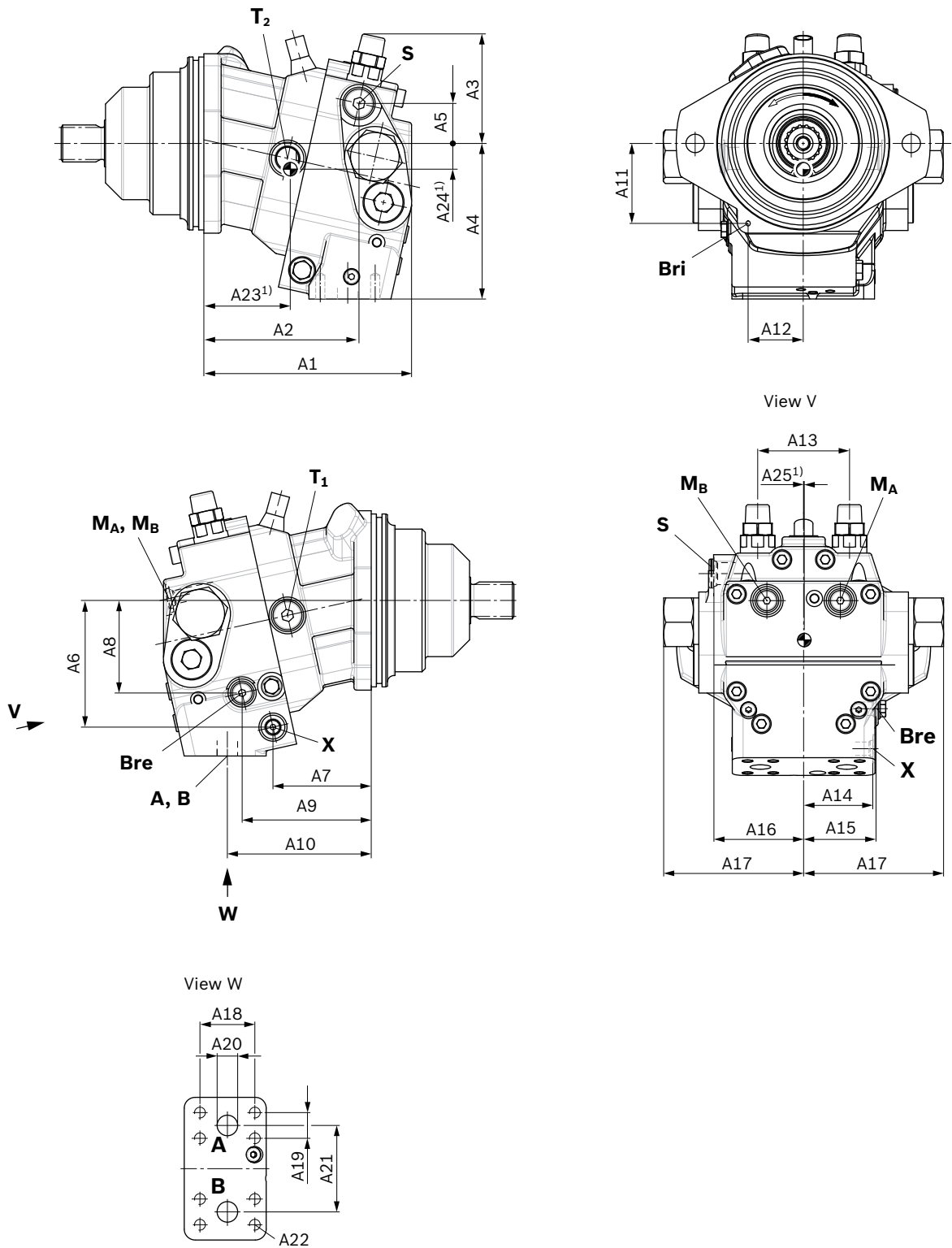

▼ **Circuit diagram HA3T3**

Integrated BVI counterbalance valve dimensions

HZ7 – Two-point control, hydraulic

Port plate 6, with integrated BVI counterbalance valve — SAE working ports **A** and **B** at bottom

View V

View W

⊕ Center of gravity

A6VE NG...plate	Port A, B[1]	Dimensions A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
107...6	1 in	204	161	122	172	40	143	99	98	131	144	96	58	96
160...6	1 1/4 in	240	195	136	197	47	162	128	113	161	177	94	65	108

A6VE NG...plate	Port A, B	Dimensions A14	A15	A16	A17	A18	øA19	A20	A21	A22 (DIN 13)	A23	A24	A25
107...6	1 in	70	74	85	129.5	57.2	27.8	25	86	M12 × 1.75; 17 deep	68	24.4	0.3
160...6	1 1/4 in	78	85	101.5	129.5	66.7	31.8	32	94	M14 × 2; 19 deep	91.7	28.8	0.5

Port	Working line SAE J518[1]	Reservoir line ISO 6149[4]	Pilot signal	Infeed ISO 6149[4]	Stroking chamber measurement	Stroking chamber measurement
NG	A, B	T_1, T_2	X	S	M_A, M_B	M_1 only for HA3
107	see table above	M22 × 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M22 × 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M10 x 1; 10 deep
160		M27 x 2; 19 deep	M14 x 1.5; 11.5 deep	M27 x 2; 19 deep	M14 x 1.5; 11.5 deep	M10 x 1; 10 deep
p_{max} [bar][2]	420	3	100	30	420	420
State[5]	O	X/O (T_2)[3]	O	X	X	X

Port	Brake release, external ISO 6149[4]	Brake release, internal
NG	Bre	Bri
107	M14 x 1.5; 11.5 deep	ø4
160	M14 x 1.5; 11.5 deep	ø4
p_{max} [bar][2]	30	30
State[5]	O/X[6]	X/O[7]

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

[2] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[3] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 38).

[4] The countersink can be deeper than as specified in the standard.

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

[6] Must be connected for external piping. Is plugged for internal channel routing.

[7] Is plugged for external channel routing. Must be connected for internal piping.

Speed sensor

The A6VE...U version ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.

A signal proportional to the rotational speed of the motor can be generated with the mounted DSA speed sensor. The DSA sensor registers the rotational speed and direction of rotation.

Type code, technical data, dimensions and parameters for the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95133 – DSA. The sensor is mounted on the port provided specially for this with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.

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

▼ **Circuit diagram EP**
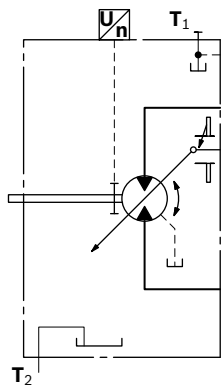
▼ **Dimensions**

Version "V" with mounted speed sensor

View AA
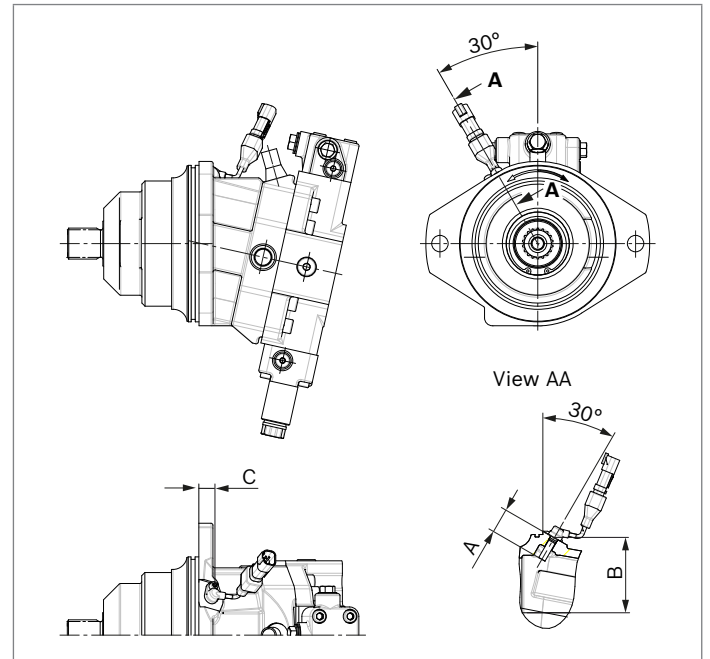
Size	55	80	107	160	200
Number of teeth	54	58	67	75	80
A Insertion depth (tolerance -0.25)	32	32	32	32	32
B Contact surface	83.3	87.3	96.3	104.3	109.2
C	26	16.5	14.2	28.5	22.7

Setting range for displacement

	55				80				107			
	$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to
A	54.8	54.8	0.0	13.3	80.0	80.0	0.0	23.0	107.0	107.0	0.0	22.2
	without screw		M10 × 60 R909154690		without screw		M12 × 70 R909085976		without screw		M12 × 70 R909085976	
B	54.8	54.8	> 13.3	27.0	80.0	80.0	> 23.0	41.0	107.0	107.0	> 22.0	43.8
	without screw		M10 × 70 R909153779		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
C	54.8	54.8	> 27.0	38.0	80.0	80.0	> 41.0	56.0	107.0	107.0	> 43.8	65.5
	without screw		M10 × 80 R909154058		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
D	x		x		x		x		107.0	107.0	> 65.5	75.0
									without screw		M12 × 100 R909153975	
E	< 54.8	42.0	0.0	13.0	< 80.0	58.0	0.0	23.0	< 107.0	86.0	0.0	22.2
	M10 × 60 R909154690		M10 × 60 R909154690		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976	
F	< 54.8	42.0	> 13.3	27.0	< 80.0	58.0	> 25.0	41.0	< 107.0	86.0	> 22.2	43.8
	M10 × 60 R909154690		M10 × 70 R909153779		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909153075	
G	< 54.8	42.0	> 27.0	38.0	< 80.0	58.0	> 41.0	56.0	< 107.0	86.0	> 43.8	65.5
	M10 × 60 R909154690		M10 × 80 R909154058		M12 × 70 R909085976		M12 × 90 R909154041		M12 × 70 R909085976		M12 × 90 R909154041	
H	x		x		x		x		< 107.0	86.0	> 65.5	75.0
									M12 × 70 R909085976		M12 × 100 R909153975	
J	< 42.0	29.0	0.0	13.3	< 58.0	41.0	0.0	23.0	< 86.0	64.0	0.0	22.2
	M10 × 70 R909153779		M10 × 60 R909154690		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976	
K	< 42.0	29.0	> 13.3	27.0	< 58.0	41.0	> 23.0	41.0	< 86.0	64.0	> 22.2	43.8
	M10 × 70 R909153779		M10 × 70 R909153779		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
L	< 42.0	29.0	> 27.0	38.0	< 58.0	41.0	> 41.0	56.0	< 86.0	64.0	> 43.8	65.5
	M10 × 70 R909153779		M10 × 80 R909154058		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
M	x		x		x		x		< 86.0	64.0	> 65.5	75.0
									M12 × 80 R909153075		M12 × 100 R909153975	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text
when ordering:
▶ $V_{g\,min}$ = ... cm³, $V_{g\,max}$ = ...cm³
Theoretical, maximum setting:
▶ for $V_{g\,min}$ = 0.7 × $V_{g\,max}$
▶ for $V_{g\,max}$ = 0.3 × $V_{g\,max}$
Settings that are not listed in the table may lead to damage.
Please contact us.

	160				200			
	$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)		$V_{g\,max}$ (cm³/rev)		$V_{g\,min}$ (cm³/rev)	
	from	to	from	to	from	to	from	to
A	160.0	160.0	0.0	26.0	200.0	200.0	0.0	39.0
	without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
B	160.0	160.0	> 26.0	54.0	200.0	200.0	> 39.0	72.0
	without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
C	160.0	160.0	> 54.0	83.0	200.0	200.0	> 72.0	105.0
	without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975	
D	160.0	160.0	> 83.0	110.0	200.0	200.0	> 105.0	140.0
	without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212	
E	< 160.0	136.0	0.0	26.0	< 200.0	164.0	0.0	39.0
	M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
F	< 160.0	136.0	> 26.0	54.0	< 200.0	164.0	> 39.0	72.0
	M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
G	< 160.0	136.0	> 54.0	83.0	< 200.0	164.0	> 72.0	105.0
	M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975	
H	< 160.0	136.0	> 83.0	110.0	< 200.0	164.0	> 105.0	140.0
	M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212	
J	< 136.0	109.0	0.0	26.0	< 164.0	130.5	0.0	39.0
	M12 × 90 R909154041		M12 x 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075	
K	< 136.0	109.0	> 26.0	54.0	< 164.0	130.5	> 39.0	72.0
	M12 x 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041	
L	< 136.0	109.0	> 54.0	83.0	< 164.0	130.5	> 72.0	105.0
	M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975	
M	< 136.0	109.0	> 83.0	110.0	< 164.0	130.5	> 105.0	140.0
	M12 × 90 R909154041		M12 × 110 R909154212		M12 × 90 R909154041		M12 × 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering:

▶ $V_{g\,min}$ = ... cm³, $V_{g\,max}$ = ...cm³

Theoretical, maximum setting:

▶ for $V_{g\,min}$ = 0.7 × $V_{g\,max}$
▶ for $V_{g\,max}$ = 0.3 × $V_{g\,max}$

Settings that are not listed in the table may lead to damage.
Please contact us.

Installation instructions

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
The leakage in the housing area must be directed to the reservoir via the highest 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 maximum permissible case pressure of all connected units is not exceeded at any operational conditions. If this is not possible, separate drain lines must be laid.
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.

Notice

In certain installation positions, an influence on the control or closed loop control can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

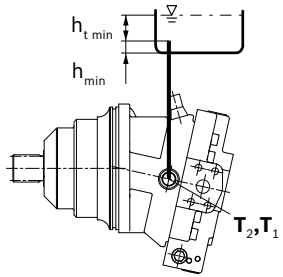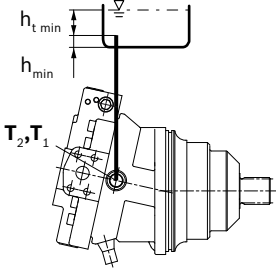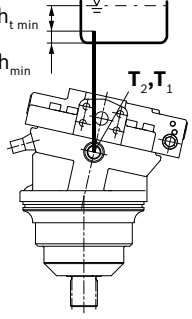| Key	
F	Filling / air bleeding
T_1, T_2	Drain port
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)

Installation position

See the following examples **1** to **6**.
Further installation positions are available upon request.
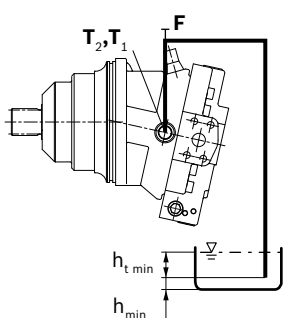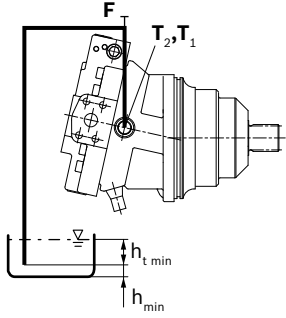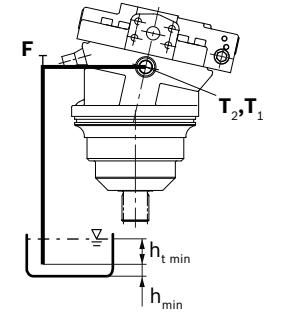Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

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

Installation position	Air bleed	Filling
1		T_2, T_1
2		T_2, T_1
3		T_2, T_1

Above-reservoir installation

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

Installation position	Air bleed	Filling
4	F	T_2, T_1 (**F**)
5	F	T_2, T_1 (**F**)
6	F	T_2, T_1 (**F**)

Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- 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 skilled 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.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- For safety reasons, controls with beginning of control at $V_{g\,min}$ (e.g. HA) are not permissible for winch drives, e.g. anchor winches.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.

- Working 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 working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

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

▶ Moving parts in control equipment (e.g. valve pistons) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk.
The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

▶ Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.
The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.

▶ When using the axial piston motor in winch drives, make certain that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is extremely overloaded (e.g. if the maximum permissible rotational speeds are exceeded during weighing of the anchor while the ship is in motion), the rotary group may be damaged and, in the worst case, the axial piston motor may burst. The machine manufacturer / system manufacturer is to undertake additional measures, up to and including encapsulation.