Axial piston variable motor
A6VM series 71

RE 91610
Edition: 06.2014
Replaces: 04.2013

- Sizes 60 to 215
- Nominal pressure 450 bar
- Maximum pressure 500 bar
- Open and closed circuits

Features

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuit
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min}$ = 0.
- 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 and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting efficiency
- Version with 9-piston rotary group
- Good low speed characteristics
- High uniformity

Contents

Ordering code

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A6V**

Operating mode

02	Motor	**M**

Size (NG)

03	Geometric displacement, see technical data on page 9	**060**	**085**	**115**	**150**	**170**	**215**	

Control device				060	085	115	150	170	215	
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 DC	●	●	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	●	●	**HZ5**
				●	●	●	–	–	–	**HZ7**
	Two-point control electrical	negative control	U = 12 V DC	–	–	–	●	●	●	**EZ5**
			U = 24 V DC	–	–	–	●	●	●	**EZ6**
			U = 12 V DC	●	●	●	–	–	–	**EZ7**
			U = 24 V DC	●	●	●	–	–	–	**EZ8**
	Automatic control high-pressure related, positive control	with minimum pressure increase	Δp ≤ approx. 10 bar	●	●	●	●	●	●	**HA1**
		with pressure increase	Δp = 100 bar	●	●	●	●	●	●	**HA2**
	Automatic control speed related, negative control p_{St} / p_{HD} = 5/100	hydr. travel direction valve		●	●	●	●	●	●	**DA0**
		electric travel direction valve + electric $V_{g\,max}$ circuit	U = 12 V DC	●	●	●	●	●	●	**DA1**
			U = 24 V DC	●	●	●	●	●	●	**DA2**

Pressure control/override				060	085	115	150	170	215	
05	Without pressure control/override			●	●	●	●	●	●	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6			●	●	●	●	●	●	**D1**
	Override of controls HA1 and HA2	hydraulic remote control, proportional		●	●	●	●	●	●	**T3**
		electric, two-point	U = 12 V DC	●	●	●	●	●	●	**U1**
			U = 24 V DC	●	●	●	●	●	●	**U2**
		electric and travel direction valve, electric	U = 12 V DC	●	●	●	●	●	●	**R1**
			U = 24 V DC	●	●	●	●	●	●	**R2**

Connector for solenoids[1] (see page 62)

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

● = Available ○ = On request – = Not available

1) Connectors for other electric components can deviate.

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**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 counterbalance valve BVD/BVE	**1**
		One-sided in inlet to large stroking chamber (HA)	**4**
		One-sided in outlet from large stroking chamber (DA)	**7**

Setting range for displacement[2)]

10	$V_{g\,max}$-setting screw	$V_{g\,min}$-setting screw	**060**	**085**	**115**	**150**	**170**	**215**	
	Without 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 7, index 1	**71**

Configuration of ports and fastening threads

12	Metric, port threads with O-ring sealing 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			**060**	**085**	**115**	**150**	**170**	**215**	
16	ISO 3019-2	125-4	●	–	–	–	–	–	**M4**
		140-4	–	●	–	–	–	–	**N4**
		160-4	–	–	●	–	–	–	**P4**
		180-4	–	–	–	●	●	–	**R4**
		200-4	–	–	–	–	–	●	**S4**

● = Available ○ = On request – = Not available

2) The settings for the setting screws can be found in the table (see pages 70 and 71).

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Drive shaft			**060**	**085**	**115**	**150**	**170**	**215**	
17	Splined shaft ANSI B92.1a	1 1/4 in 14T 12/24 DP	●	–	–	–	–	–	**S7**
		1 124 in 17T 12/24 DP	–	●	–	–	–	–	**S9**
		1 3/4 in 13T 8/16 DP	–	–	●	●	–	–	**T1**
		2 in 15T 8/16 DP	–	–	–	○	●	●	**T2**
	Splined shaft DIN 5480	W35×2×16×9g	●	–	–	–	–	–	**Z8**
		W40×2×18×9g	–	●	●	–	–	–	**Z9**
		W45×2×21×9g	–	–	–	●	●	–	**A1**
		W50×2×24×9g	–	–	–	–	–	●	**A2**

Port plate for service lines			**060**	**085**	**115**	**150**	**170**	**215**	
18	SAE flange ports A and B at rear		●	●	●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	●	●	**2**
	Port plate with 1-stage pressure limitation valves for mounting a counterbalance valve[3]	BVD20	●	●	●	–	–	–	**7**
		BVD25, BVE25	–	–	●	●	●	●	**8**

Valve (see pages 63 to 67)			**060**	**085**	**115**	**150**	**170**	**215**	
19	Without valve		●	●	●	●	●	●	**0**
	With counterbalance valve BVD/BVE mounted[4]		●	●	●	●	●	●	**W**
	With flushing and boost pressure valve, mounted Flushing on both sides Flushing flow at: $\Delta p = p_{ND} - p_G = 25$ bar and $v = 10$ 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**
		17	–	–	–	●	●	●	**G**
		20	–	–	●[5]	●	●	●	**H**
		25	–	–	●[5]	●	●	●	**J**
		30	–	–	●[5]	●	●	●	**K**
		35	–	–	–	●	●	●	**L**
		40	–	–	–	●	●	●	**M**

● = Available ○ = On request – = Not available

3) Only possible in conjunction with HP, EP and HA control. Note the restrictions described on page 65.

4) State ordering code for counterbalance valve separately in accordance with data sheet 95522 for BVD or 95525 for BVE. Note the restrictions described on page 65.

5) Not for EZ7, EZ8 and HZ7.

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A6V	**M**					**0**	**0**			**/**	**71**	**M**	**W**	**V**	**0**						**–**	

Speed sensor (see page 69)

		060	085	115	150	170	215	
20	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared with speed sensor DSM/DSA	●	●	●	●	●	●	**U**
	With speed sensor DSM/DSA mounted[6)]	●	●	●	●	●	●	**V**

Standard / special version

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

● = Available ○ = On request – = Not available

Notes

- Note the project planning notes on page 74.
- Preservation:
  - up to 12 months as standard
  - up to 24 months long-term
    (state in plain text when ordering)

6) State ordering code for sensor separately in accordance with data sheet 95132 for DSM or 95133 for DSA and note the requirements relating to the electronics.

Hydraulic fluids

The variable motor A6VM is designed for operation with mineral oil HLP 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 friendly hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

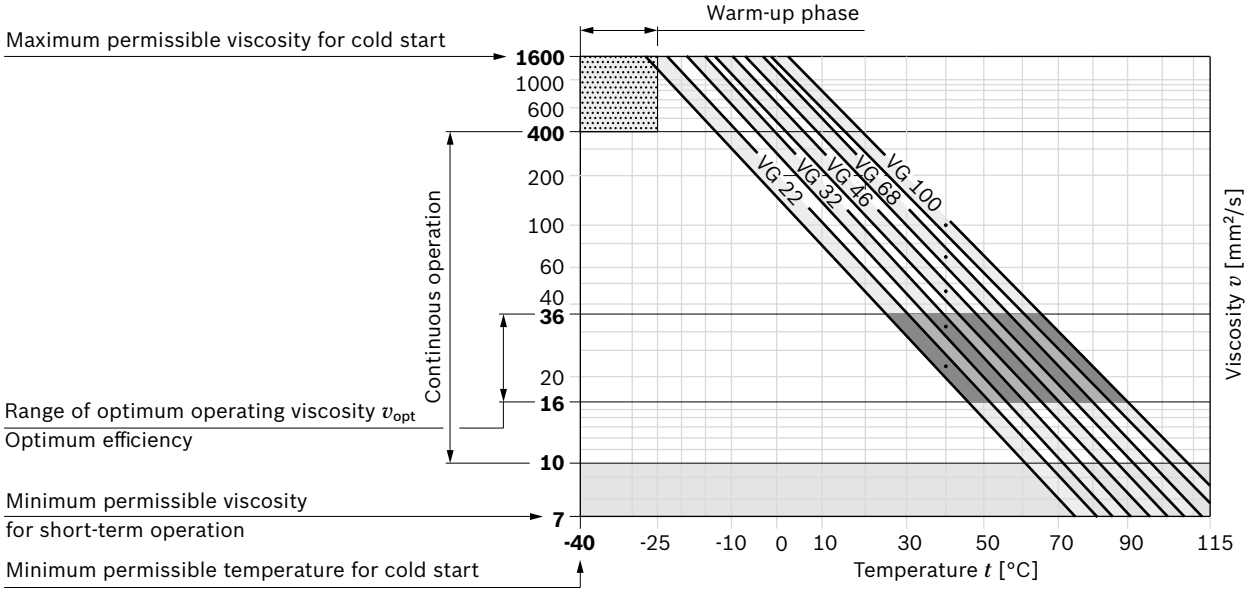
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (v_{opt} see selection diagram).

Note
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 maintained due to extreme operating parameters, we recommend flushing the case at port **U** or using a flushing and boost pressure valve (see page 63).

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	v_{max} ≤ 1600 mm²/s	θ_{St} ≥ -40 °C	t ≤ 3 min, n ≤ 1000 rpm, without load p ≤ 50 bar
Permissible temperature difference		ΔT ≤ 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 ≤ 0.7 × p_{nom}, n ≤ 0.5 × n_{nom} and t ≤ 15 min
Continuous operation	v = 400 to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = -25 °C to +103 °C	measured at port **T** Note the permissible temperature range of the shaft seal (ΔT = approx. 12 K between the 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} ≥ 7 mm²/s		t < 3 min, p < 0.3 × p_{nom}

▼ **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.

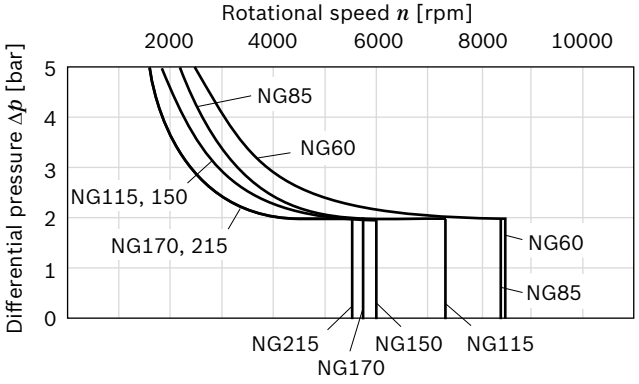
At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal will be influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary pressure spikes (t < 0.1 s) of up to 10 bar are permitted. The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure.

The case pressure must be equal to or higher than the ambient pressure.



The FKM shaft seal 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).

Influence of case pressure on beginning of control

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

- HP, HA.T3: Increase
- DA: Decrease

With the following settings, an increase in case pressure will have no effect on the beginning of control:

HA.R and HA.U, EP, HA

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

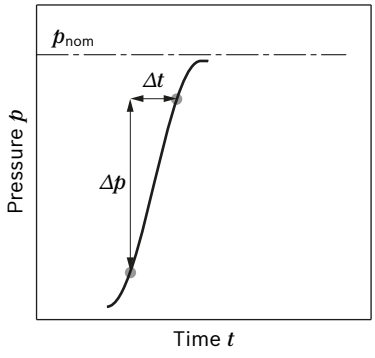
Flow direction

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

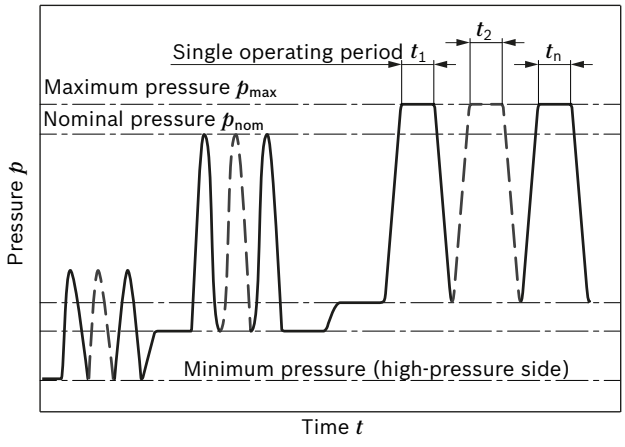
Operating pressure range

Pressure at service line port A or B		Definition
Nominal pressure p_{nom}	450 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	500 bar absolute	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.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	Minimum pressure at the high-pressure side (**A** or **B**) which is required in order to prevent damage to the axial piston unit.
Minimum pressure – pump operating mode (inlet)	See the diagram below	To prevent damage to the axial piston motor in pump operating 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)
Summation pressure p_{Su} (pressure **A** + pressure **B**)	700 bar	The summation pressure is the sum of the pressures at both service line ports (**A** and **B**)
Rate of pressure change $R_{A\,max}$		Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
With integrated pressure-relief valve	9000 bar/s	
Without pressure-relief valve	16000 bar/s	

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

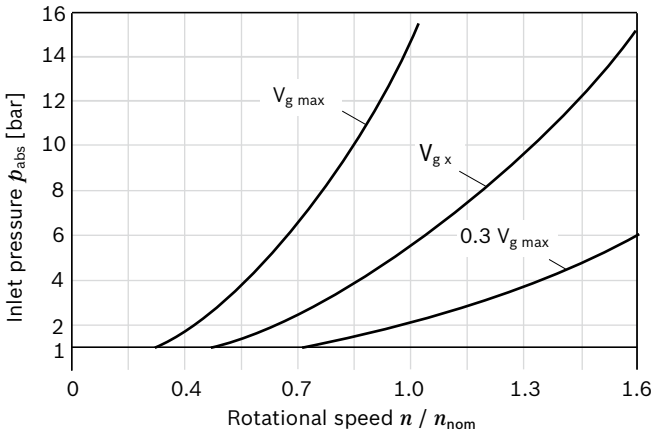


▼ **Pressure definition**



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

▼ **Minimum pressure – pump operating mode (inlet)**



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

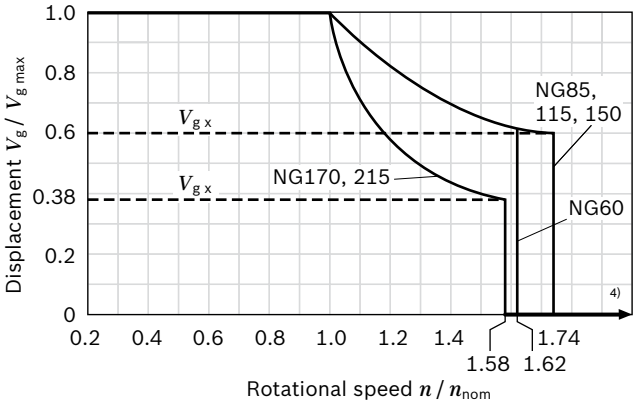
Notes

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

Technical data

Size		NG		60	85	115	150	170	215
Displacement geometric, per revolution		$V_{g\,max}$	cm³	62.0	85.2	115.6	152.1	171.8	216.5
		$V_{g\,min}$	cm³	0	0	0	0	0	0
		$V_{g\,x}$	cm³	37	51	69	91	65	82
Maximum speed[1] (complying with the maximum permissible inlet flow)	at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3250	3100	2900
	at $V_g < V_{g\,x}$ (see diagram)	n_{max}	rpm	7200	6800	6150	5600	4900	4600
	at $V_{g\,0}$	n_{max}	rpm	8400	8350	7350	6000	5750	5500
Inlet flow[2]	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	L/min	275	332	410	494	533	628
Torque[3]	at $V_{g\,max}$ and Δp = 450 bar	T	Nm	444	610	828	1089	1230	1550
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	15	22	37	44	52	70
	$V_g/2$ to 0 (interpolated)	c_{min}	kNm/rad	45	68	104	124	156	196
Moment of inertia for rotary group		J_{GR}	kgm²	0.0043	0.0072	0.0110	0.0181	0.0213	0.0303
Maximum angular acceleration		α	rad/s²	21000	17500	15500	11000	11000	10000
Case volume		V	L	0.8	1.0	1.5	1.7	2.3	2.8
Weight, approx.		m	kg	28	36	46	61	62	78

▼ **Permissible displacement in relation to speed**



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

Key

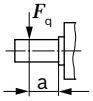
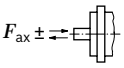
V_g	=	Displacement per revolution [cm³]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{mh}	=	Mechanical-hydraulic efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \bullet \eta_{mh}$)

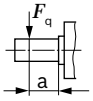
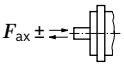
Notes

- Theoretical values, without efficiency levels 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.
- Transport and storage
  - $\theta_{min} \geq -50$ °C
  - θ_{opt} = +5 °C to +20 °C

1) The values are valid:
   - For the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   - with hydraulic fluid on the basis of mineral oil
2) Note inlet flow limitation due to counterbalance valve (see page 65).
3) Torque without radial force, With radial force see page 10.
4) Values in this range on request

Permissible radial and axial forces of the drive shafts

Size	NG		60	60	85	85	115	115	150	150	150
Drive shaft			1 1/4 in	W35	1 1/2 in	W40	1 3/4 in	W40	1 3/4 in	2 in	W45
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	N	7620	10266	12463	12323	14902	16727	15948	17424	19534
	a	mm	24.0	20.0	27.0	22.5	33.5	22.5	33.5	33.5	25.0
with permissible torque	T_{max}	Nm	310	444	595	610	828	828	890	1089	1089
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm}$	bar	315	450	440	450	450	450	370	450	450
Maximum axial force[2] 	+ $F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
	− $F_{ax\,max}$	N	500	500	710	710	900	900	1300	1300	1300
Permissible axial force per bar operating pressure	+ $F_{ax\,perm/bar}$	N/bar	7.5	7.5	9.6	9.6	11.3	11.3	13.3	13.3	13.3

Size	NG		170	170	215	215
Drive shaft			2 in	W45	2 in	W50
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\,max}$	N	19370	21220	22602	25016
	a	mm	33.5	25.0	33.5	27.5
with permissible torque	T_{max}	Nm	1230	1200	1445	1550
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm}$	bar	450	440	420	450
Maximum axial force[2] 	+ $F_{ax\,max}$	N	0	0	0	0
	− $F_{ax\,max}$	N	1120	1120	1250	1250
Permissible axial force per bar operating pressure	+ $F_{ax\,perm/bar}$	N/bar	15.1	15.1	17.0	17.0

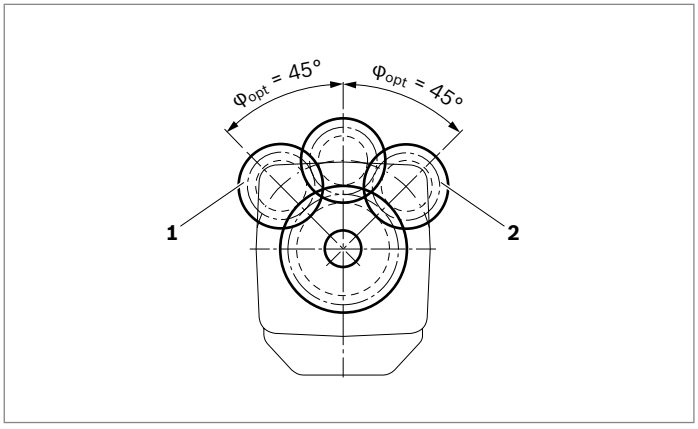
Effect of radial force F_q on the service life of bearings

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:

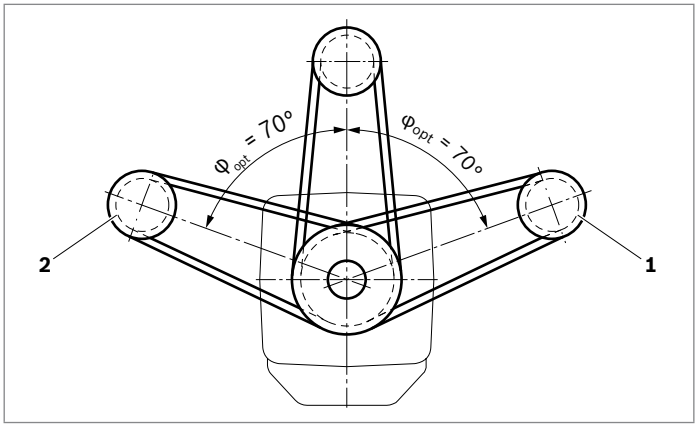
Notes

- Influence of the direction of the permissible axial force:
  + $F_{ax\,max}$ = Increased shelf life
  − $F_{ax\,max}$ = Reduced shelf life (to be avoided)
- Special requirements apply in the case of belt drives. Please contact us.

▼ **Toothed gear output drive**



▼ **V-belt output drive**



1 Direction of rotation " counter-clockwise", pressure at port **B**
2 Direction of rotation "clockwise", pressure at port **A**
3 Bidirectional direction of rotation

1) For intermittent operation
2) Maximum permissible axial force at standstill or depressurized rotation of the axial piston unit

HP – Proportional hydraulic control

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

HP1, HP2 positive control

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

HP5, HP6 negative control

- 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 from 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 500 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 HP characteristic curve are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

HP1, HP5

Increase in pilot pressure Δp_{St} = 10 bar

HP1 positive control

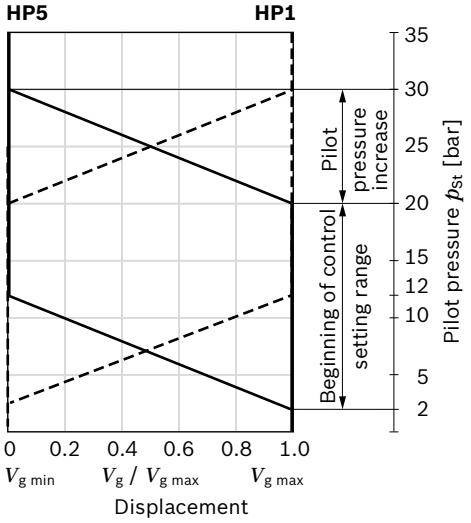
A pilot pressure increase of 10 bar at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

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

Increase in pilot pressure Δp_{St} = 25 bar

HP2 positive control

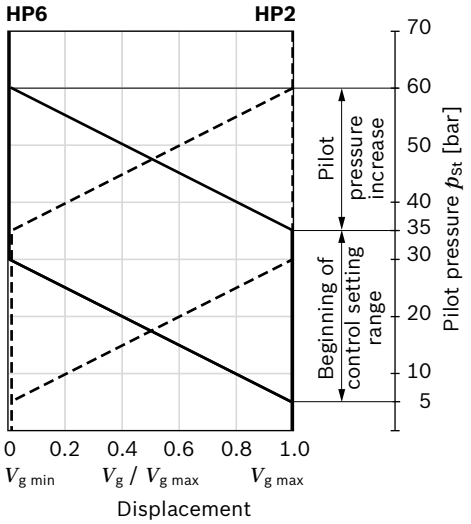
A pilot pressure increase of 25 bar at port **X** results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP6 negative control

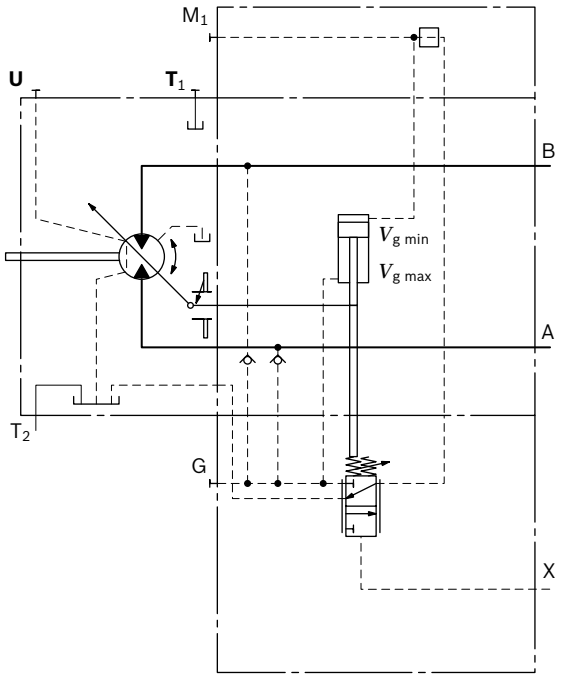
A pilot pressure increase of 25 bar at port **X** results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

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

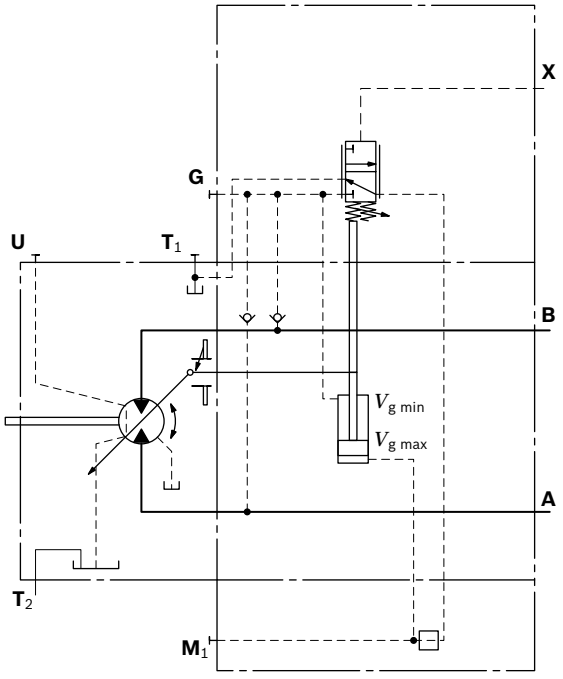
▼ **Characteristic curve**



▼ **Schematic HP1, HP2: Positive control**



▼ **Schematic HP5, HP6: negative control**



HP5D1, HP6D1

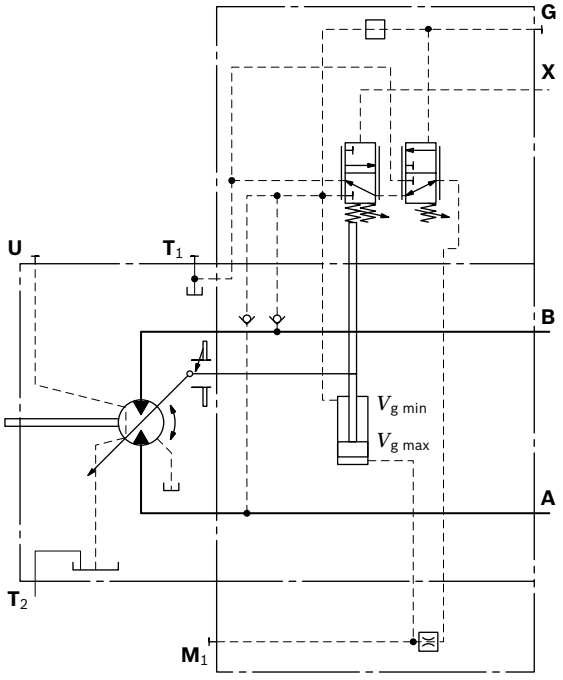
Pressure control, fixed setting

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 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 80 to 450 bar

▼ **Schematic HP5D1, HP6D1: negative control**

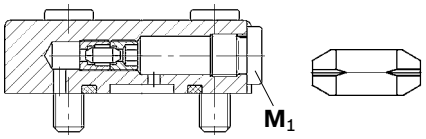


Response time damping

Standard for HP without damping

HP, HP5D1, HP6D1 – with throttle pin on both sides, symmetrical

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65



EP – Proportional electric control

The proportional electric control, type EP, provides infinite adjustment of the displacement, proportional to the control current applied to the solenoid.

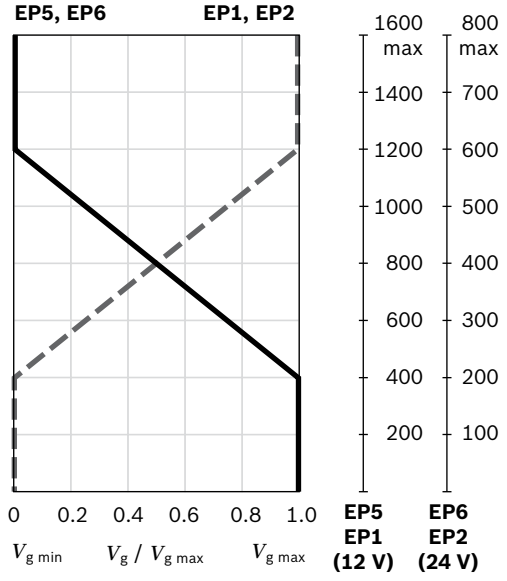
EP1, EP2 positive control

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

EP5, EP6 negative control

- 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 curve**



Note

The control oil is internally taken from 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.

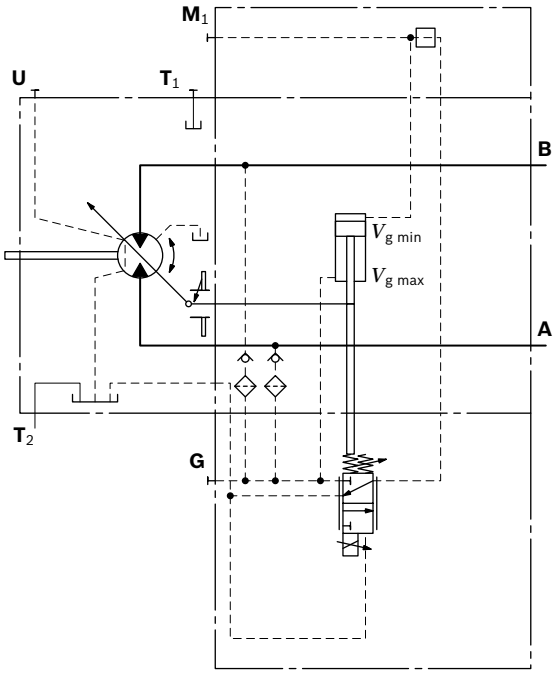
Please note that pressures up to 500 bar can occur at port **G**.

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
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

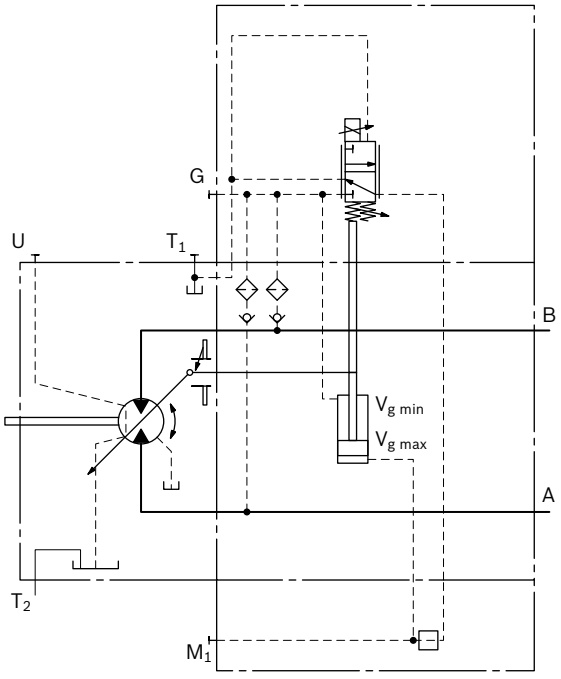
Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

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

▼ **Schematic EP1, EP2: positive control**



▼ **Schematic EP5, EP6: negative control**

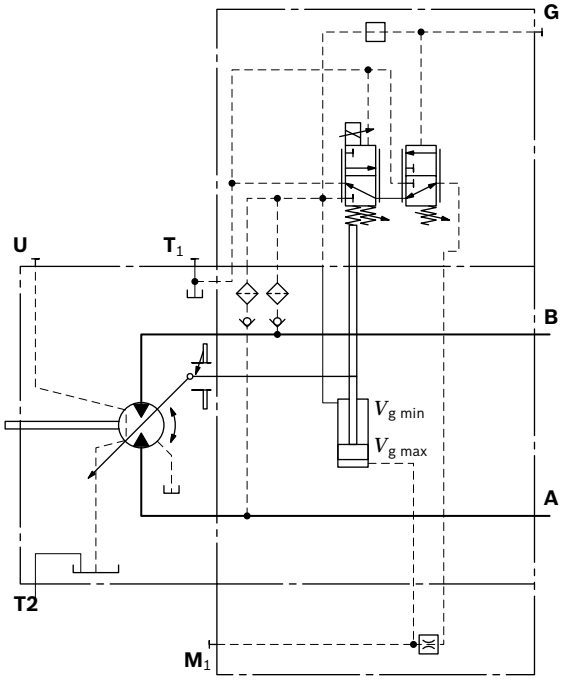


EP5D1, EP6D1

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 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 80 to 450 bar

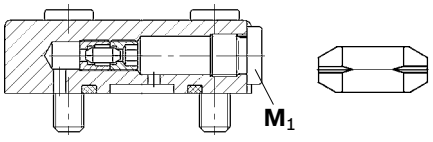
▼ **Schematic EP5D1, EP6D1: negative control**



Response time damping

Standard for EP without damping
EP, EP5D1, EP6D1 – with throttle pin on both sides, symmetrical

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65



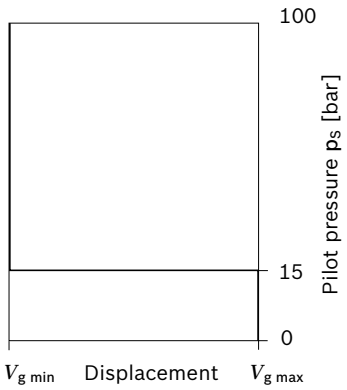
HZ – Two-point hydraulic control

The two-point hydraulic control, type HZ, 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 speed)
- Position at $V_{g\,min}$ (with pilot pressure > 15 bar activated, minimum torque, maximum permissible speed)

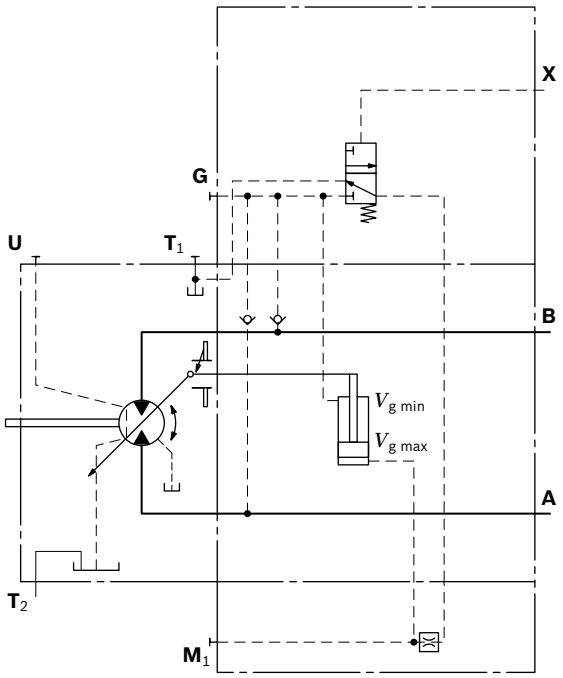
▼ **Characteristic curve HZ5, HZ7**



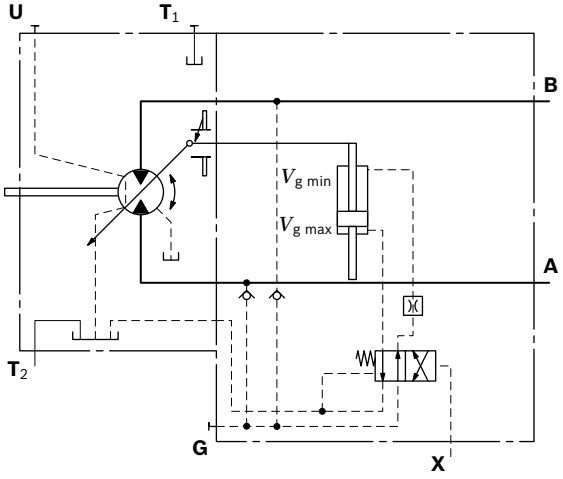
Note

- 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 500 bar can occur at port **G**.

▼ **Schematic HZ5: Negative control, size 150 to 215**



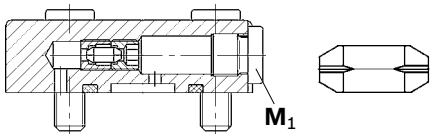
▼ **Schematic HZ7: Negative control, size 60 to 115**



Response time damping

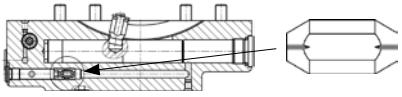
HZ5 – with throttle pin on both sides, symmetrical

Size	150	170	215
Groove size [mm]	0.55	0.55	0.65



HZ7 – with throttle pin on both sides, symmetrical

Size	60	85	115
Groove size [mm]	0.30	0.30	0.30



EZ – Two-point electric control

The two-point electric control, type EZ, 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.

Note

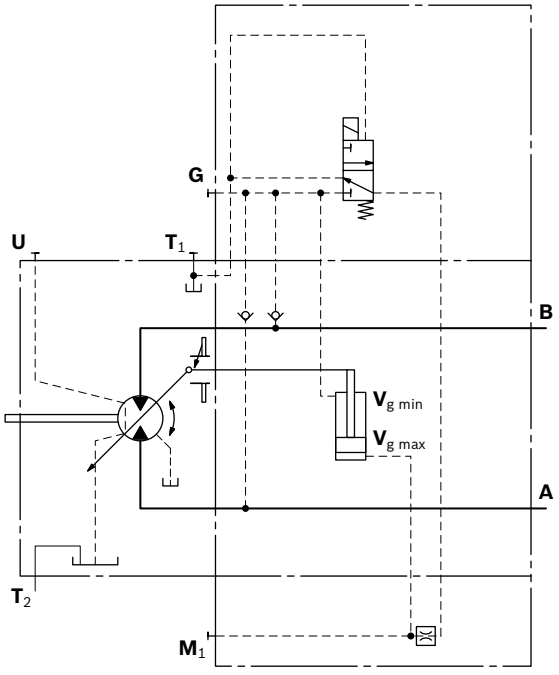
The control oil is internally taken out of the high pressure side of the motor (**A** or **B**). For reliable control, an operating pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar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

Please note that pressures up to 500 bar can occur at port **G**.

Sizes 150 to 215

Technical data, solenoid with ø37	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

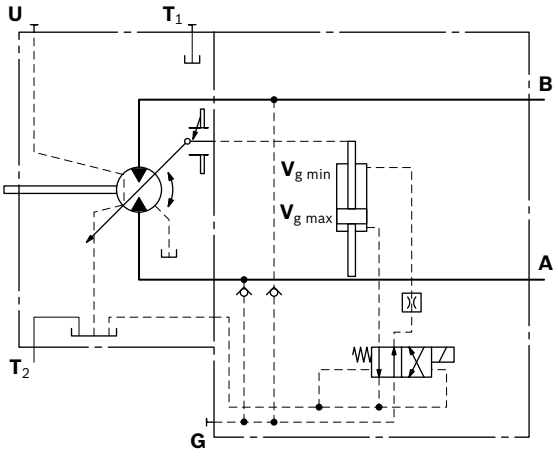
▼ **Schematic EZ5, EZ6: negative control**



Sizes 60 to 115

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 required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

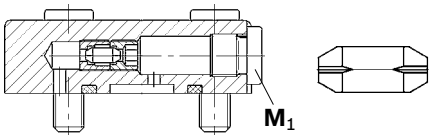
▼ **Schematic EZ7, EZ8: negative control**



Response time damping

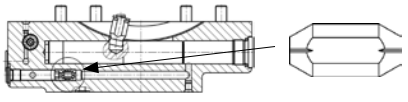
EZ5, EZ6 – with throttle pin on both sides, symmetrical

Size	150	170	215
Groove size [mm]	0.55	0.55	0.65



EZ7, EZ8 – with throttle pin on both sides, symmetrical

Size	60	85	115
Groove size [mm]	0.30	0.30	0.30



HA – Automatic high-pressure related control

The automatic high-pressure related control, type HA, adjusts the displacement automatically depending on the operating pressure.
The displacement of the A6VM motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control device measures internally the operating pressure at **A** or **B** (no control line required) and upon reaching the set beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of operating pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

HA1, HA2 positive control

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

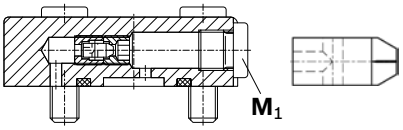
Note

- 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 from 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 500 bar can occur at port **G**.
- The beginning of control and the HA.T3 characteristic curve are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

Response time damping

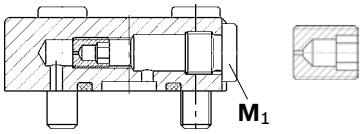
HA – with one-sided throttle pin – inlet to large stroking chamber

Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65



HA – with counterbalance valve BVD or BVE – with throttle screw

Size	60	85	115	150	170	215
Groove size [mm]	0.80	0.80	0.80	0.80	0.80	0.80



HA1

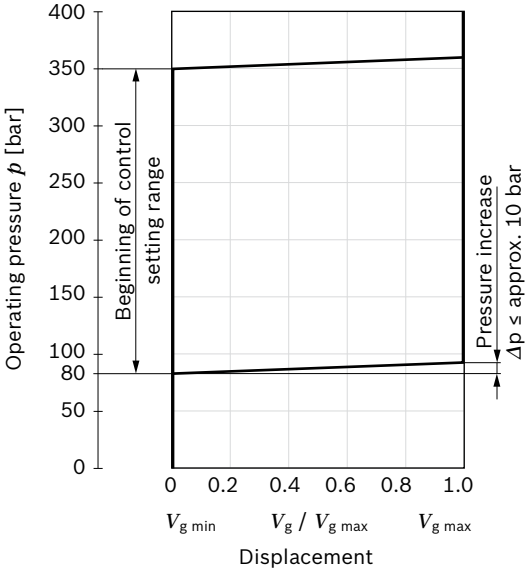
With minimum pressure increase, positive control

An operating pressure increase of $\Delta p \leq$ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

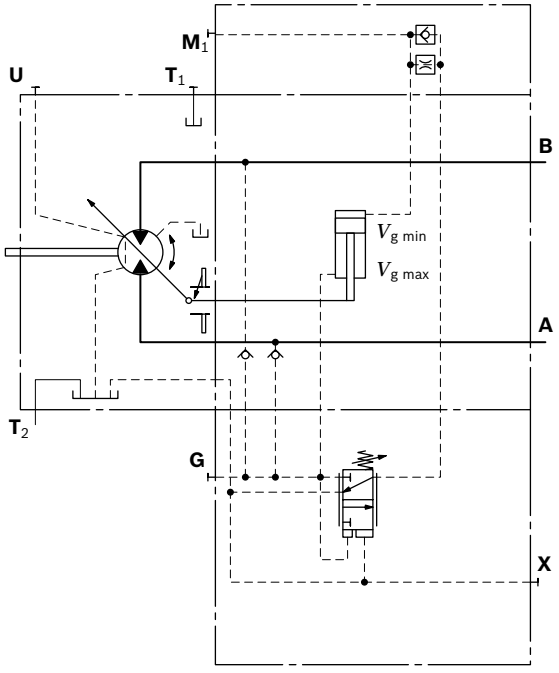
Beginning of control, setting range 80 to 350 bar

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

▼ **Characteristic curve HA1**



▼ **Schematic HA1**



HA2

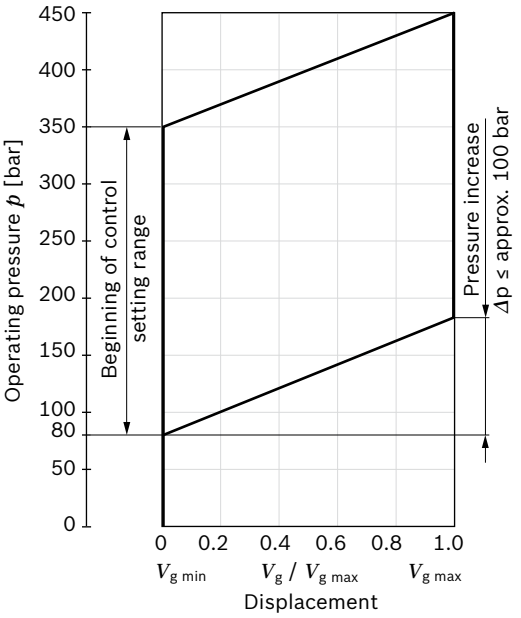
With pressure increase, positive control

An operating pressure increase of Δp approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

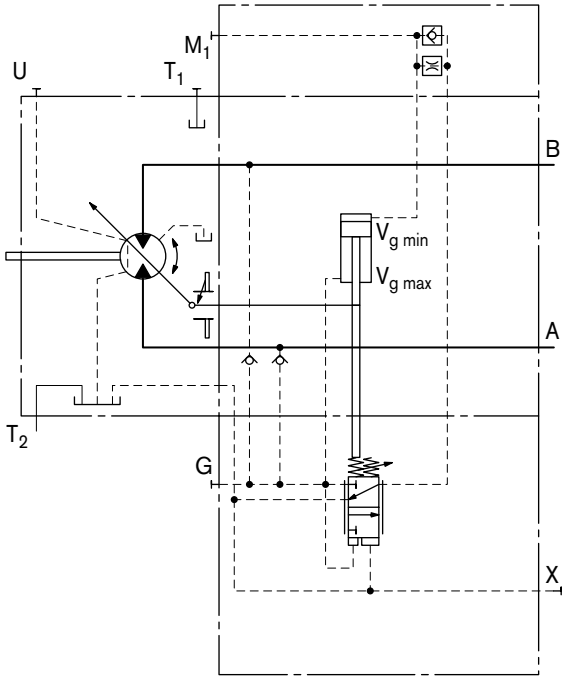
Beginning of control, setting range 80 to 350 bar

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

▼ **Characteristic curve HA2**



▼ **Schematic HA2**



HA.T3

Hydraulic override, remote control, proportional

With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port **X**.

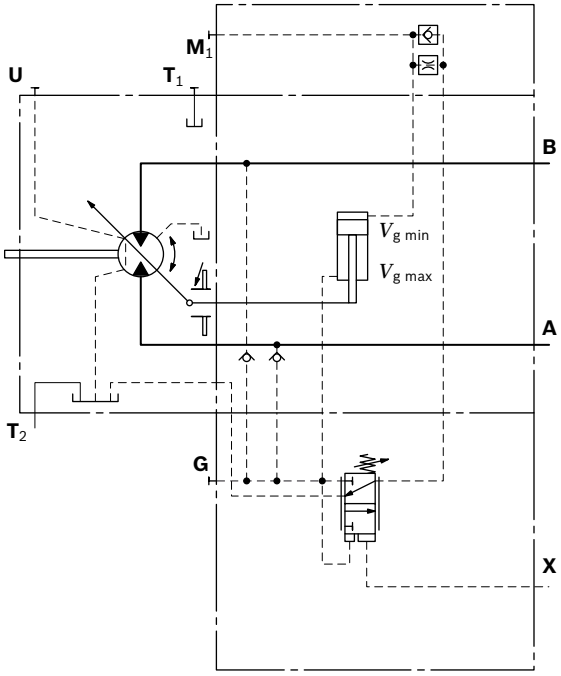
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar.

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

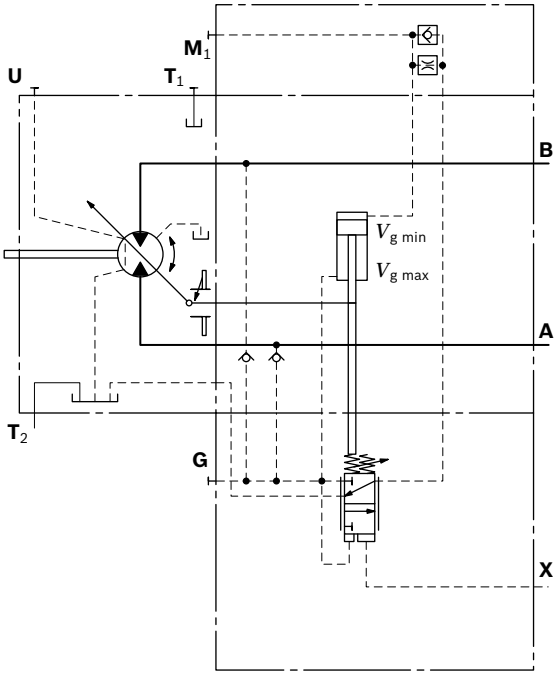
Note

Maximum permissible pilot pressure 100 bar.

▼ **Schematic HA1.T3**



▼ **Schematic HA2.T3**



HA.U1, HA.U2

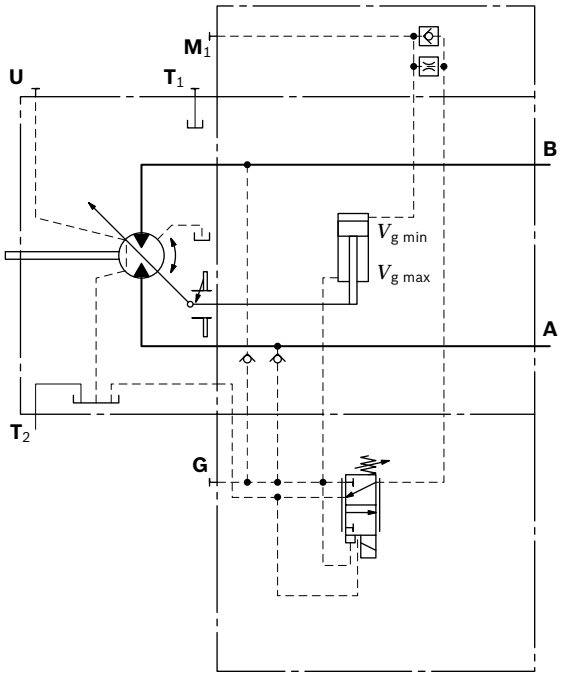
Electric override, two-point

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

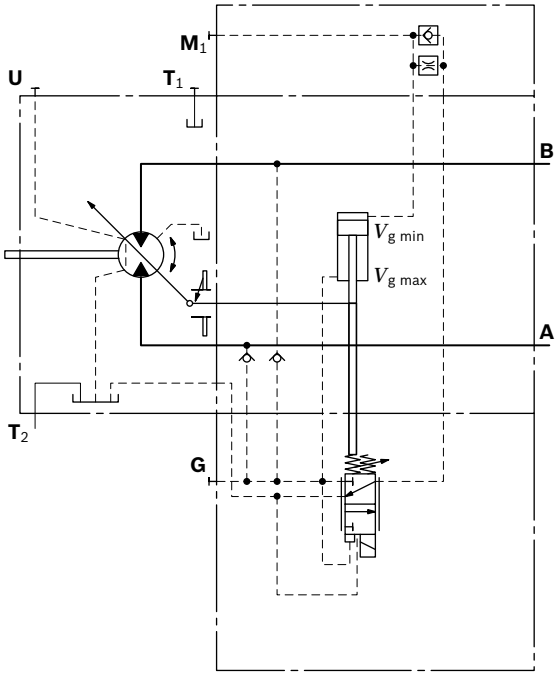
The beginning of control can be set between 80 and 300 bar (specify required setting in plain text when ordering).

Technical data, solenoid with ø45	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

▼ **Schematic HA1U1, HA1U2**



▼ **Schematic HA2U1, HA2U2**



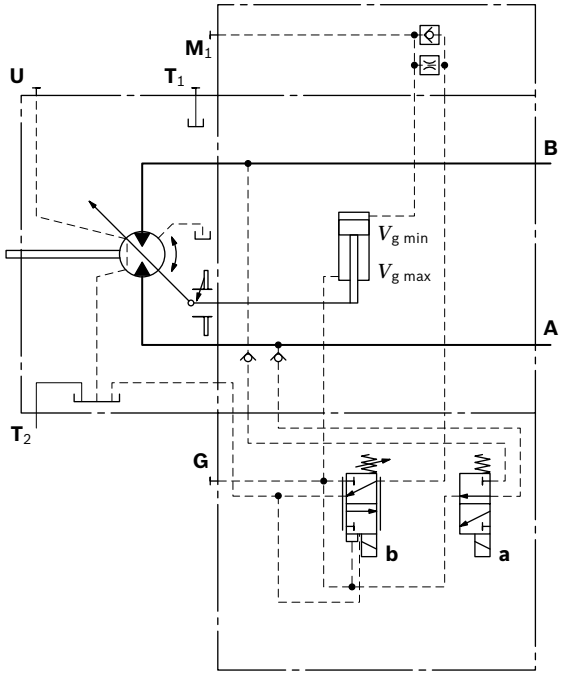
HA.R1, HA.R2
Electric override,
electric travel direction valve

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid **b**. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

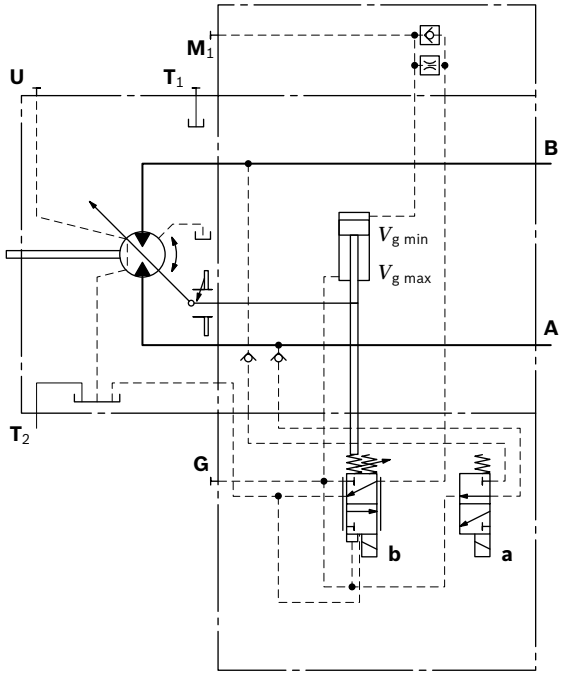
The travel direction valve ensures that the preselected pressure side of the hydraulic motor (**A** or **B**) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e. g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

The travel direction valve (see page 25) is either pressure spring or switched by energizing switching solenoid **a**, depending on the direction of rotation (travel direction).

▼ **Schematic HA1R1, HA1R2**



▼ **Schematic HA2R1, HA2R2**



Electric override

Technical data, solenoid b with ø45	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required active current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

Travel direction valve, electric

Technical data, solenoid a with ø37		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	energized	energized
cw	**A**	de-energized	de-energized
Nominal resistance (at 20 °C)		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 62			

DA – Automatic speed-related control

The variable motor A6VM with automatic speed-related control, type DA, 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).

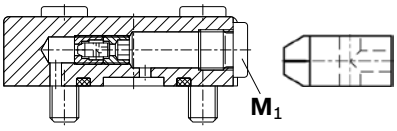
- Pressure ratio p_{St}/p_{HD} = 5/100

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 organization.

Note
The beginning of control and the DA characteristic curve a influenced by case pressure. An increase in case pressure causes an decrease in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

Response time damping
DA – with one-sided throttle pin – outlet to large stroking chamber

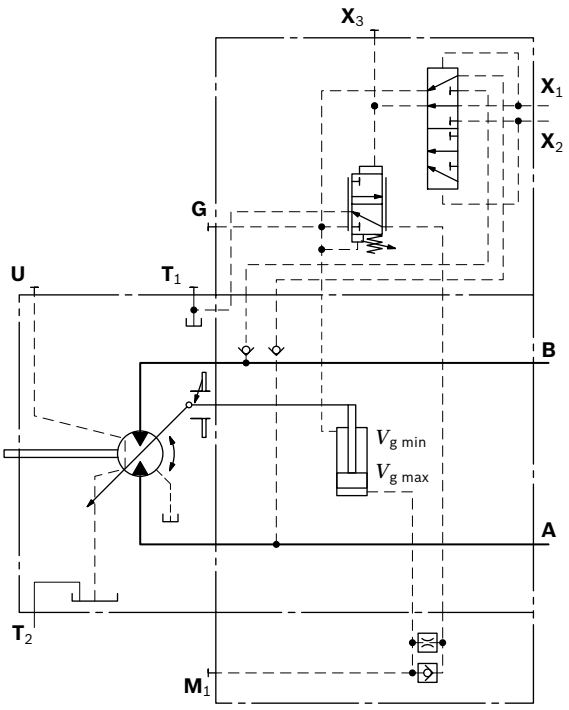
Size	60	85	115	150	170	215
Groove size [mm]	0.45	0.45	0.55	0.55	0.55	0.65



DA0
Hydraulic travel direction valve
negative control
Depending 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 DA0**

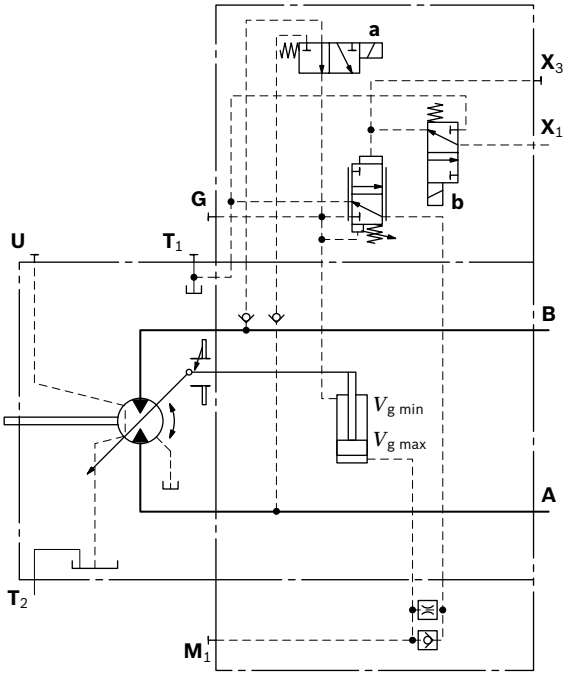


DA1, DA2

Electric travel direction valve +
electric $V_{g\,max}$ circuit, negative control

The travel direction valve is either pressure 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).

▼ **Schematic DA1, DA2**



Travel direction valve, electric

Technical data, solenoid a with ø37		DA1	DA2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	**B**	de-energized	de-energized
cw	**A**	energized	energized
Nominal resistance (at 20 °C)		5.5 Ω	21.7 Ω
Nominal power		26.2 W	26.5 W
Minimum required active current		1.32 A	0.67 A
Duty cycle		100 %	100 %
Type of protection: see connector version on page 62			

Electric override

Technical data, solenoid b with ø37	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection: see connector version on page 62		

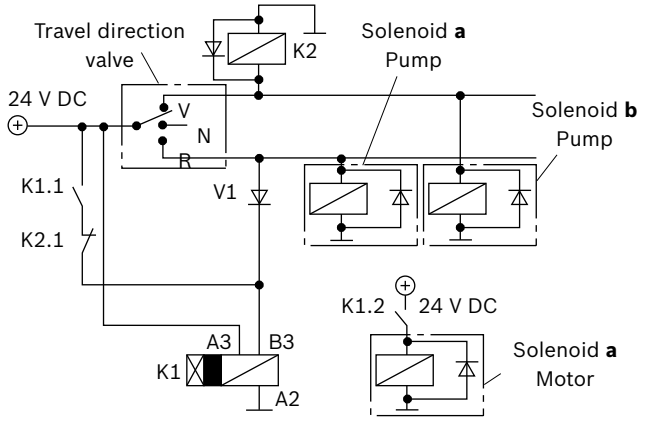
Electric travel direction valve (for DA, HA.R)

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 travel direction valve causes the travel direction valve of the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

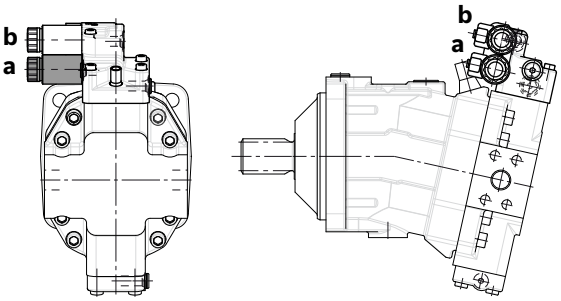
As a result, jerky deceleration or braking is prevented in both cases.

▼ **Schematic - electric travel direction valve**

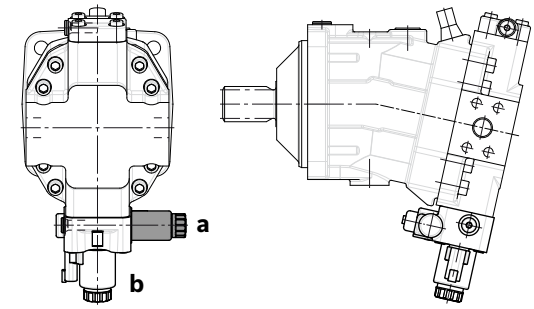


The diodes and relays shown are not included in the scope of delivery of the motor.

▼ **Control DA1, DA**



▼ **HA1R., HA2R control.**

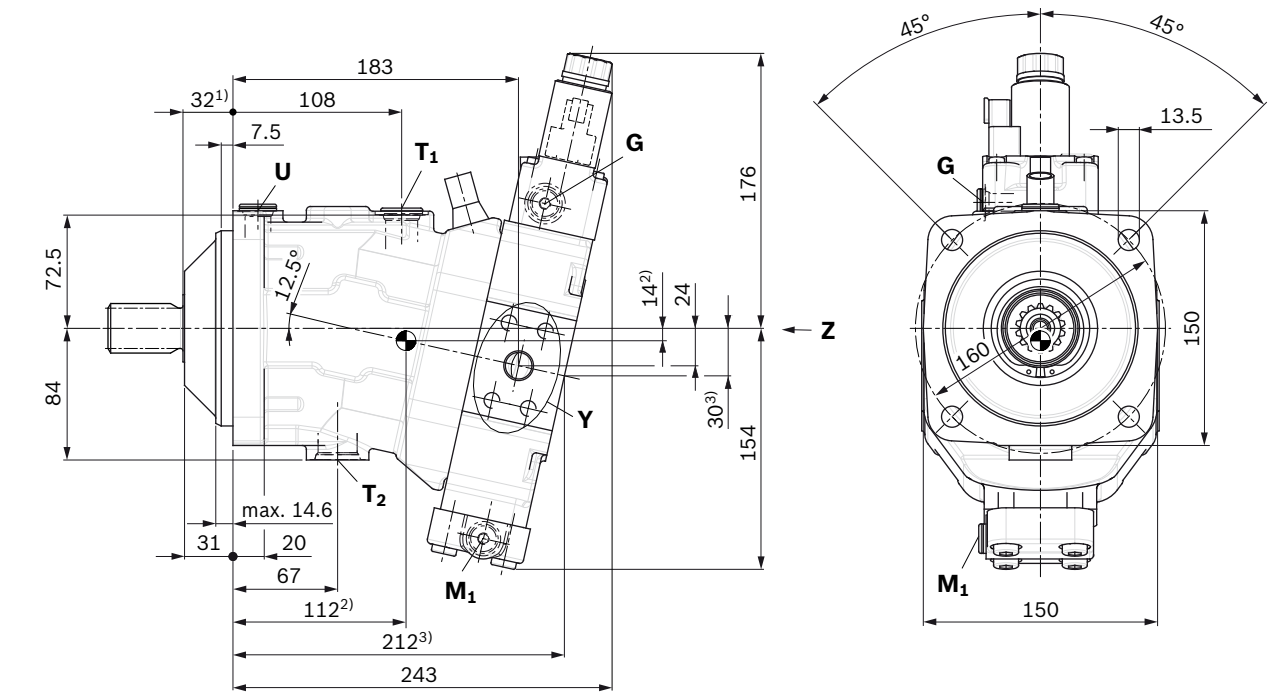


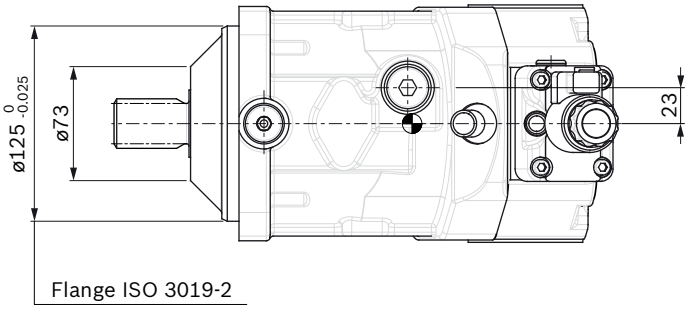
Switching solenoid **a** on the travel direction valve

Dimensions size 60

EP5, EP6 – Proportional electric control, negative control

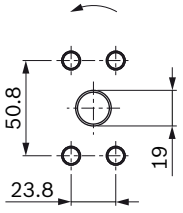
Port plate 2 — SAE flange ports A and B at side, opposite

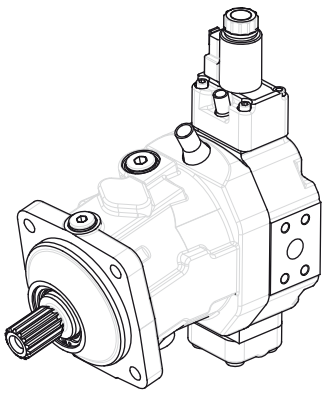




Flange ISO 3019-2

View Y

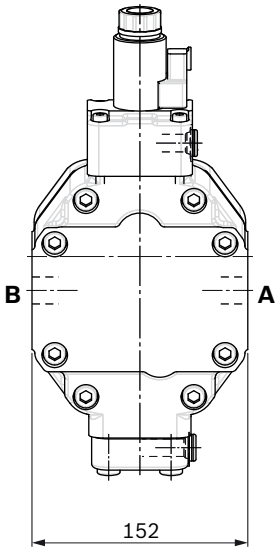




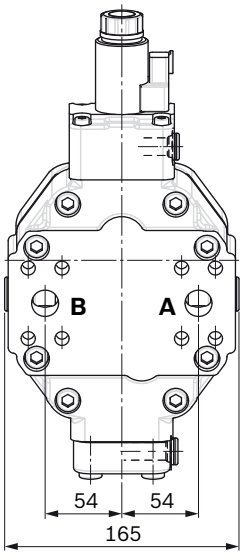
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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

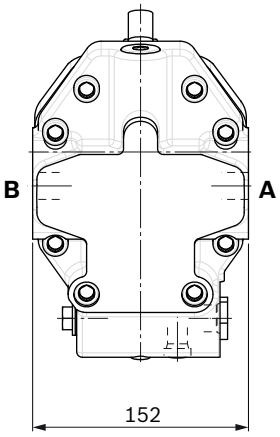
2 SAE flange port
A and **B** at side, opposite



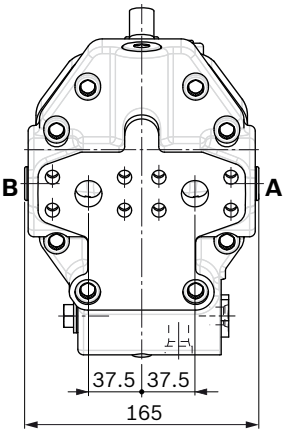
1 SAE flange port
A and **B** at rear



2 SAE flange port
A and **B** at side, opposite
only HZ7, EZ7/8

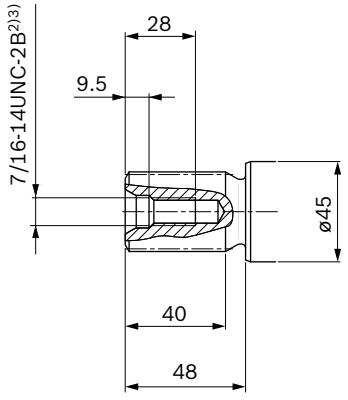


1 SAE flange port
A and **B** at rear
only HZ7, EZ7/8



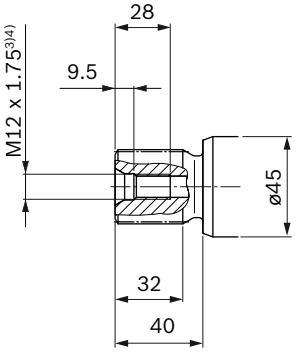
▼ **Splined shaft SAE J744**

S7 – 1 1/4 in 14T 12/24DP[1)]



▼ **Splined shaft DIN 5480**

Z8 – W35×2×16×9g

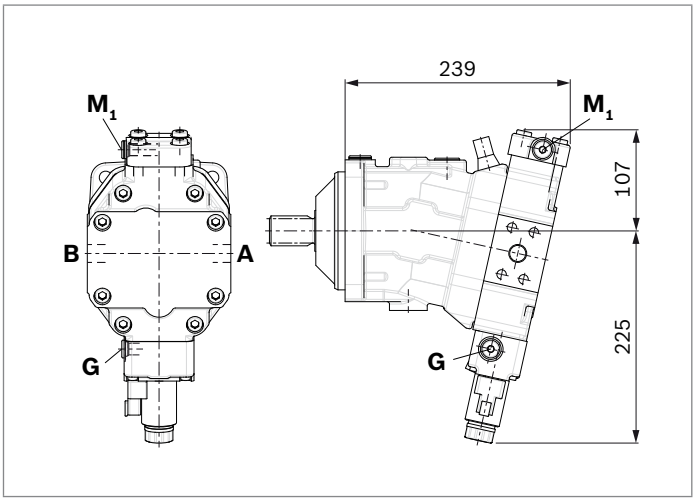


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

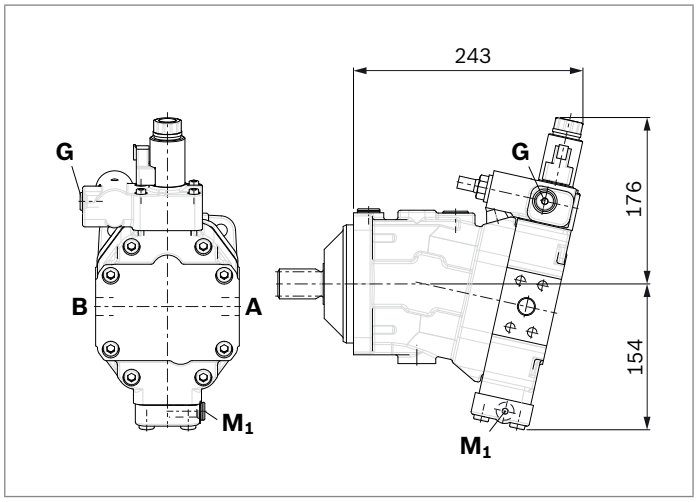
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 × 1.5; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

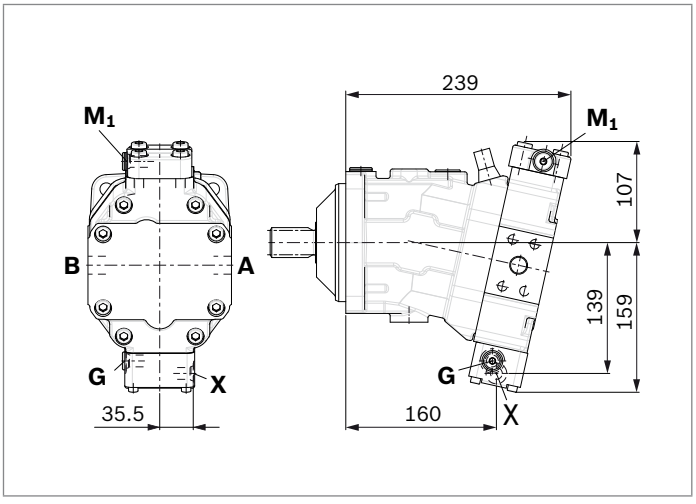
▼ **EP1, EP2** – Electric proportional control, positive control



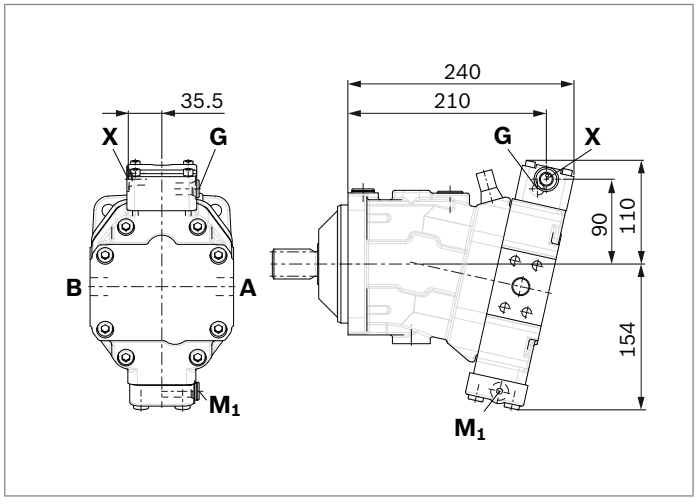
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



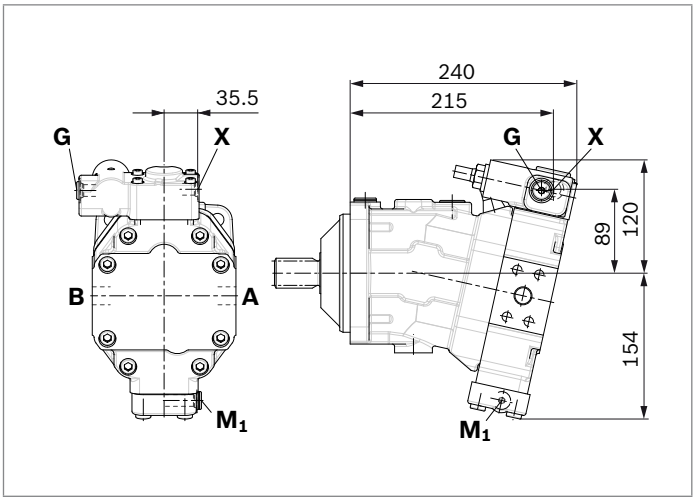
▼ **HP1, HP2** – Hydraulic proportional control, positive control



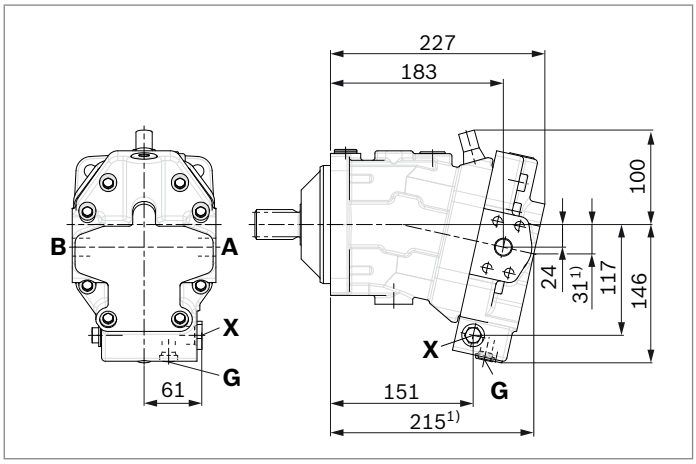
▼ **HP5, HP6** – Hydraulic proportional control, negative control



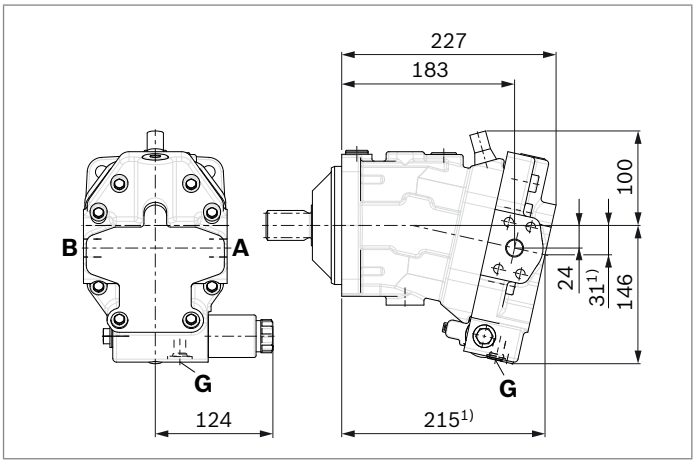
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



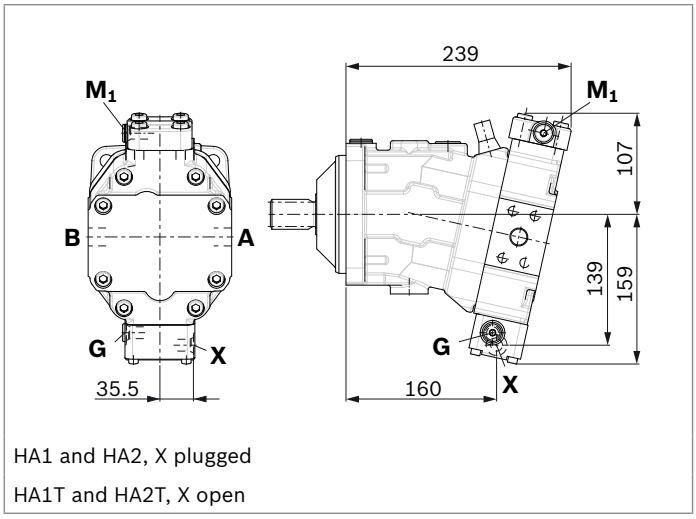
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control



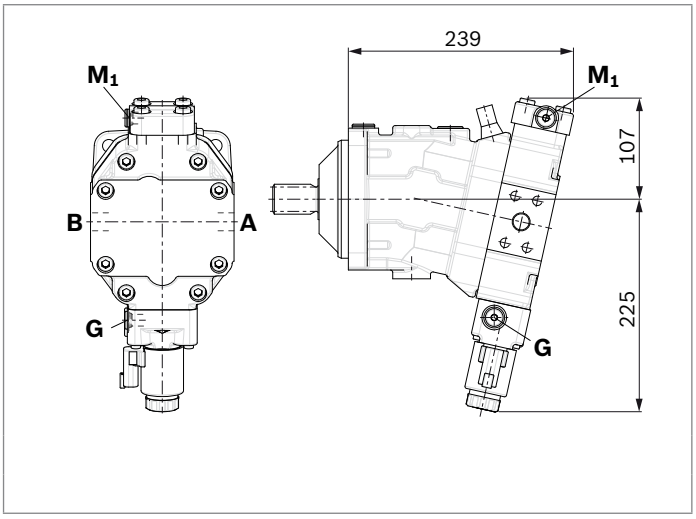
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



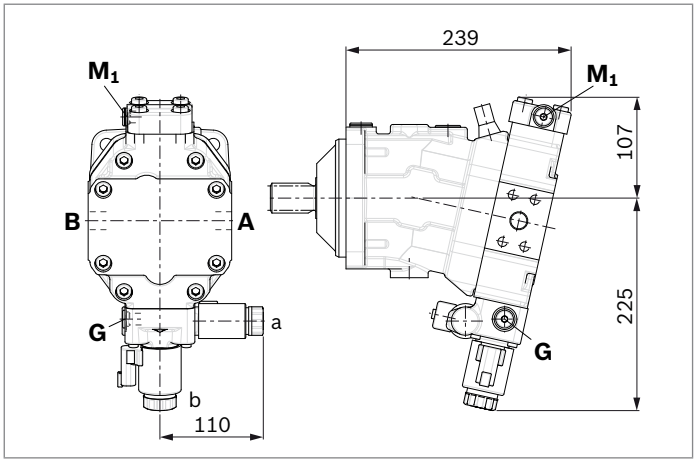
HA1 and HA2, X plugged

HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

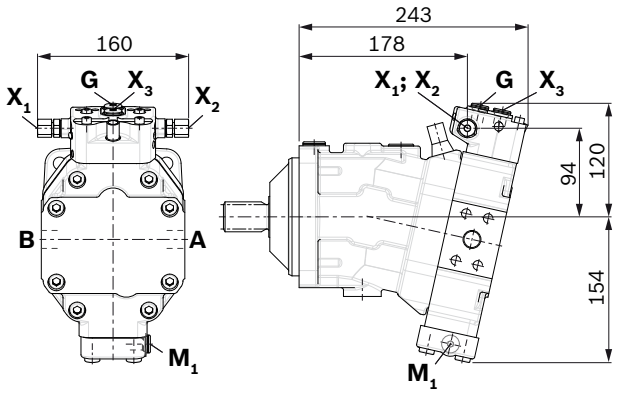


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE flange ports A and B at rear

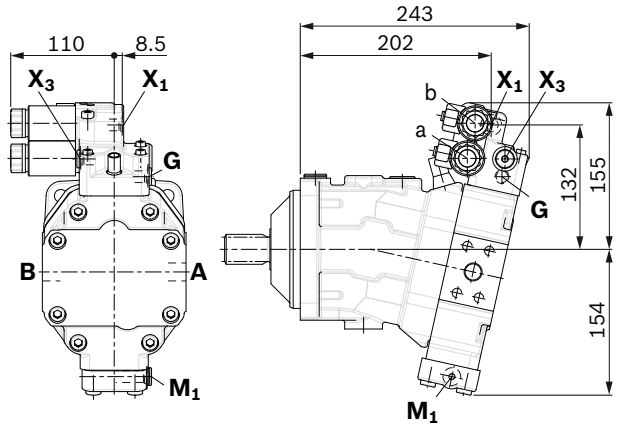
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

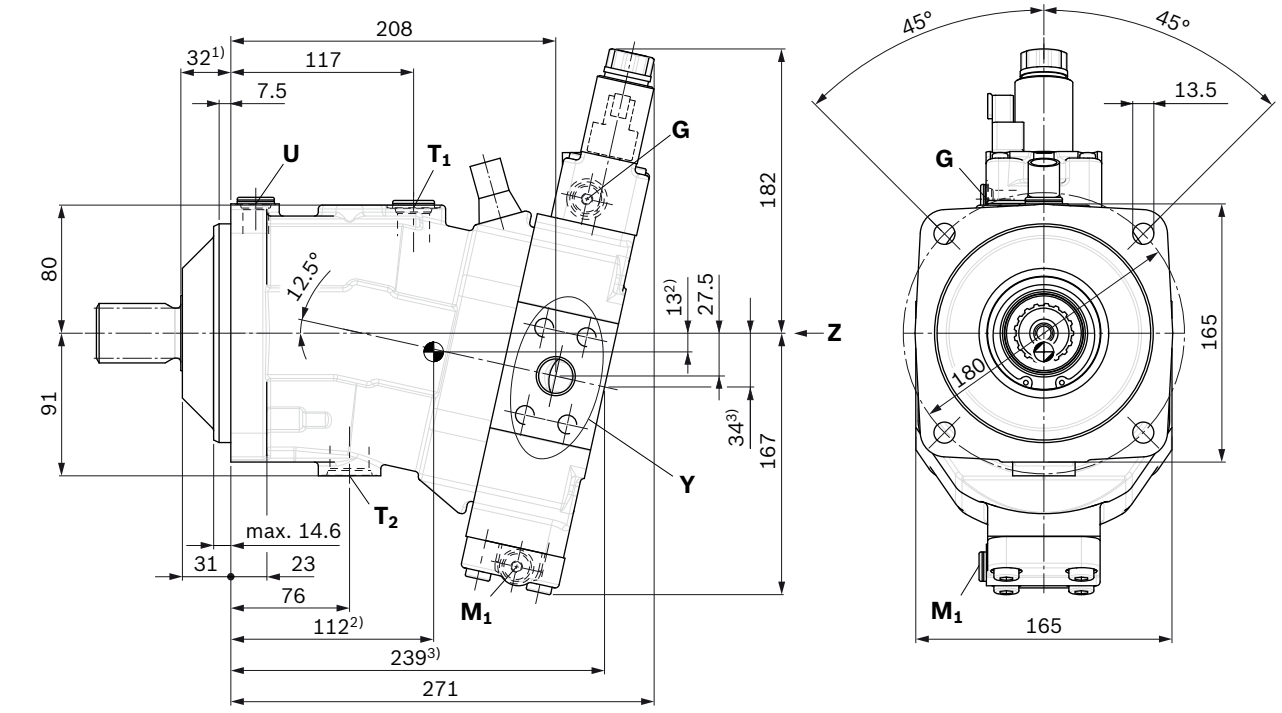
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit

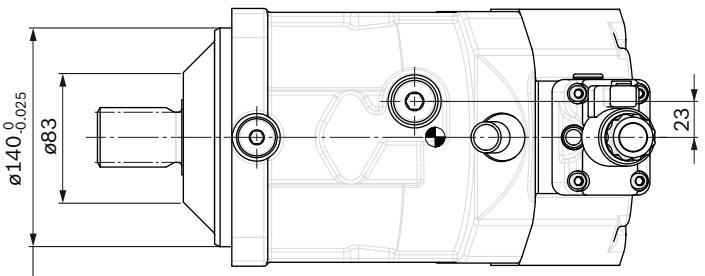


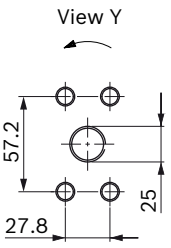
Dimensions size 85

EP5, EP6 – Proportional electric control, negative control

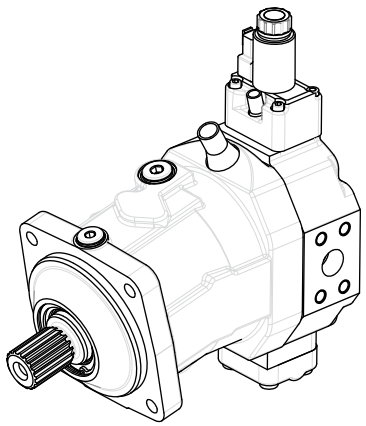
Port plate 2 — SAE flange ports A and B at side, opposite







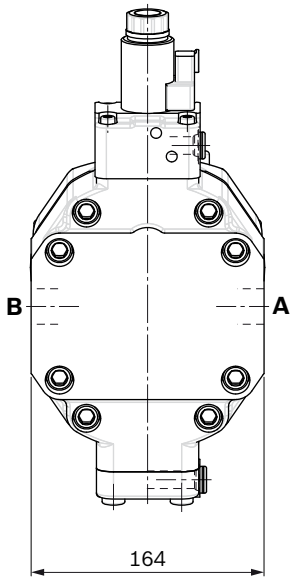
Flange ISO 3019-2



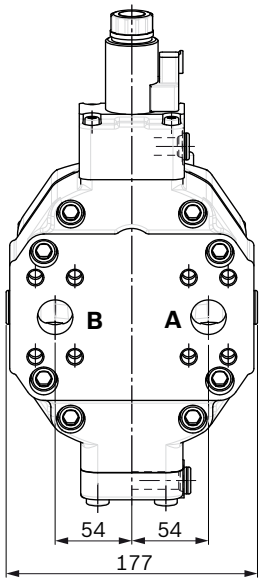
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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

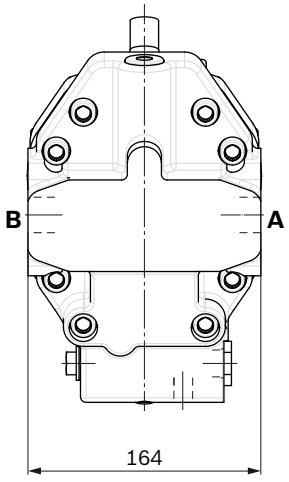
2 SAE flange port
A and **B** at side, opposite



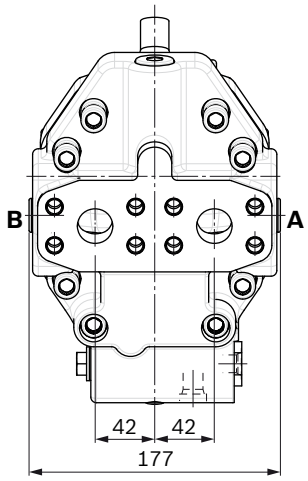
1 SAE flange port
A and **B** at rear



2 SAE flange port
A and **B** at side, opposite
only HZ7, EZ7/8

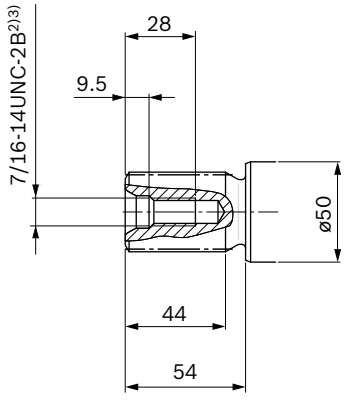


1 SAE flange port
A and **B** at rear
only HZ7, EZ7/8



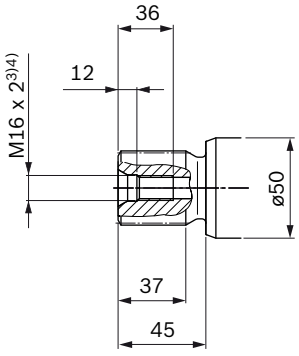
▼ **Splined shaft SAE J744**

S9 – 1 1/2 in 17T 12/24DP[1)]



▼ **Splined shaft DIN 5480**

Z9 – W40×2×18×9g

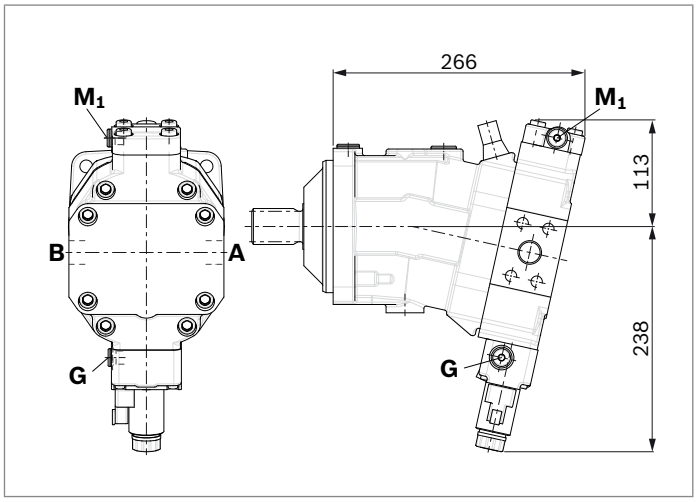


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

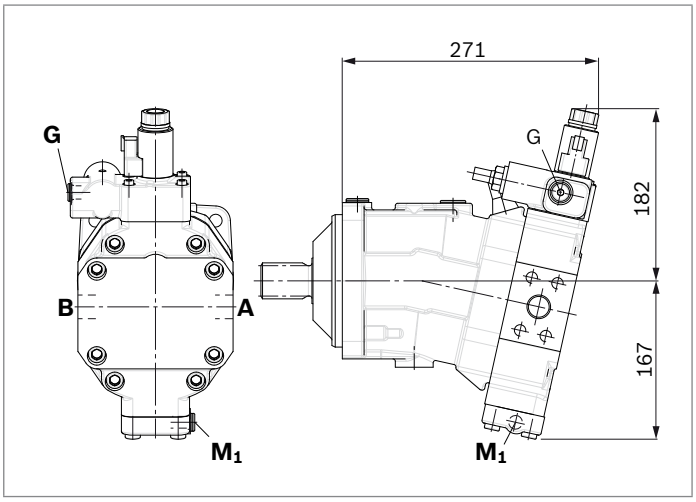
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 × 1.75; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

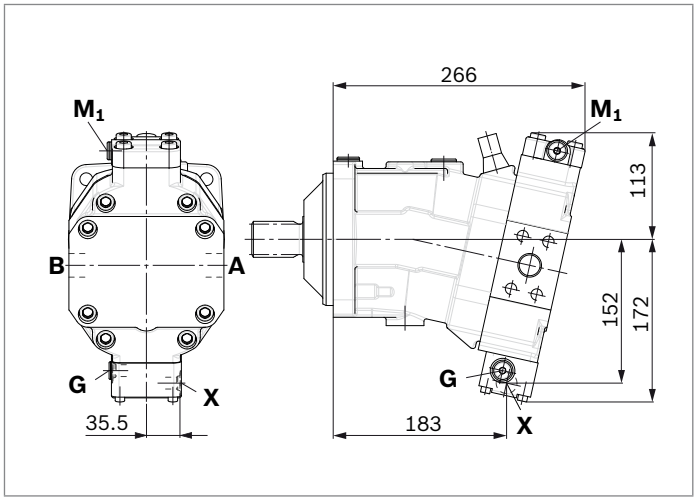
▼ **EP1, EP2** – Electric proportional control, positive control



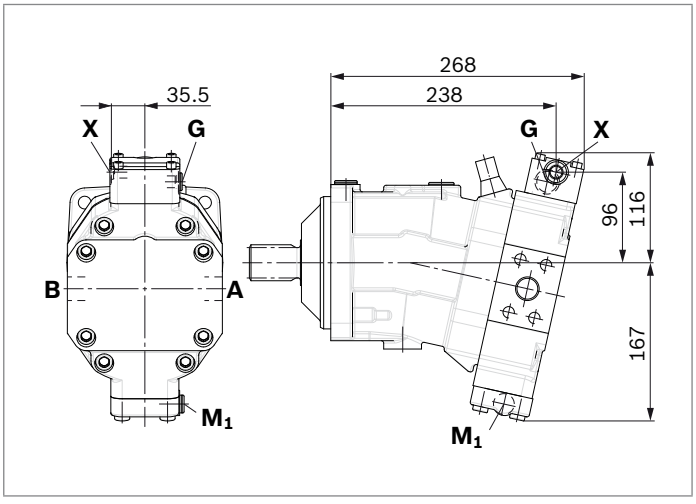
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



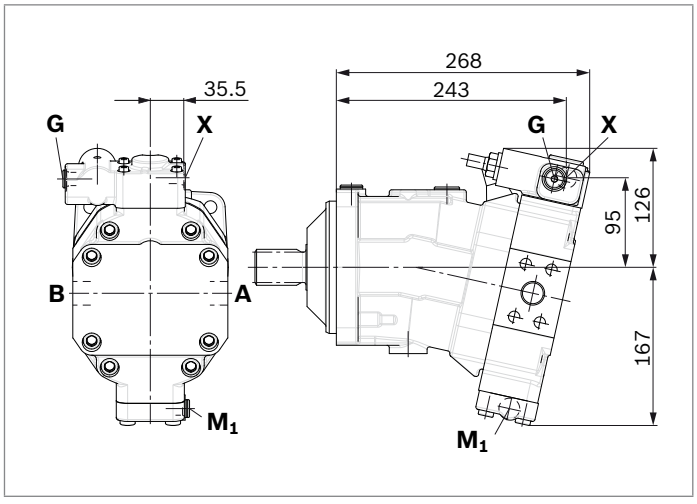
▼ **HP1, HP2** – Hydraulic proportional control, positive control



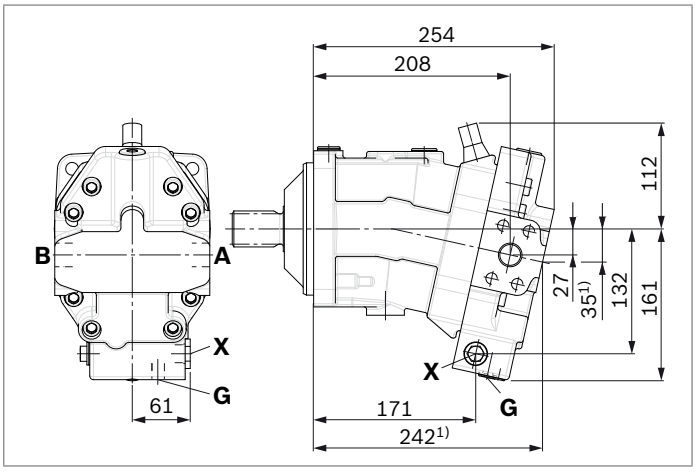
▼ **HP5, HP6** – Hydraulic proportional control, negative control



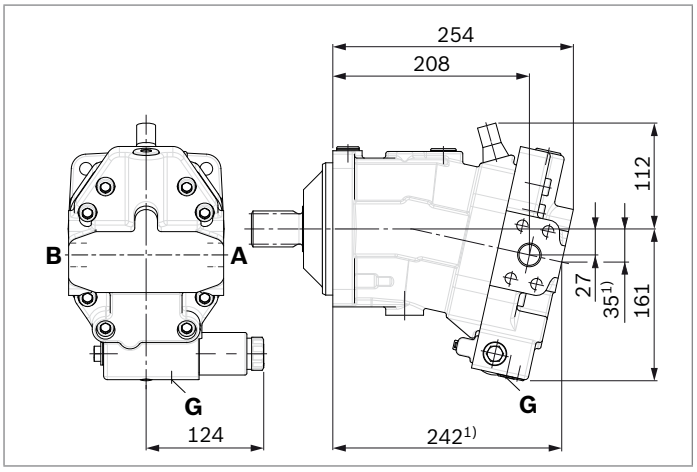
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



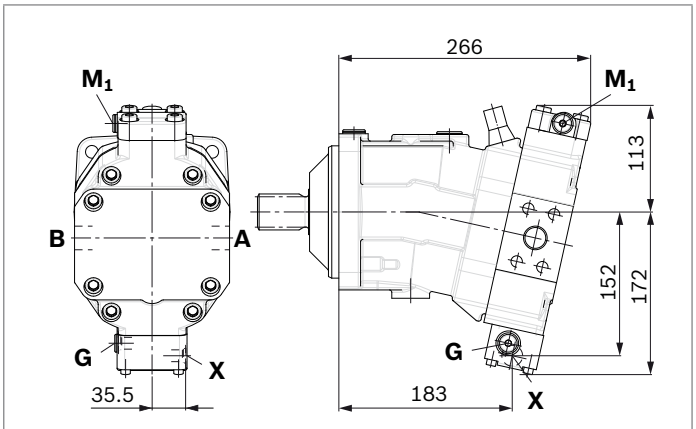
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control

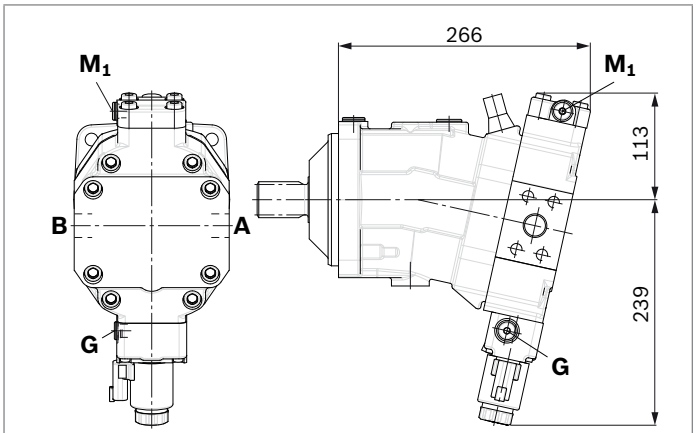


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

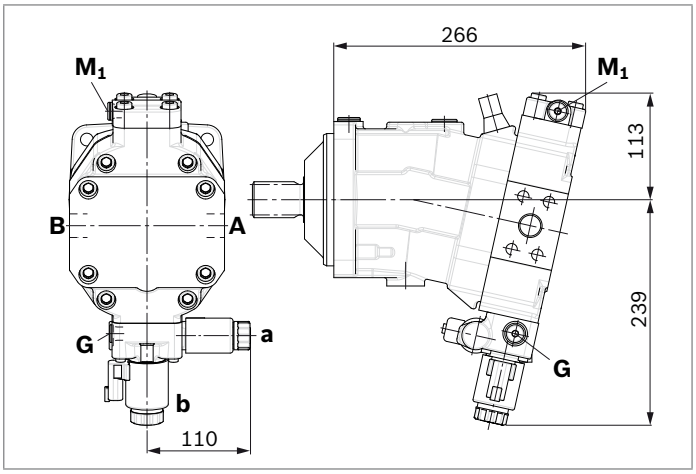


HA1 and HA2, X plugged
HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

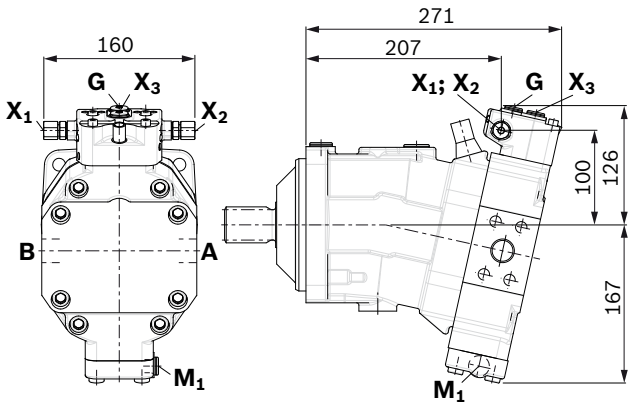


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



1) Port plate 1 – SAE flange ports A and B at rear

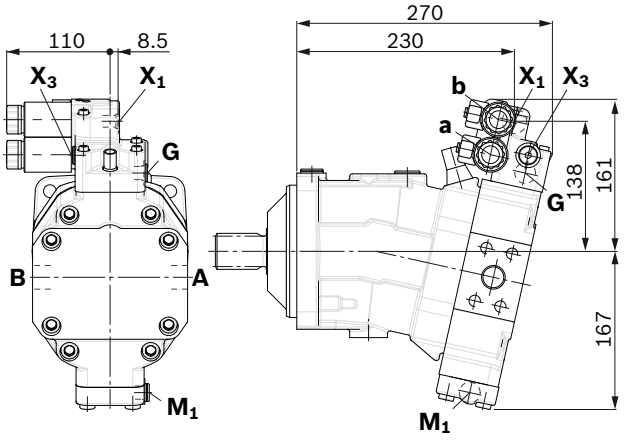
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

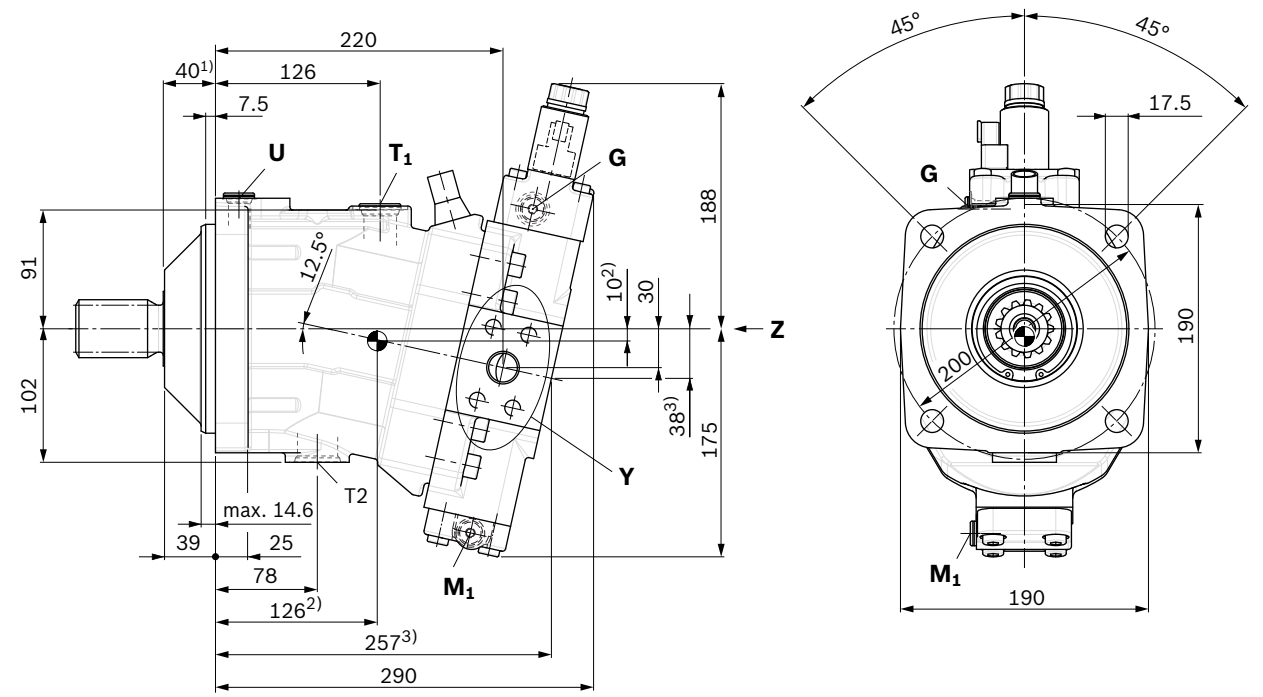
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ circuit

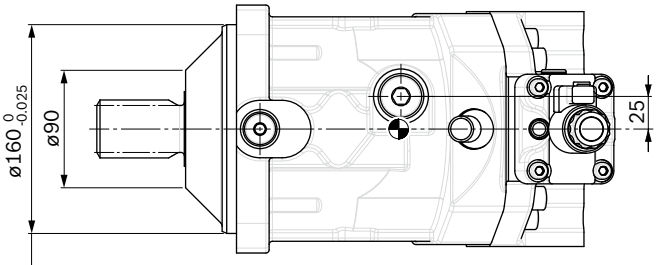


Dimensions size 115

EP5, EP6 – Proportional electric control, negative control

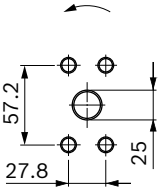
Port plate 2 — SAE flange ports A and B at side, opposite

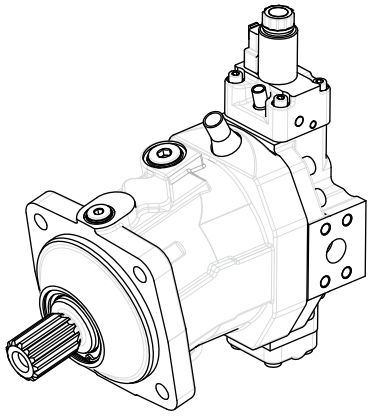




Flange ISO 3019-2

View Y

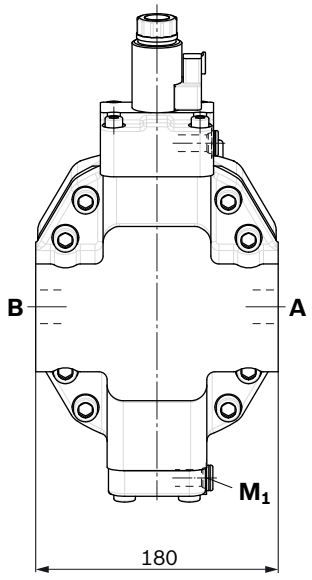




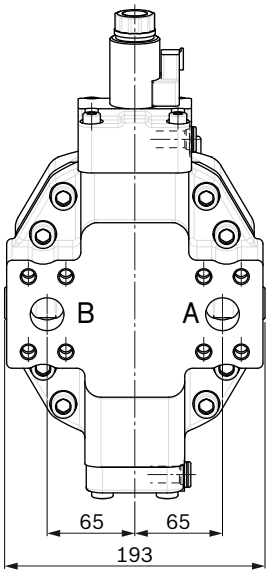
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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

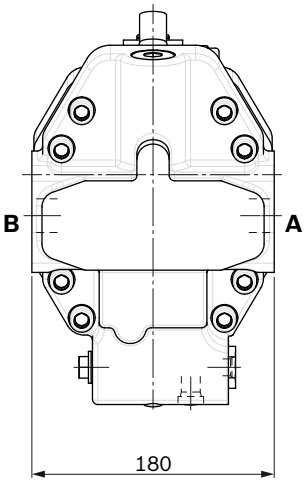
2 SAE flange port
A and **B** at side, opposite



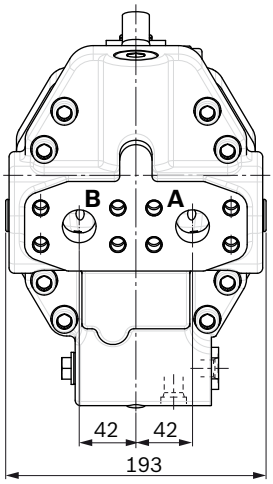
1 SAE flange port
A and **B** at rear



2 SAE flange port
A and **B** at side, opposite
only HZ7, EZ7/8

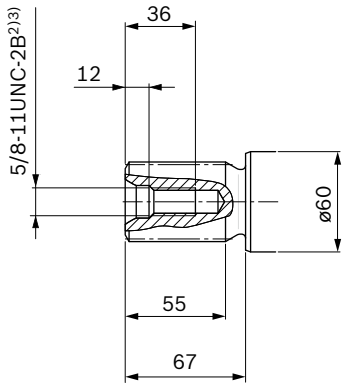


1 SAE flange port
A and **B** at rear
only HZ7, EZ7/8



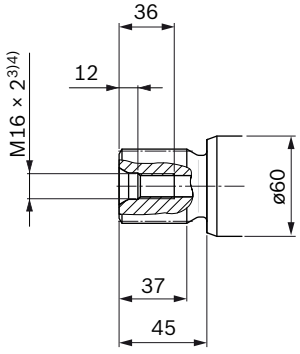
▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/13DP[1)]



▼ **Splined shaft DIN 5480**

Z9 – W40×2×18×9g

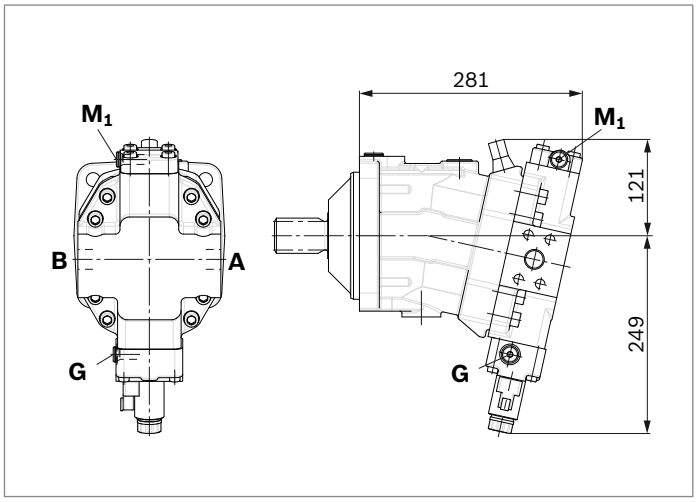


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

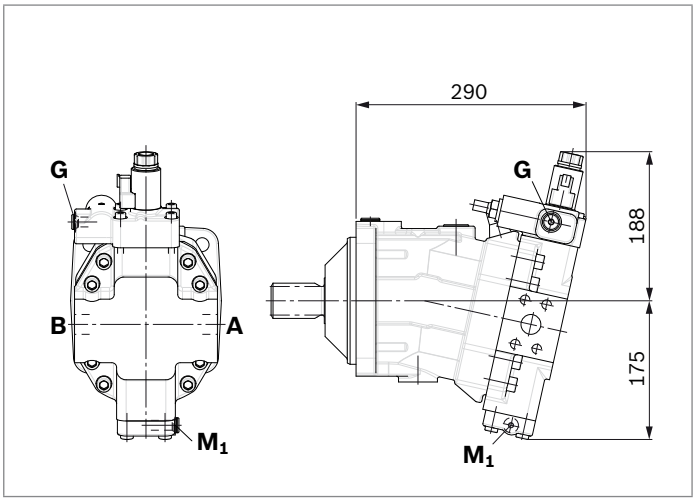
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 × 1.75; 17 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 × 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

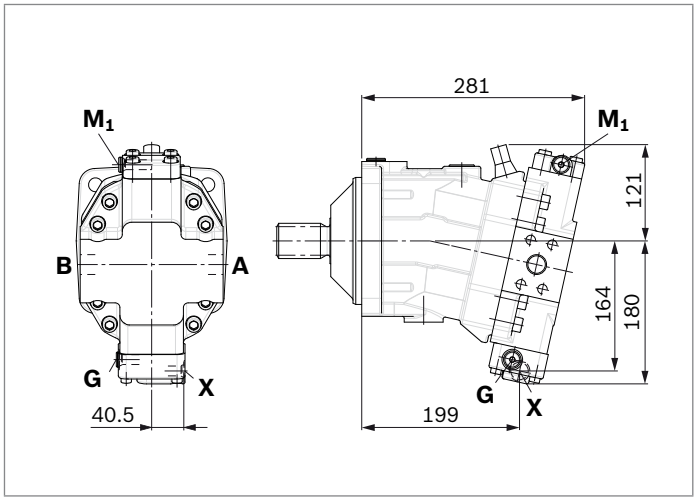
▼ **EP1, EP2** – Electric proportional control, positive control



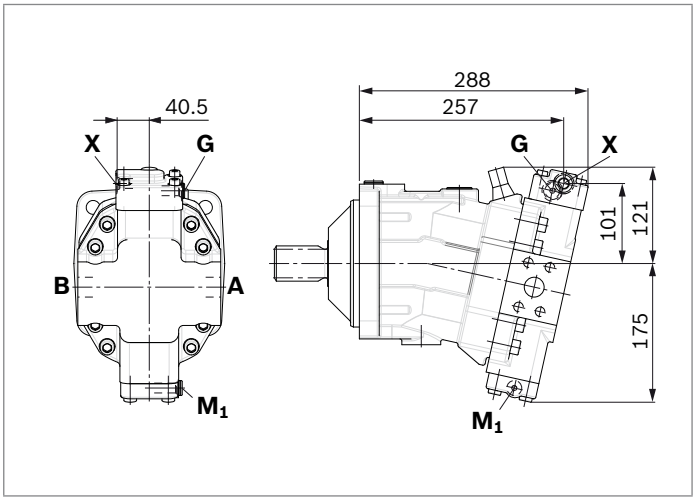
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



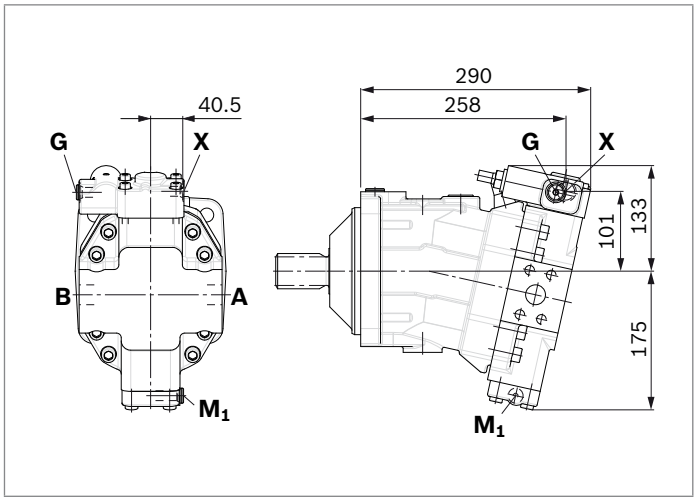
▼ **HP1, HP2** – Hydraulic proportional control, positive control



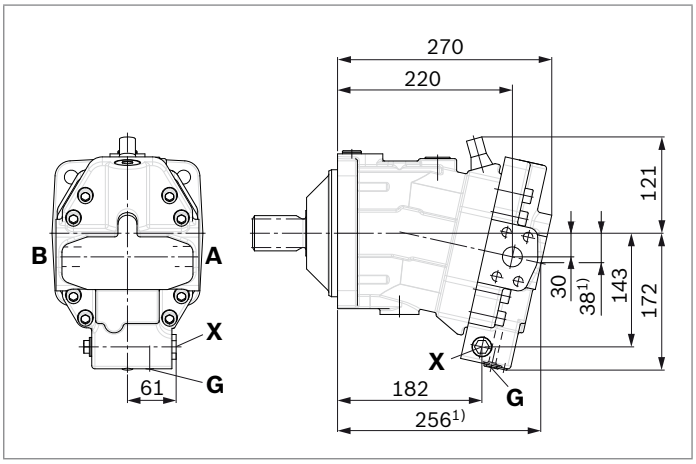
▼ **HP5, HP6** – Hydraulic proportional control, negative control



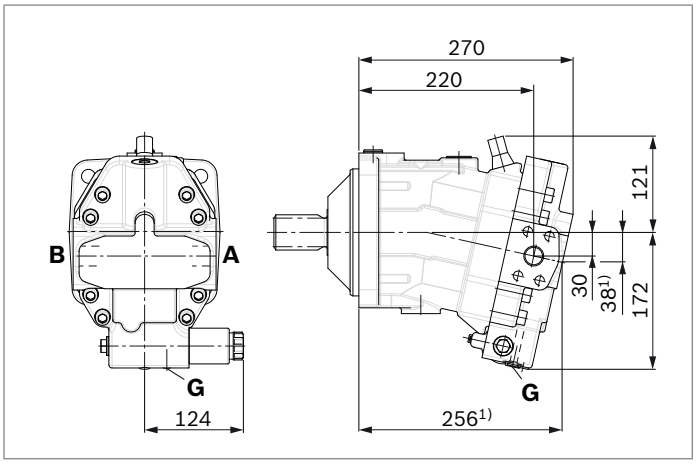
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



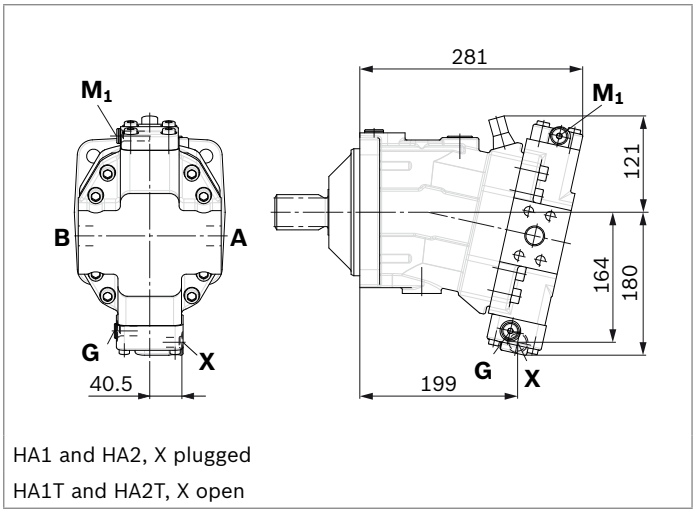
▼ **HZ7** – Hydraulic two-point control, negative control



▼ **EZ7, EZ8** – Electric two-point control, negative control

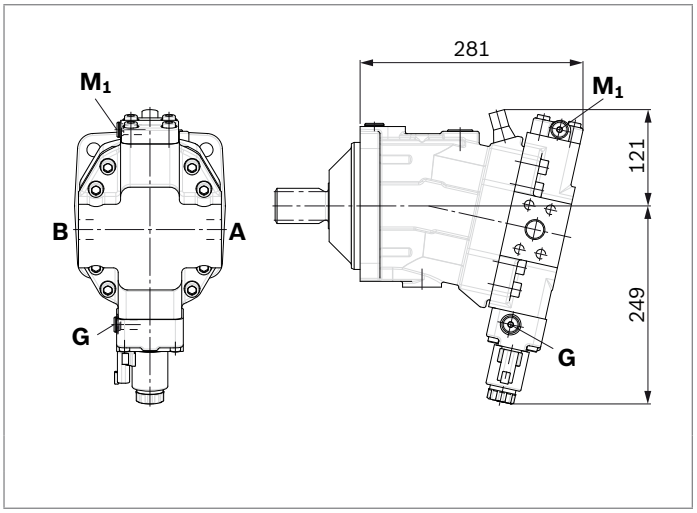


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

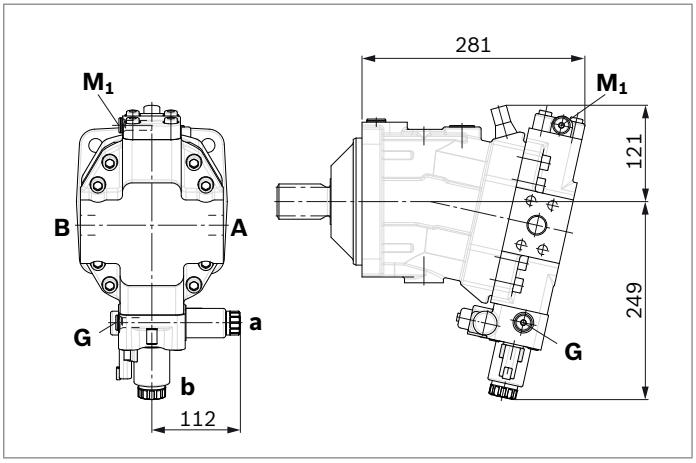


HA1 and HA2, X plugged
HA1T and HA2T, X open

▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point

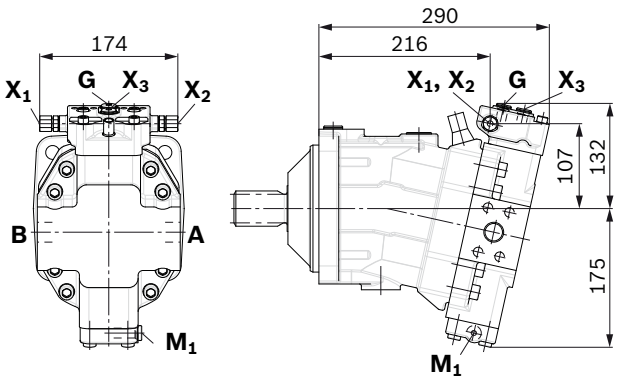


▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



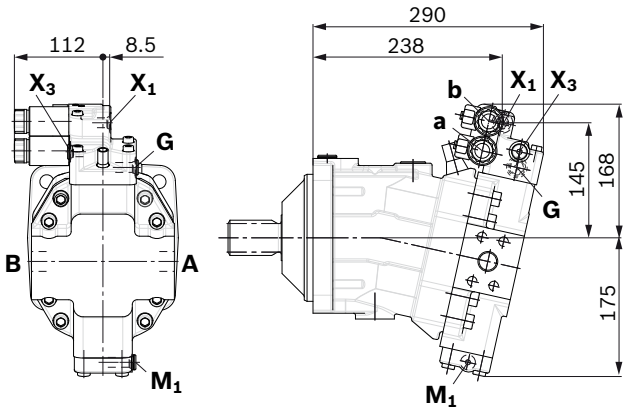
1) Port plate 1 – SAE flange ports A and B at rear

▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X_1, **X_2** pipe fitting SDSC – L8×M12 – F according to ISO 8434-1
Use assembled fitting!

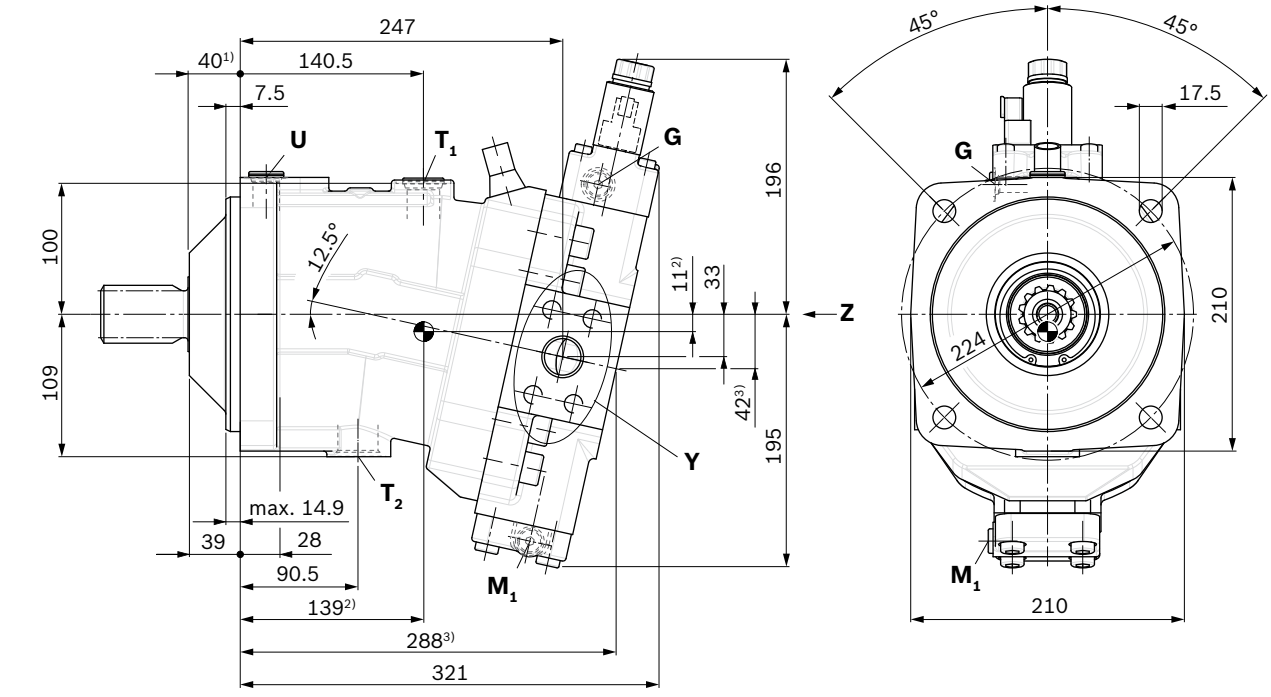
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\,max}$ circuit

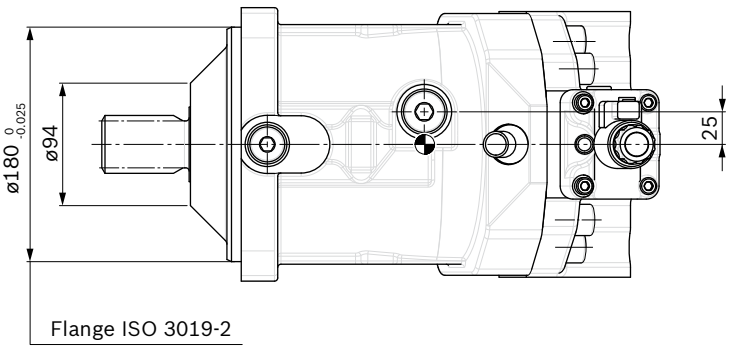


Dimensions size 150

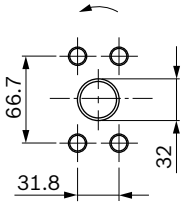
EP5, EP6 – Proportional electric control, negative control

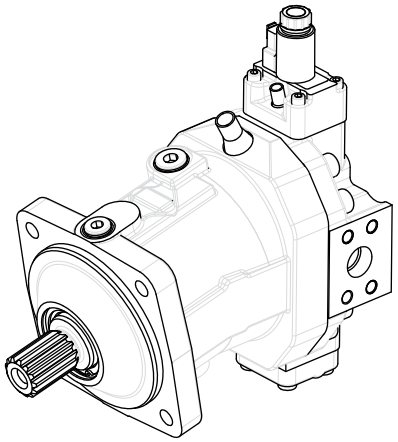
Port plate 2 — SAE flange ports A and B at side, opposite





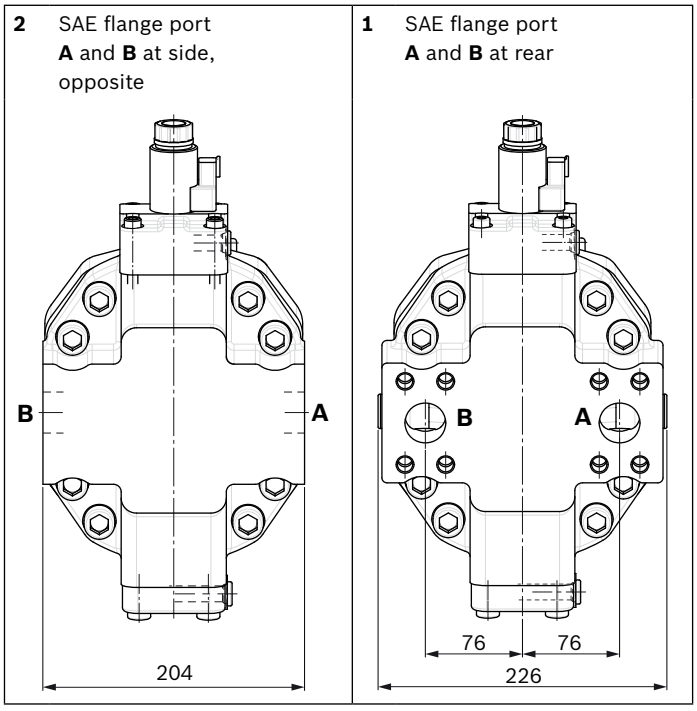
View Y





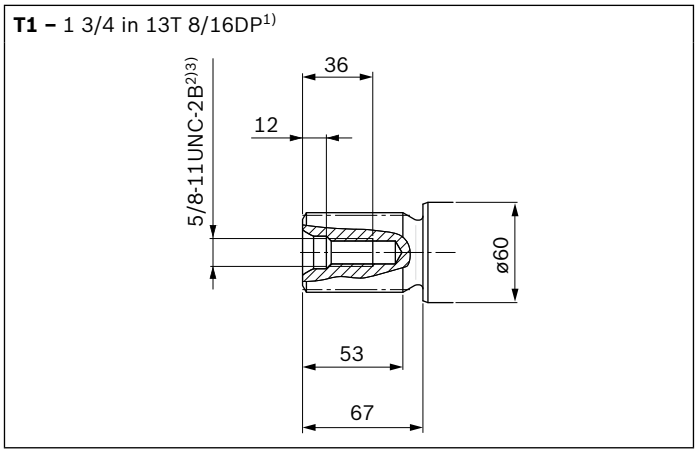
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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



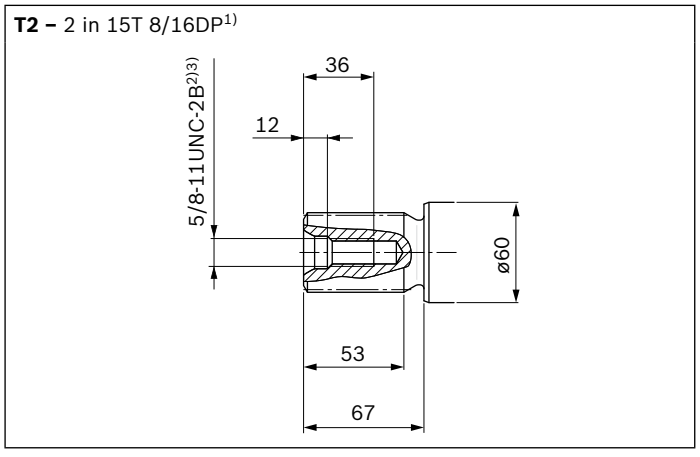
▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/16DP[1)]



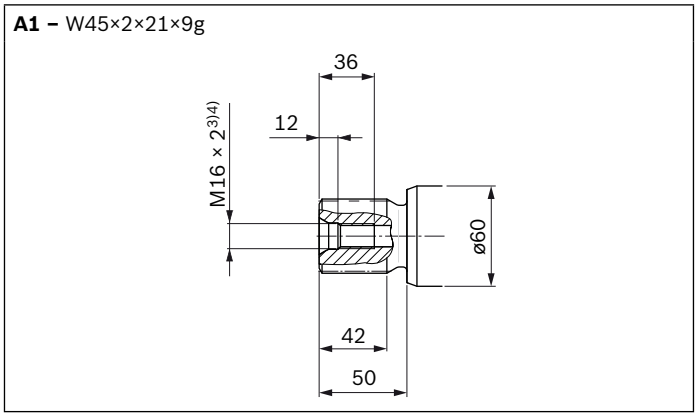
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9g

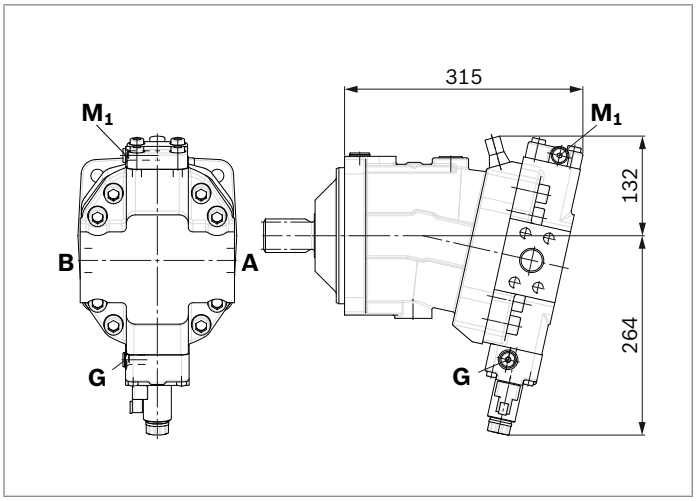


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

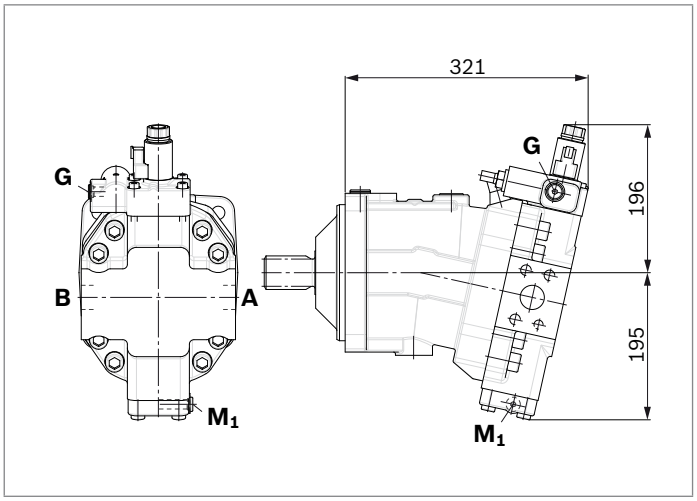
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

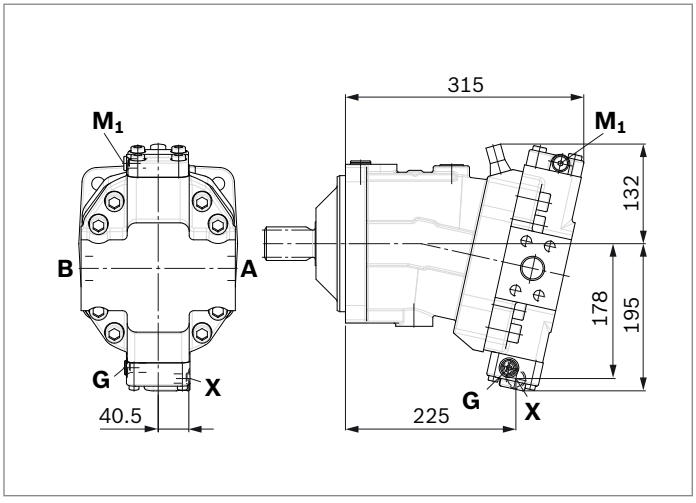
▼ **EP1, EP2** – Electric proportional control, positive control



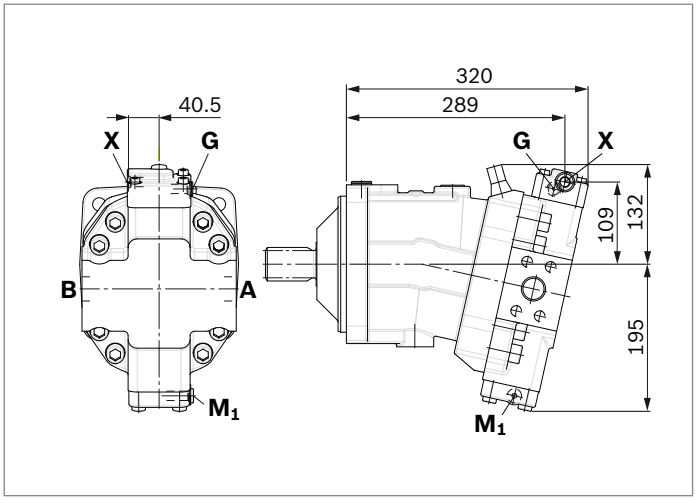
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



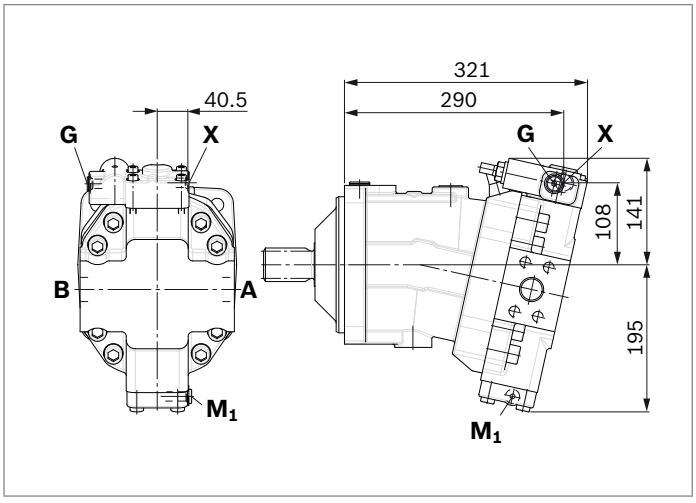
▼ **HP1, HP2** – Hydraulic proportional control, positive control



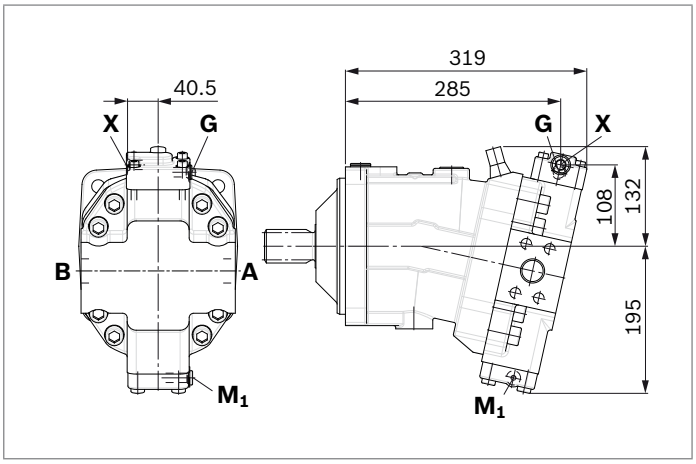
▼ **HP5, HP6** – Hydraulic proportional control, negative control



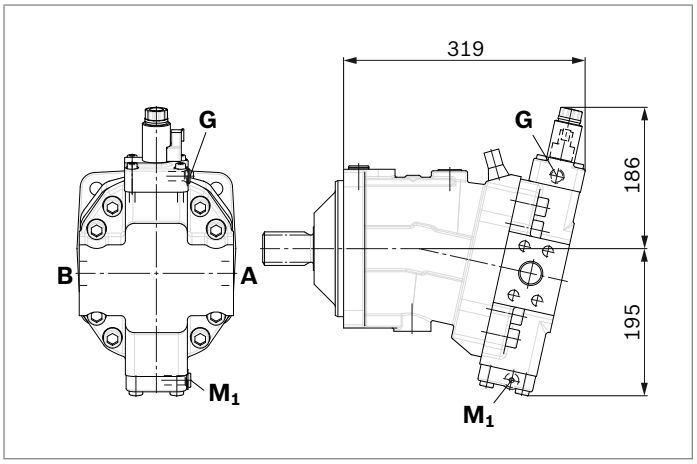
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



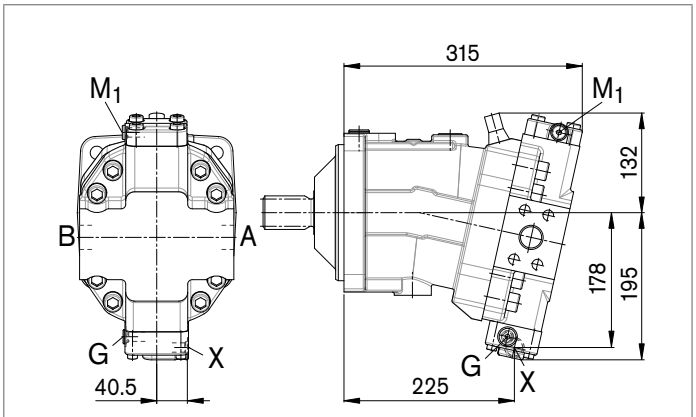
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control

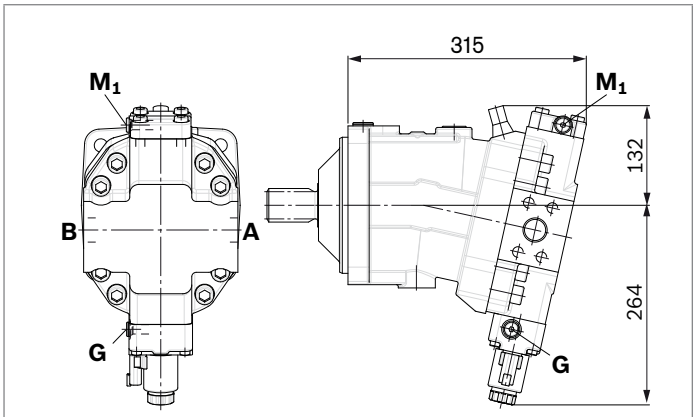


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

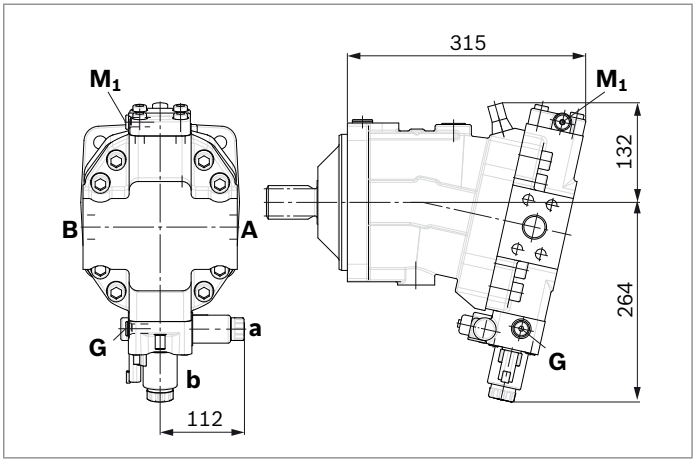


HA1 and HA2, X plugged
HA1T and HA2T, X open

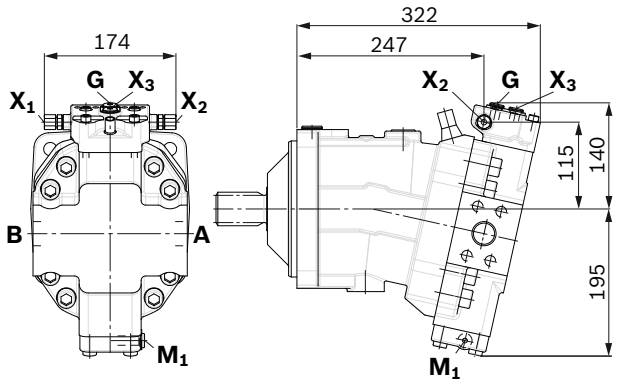
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



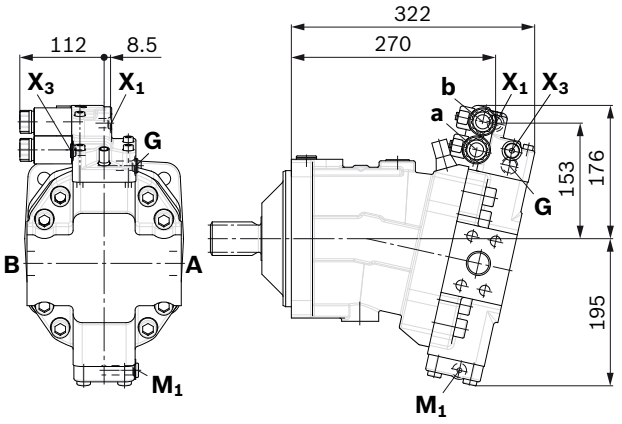
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

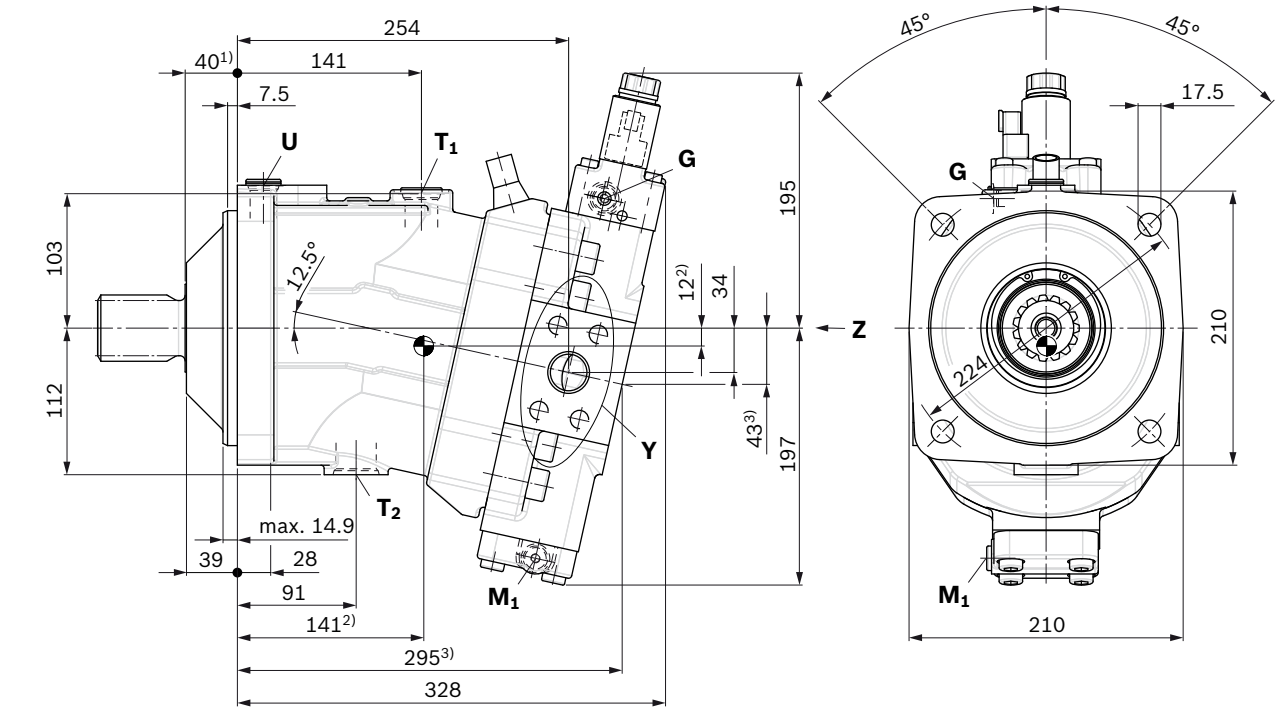
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ circuit

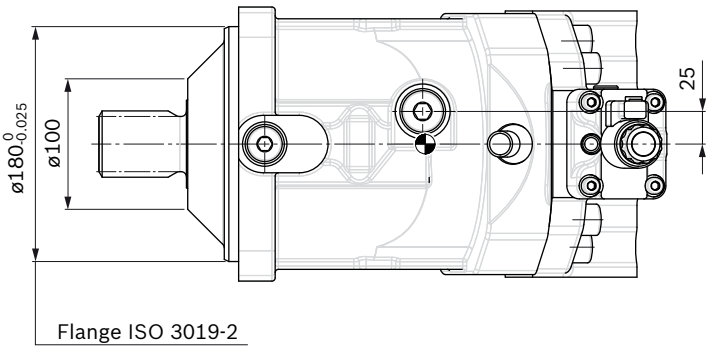


Dimensions size 170

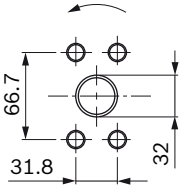
EP5, EP6 – Proportional electric control, negative control

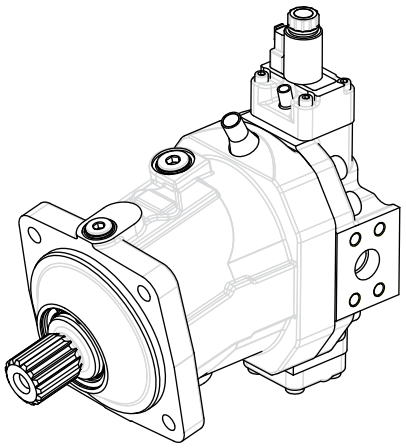
Port plate 2 — SAE flange ports A and B at side, opposite





View Y

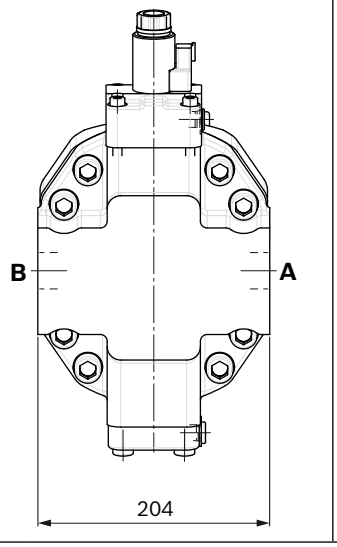




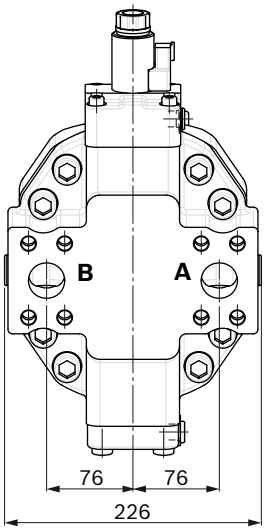
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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

2 SAE flange port
A and **B** at side,
opposite

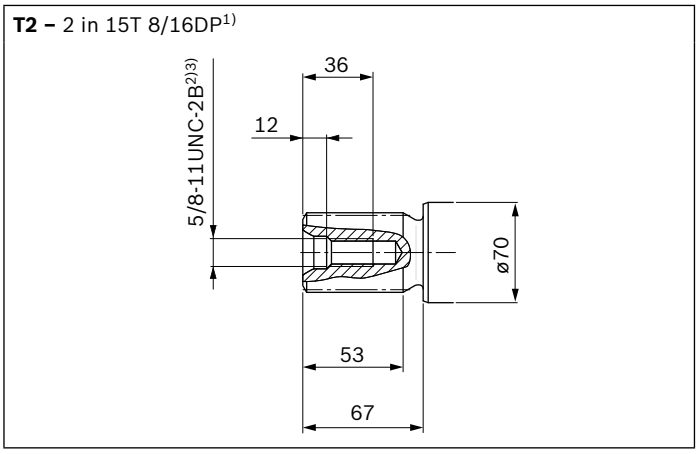


1 SAE flange port
A and **B** at rear



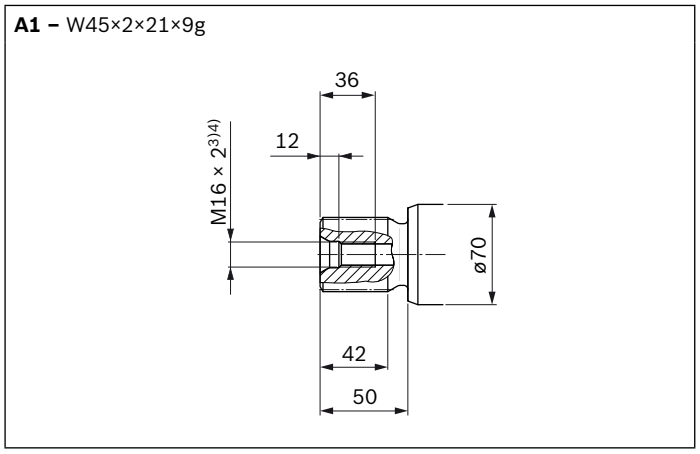
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9g

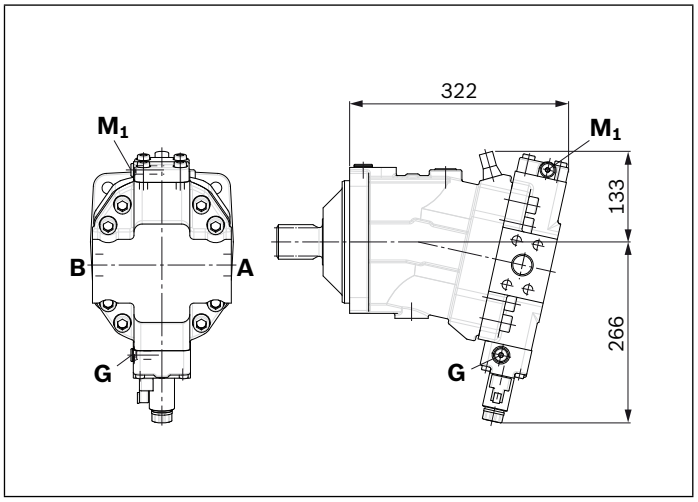


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

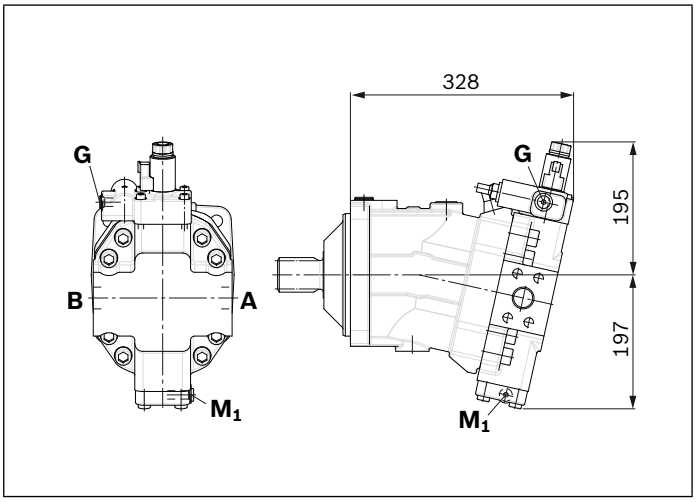
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drain port	ISO 6149[5]	M27 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

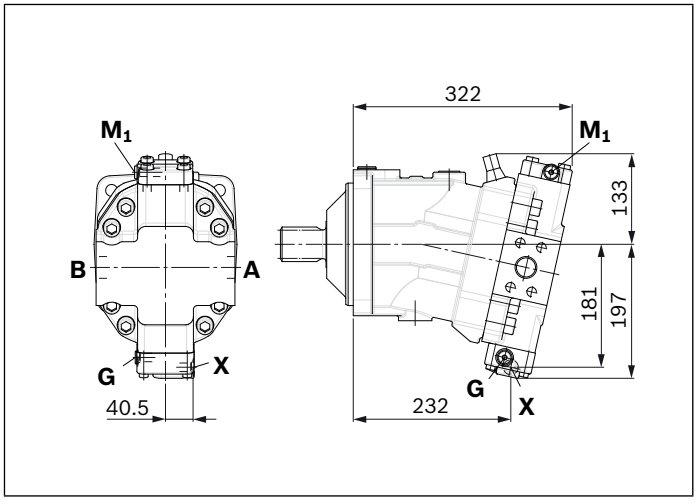
▼ **EP1, EP2** – Electric proportional control, positive control



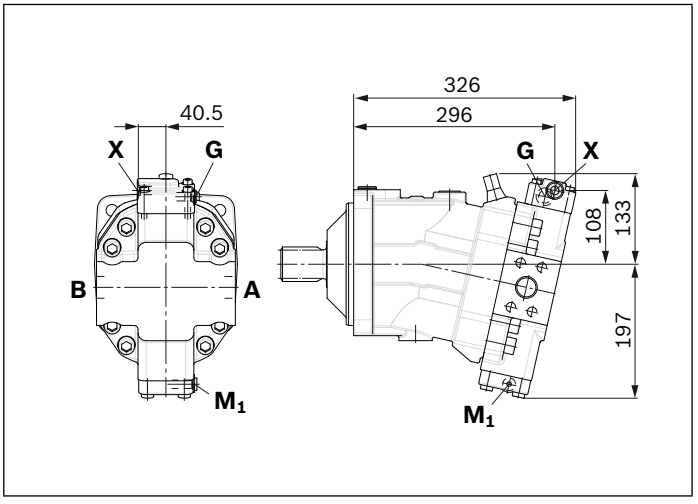
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



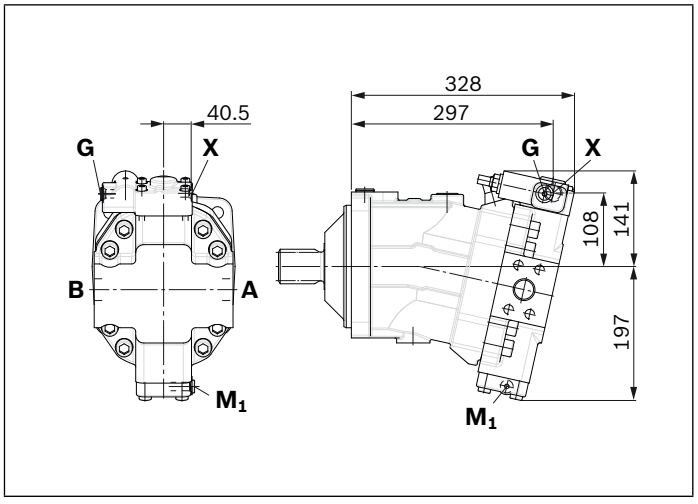
▼ **HP1, HP2** – Hydraulic proportional control, positive control



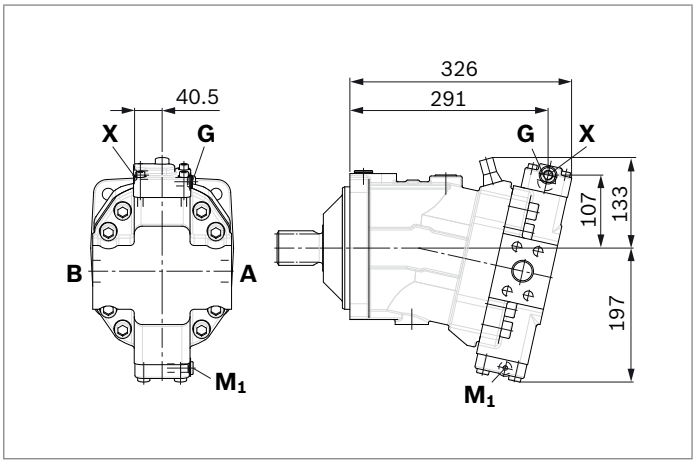
▼ **HP5, HP6** – Hydraulic proportional control, negative control



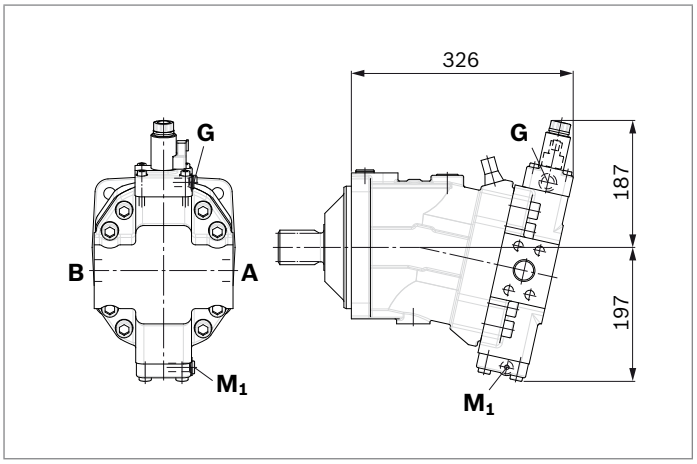
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



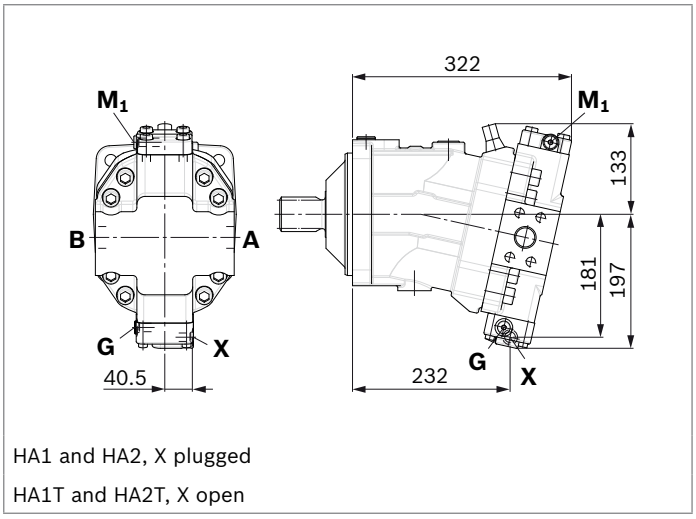
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control



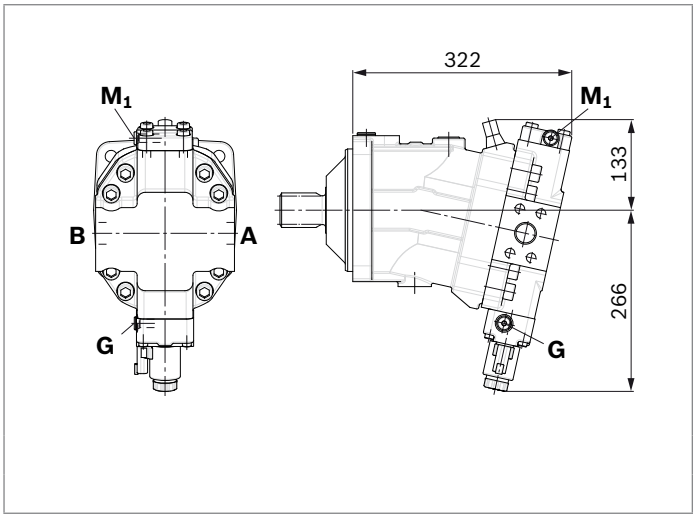
▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional



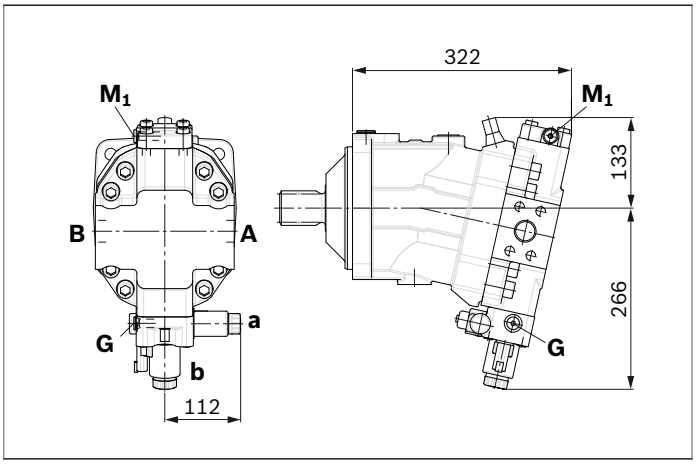
HA1 and HA2, X plugged

HA1T and HA2T, X open

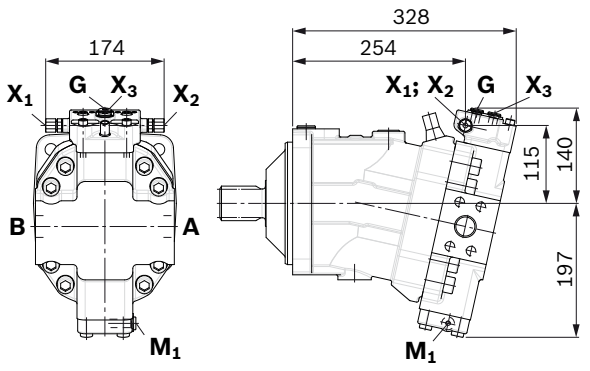
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



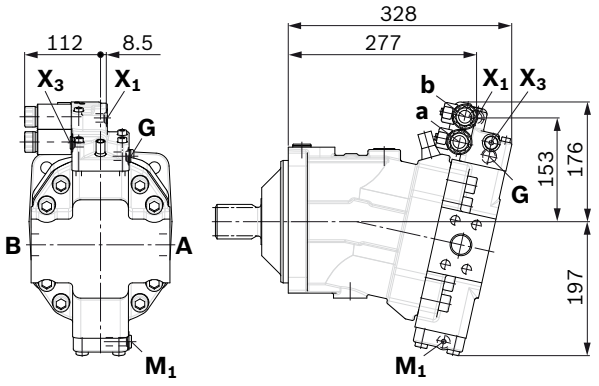
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

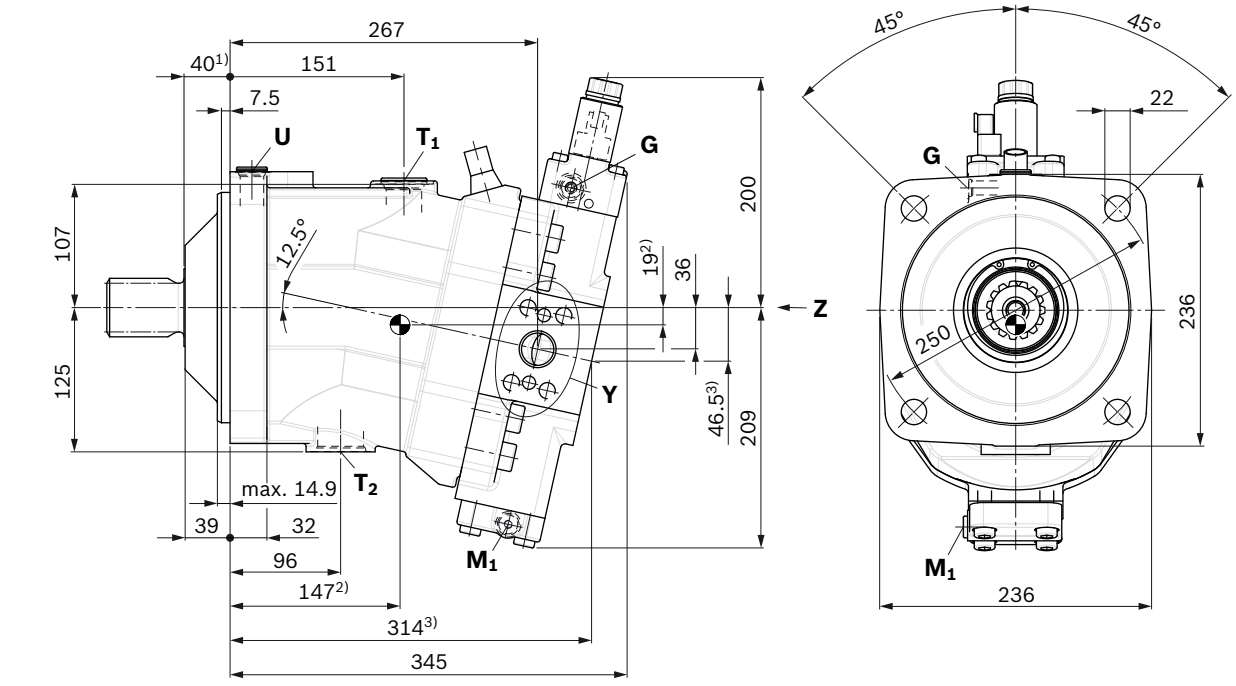
▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ circuit

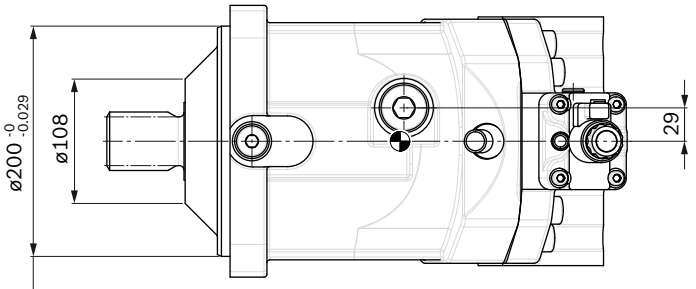


Dimensions size 215

EP5, EP6 – Proportional electric control, negative control

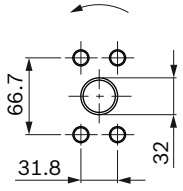
Port plate 2 — SAE flange ports A and B at side, opposite

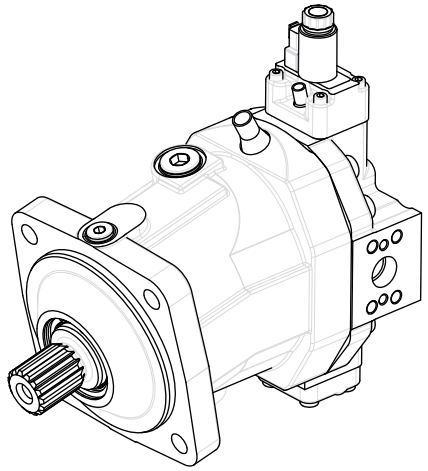




Flange ISO 3019-2

View Y

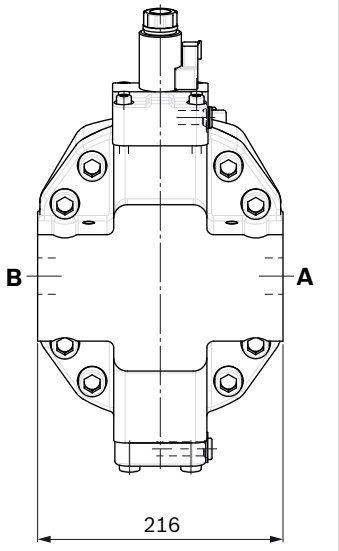




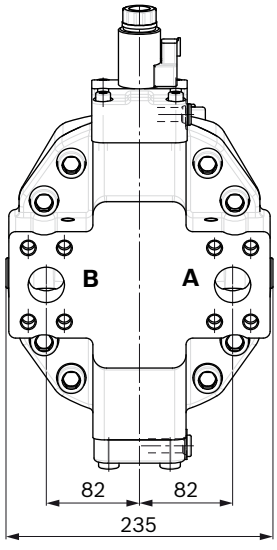
1) To shaft collar
2) Center of gravity
3) Port plate 1 — SAE flange ports A and B at rear

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

2 SAE flange port
A and **B** at side, opposite

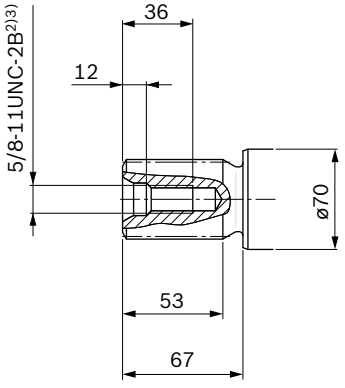


1 SAE flange port
A and **B** at rear



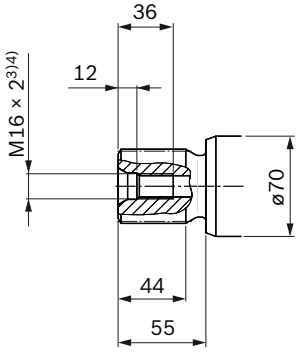
▼ **Splined shaft SAE J744**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A2 – W50×2×24×9g

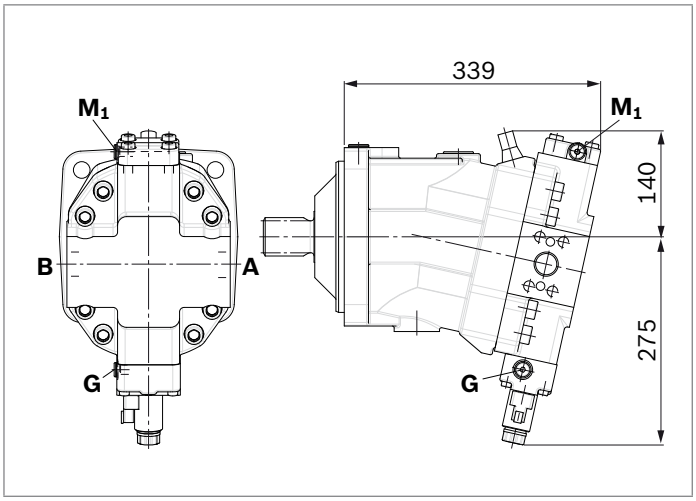


1) Involute spline acc. to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For notes on tightening torques, see instruction manual
4) Center bore according to DIN 332 (thread according to DIN 13)

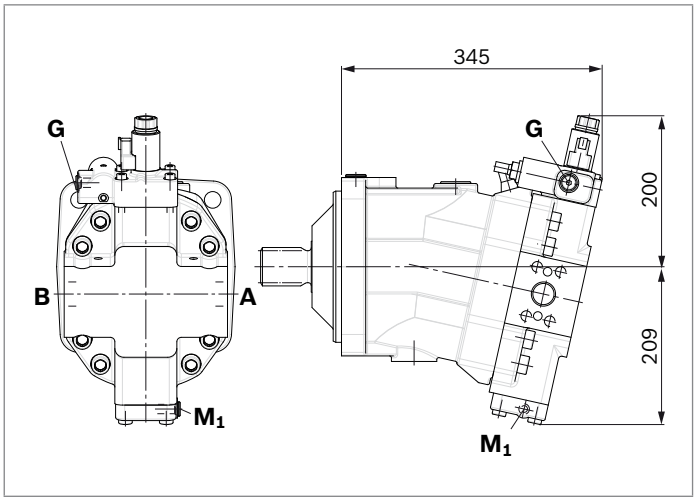
Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A, B	Service line port Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
T_1	Drain port	ISO 6149[5]	M33 × 2; 19 deep	3	X[4]
T_2	Drain port	ISO 6149[5]	M42 × 2; 19.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 × 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 × 1.5; 11.5 deep	100	O
X	Pilot signal (HA1, HA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC-L8×M12-F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 × 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 × 1.5; 11.5 deep	500	X

1) For notes on tightening torques, see instruction manual
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 72).
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

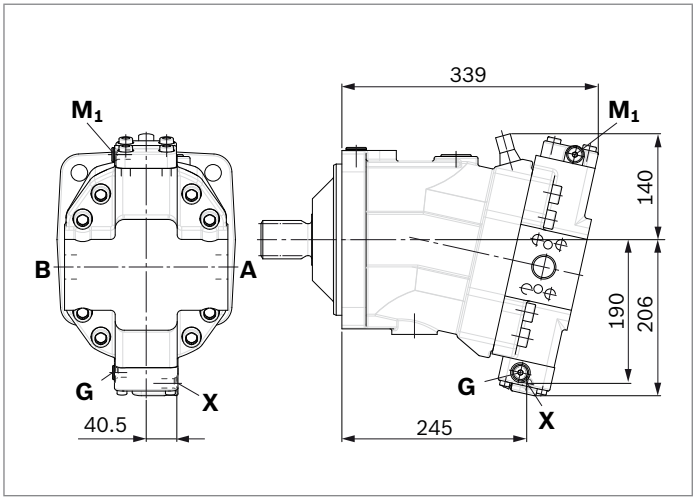
▼ **EP1, EP2** – Electric proportional control, positive control



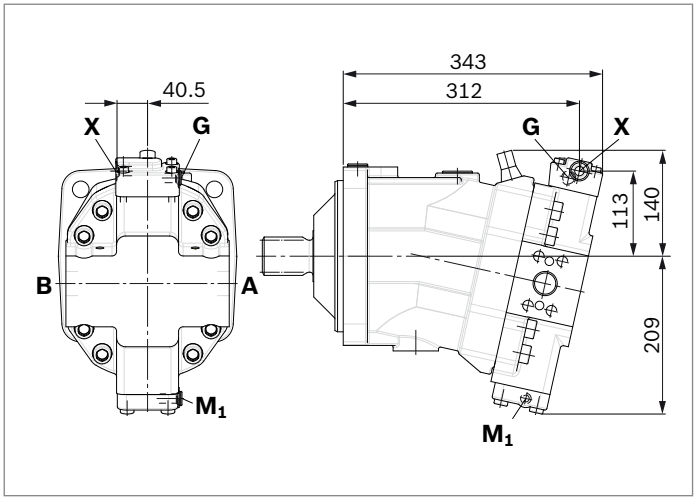
▼ **EP5D1, EP6D1** – Electric proportional control, negative control, with pressure control, fixed



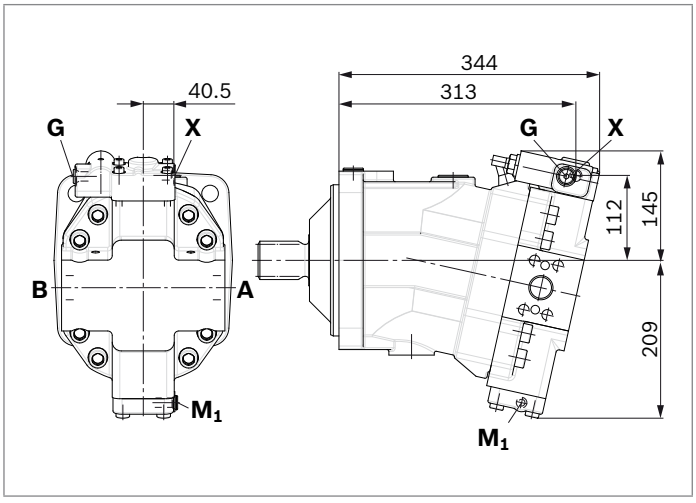
▼ **HP1, HP2** – Hydraulic proportional control, positive control



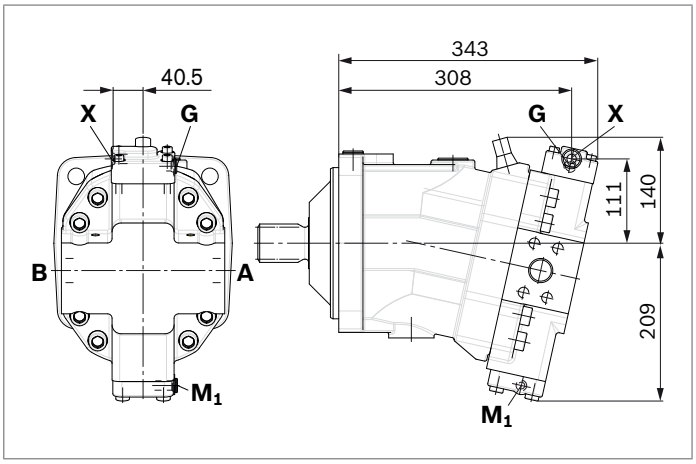
▼ **HP5, HP6** – Hydraulic proportional control, negative control



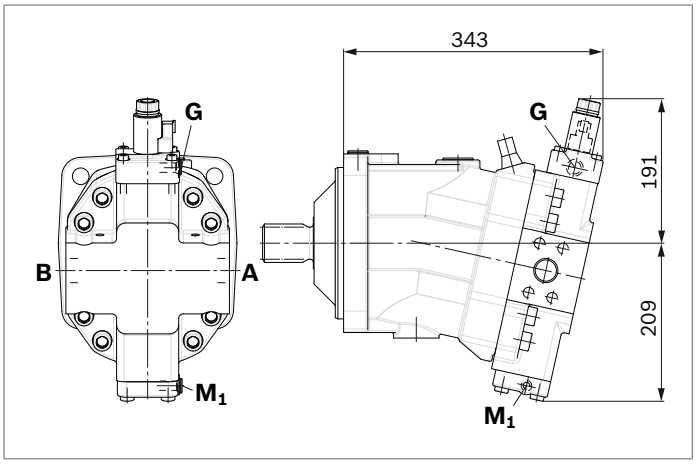
▼ **HP5D1, HP6D1** – Hydraulic proportional control, negative control, with pressure control, fixed



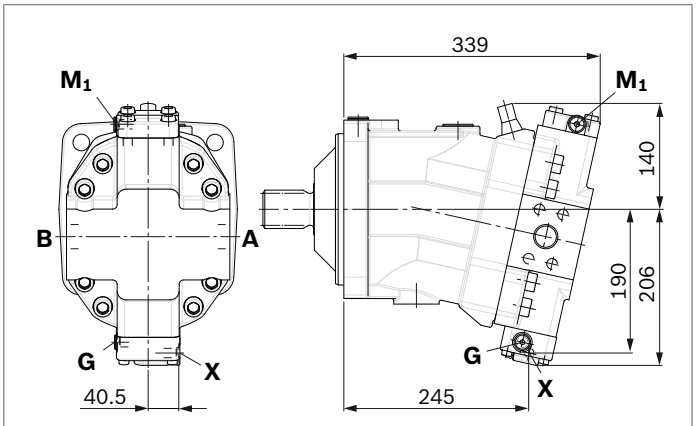
▼ **HZ5** – Hydraulic two-point control, negative control



▼ **EZ5, EZ6** – Electric two-point control, negative control

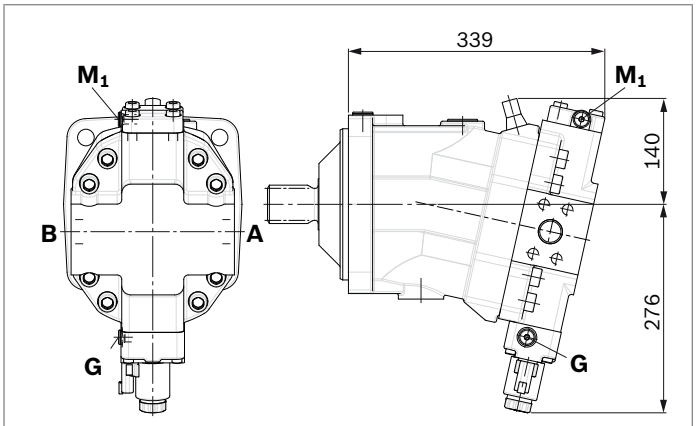


▼ **HA1, HA2 / HA1T3, HA2T3** – Automatic high-pressure-related control, positive control, with override hydraulic remote controlled, proportional

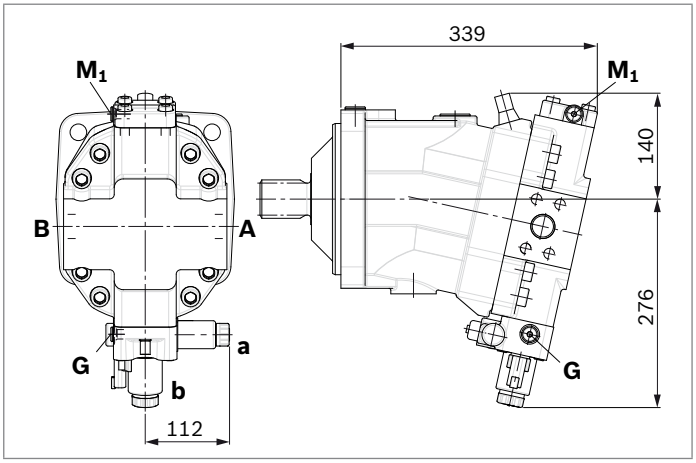


HA1 and HA2, X plugged
HA1T and HA2T, X open

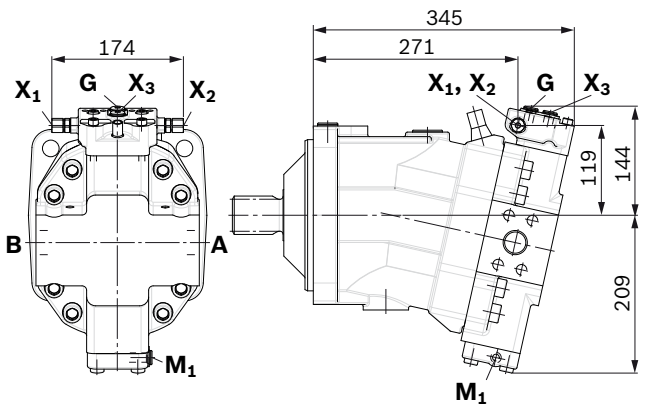
▼ **HA1U1, HA2U2** – Automatic high-pressure-related control, positive control, with override, electric, two-point



▼ **HA1R1, HA2R2** – Automatic high-pressure-related control, positive control, with override, electric and travel direction valve, electric



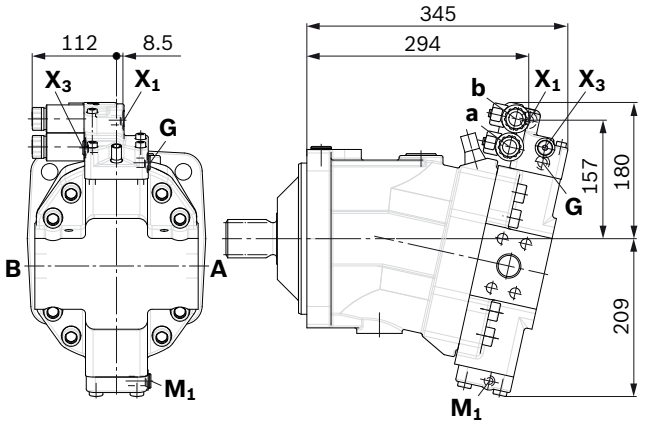
▼ **DA0** – Automatic speed-related control, negative control, with hydraulic travel direction valve



X$_1$, **X**$_2$ pipe fitting SDSC – L8×M12 – F according to ISO 8434-1

Use assembled fitting!

▼ **DA1, DA2** – Automatic speed-related control, negative control, with electric travel direction valve and electric $V_{g\ max}$ circuit



Connector for solenoids

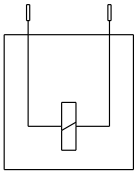
DEUTSCH DT04-2P-EP04

Molded connector, 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**

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).

Note

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

The procedure can be taken from the instruction manual.

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 leakage. 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 adjusting the primary valve)

- Sizes 60 to 215, fixed setting 16 bar

Switching pressure of flushing spool Δp

- Sizes 60 to 115 (no flushing valve) 8±1 bar
- Sizes 115 to 215 (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 information is based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 25 bar and ν = 10 mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 60 to 115

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

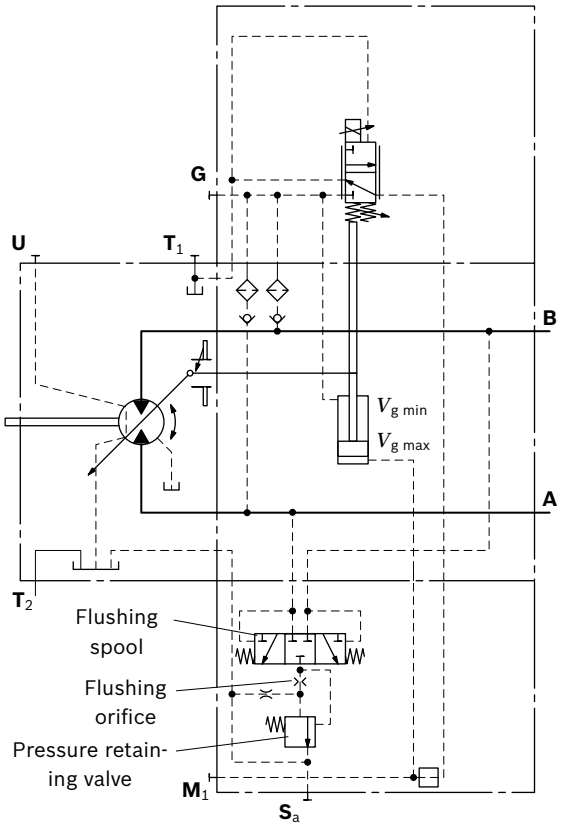
Medium flushing valve for size 115

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909431310	2.8	20	H
R909435172	3.5	25	J
R909449967	5.0	30	K

Large flushing valve for sizes 150 to 215

Material number of orifice	ø [mm]	q_v [l/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	17	G
R909431310	2.8	20	H
R902138235	3.1	25	J
R909435172	3.5	30	K
R909436622	4.0	35	L
R909449967	5.0	40	M

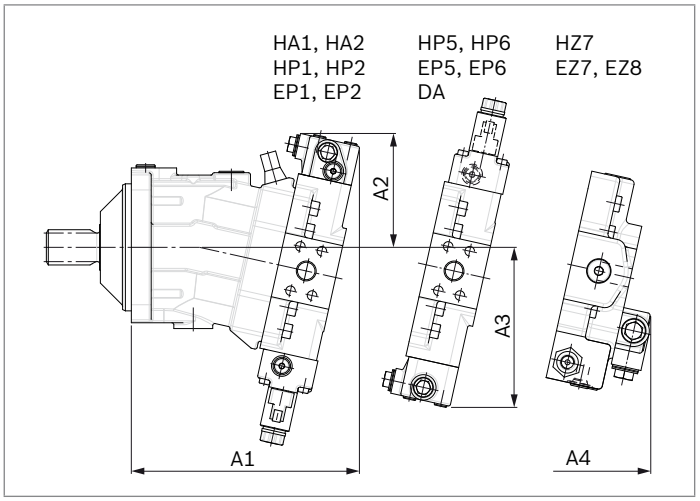
▼ **Schematic EP**



Notes

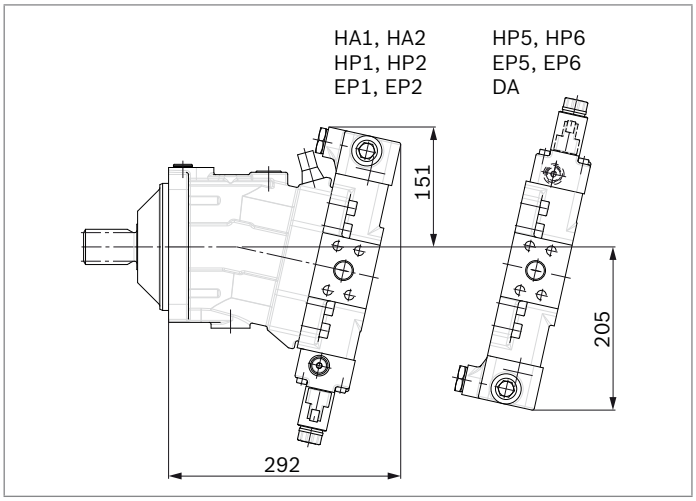
- Port **S**a only for sizes 150 to 215
- For a flushing flow greater than 35 l /min, it is recommended that port **S**a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

▼ Dimensions of sizes 60 to 115 (small flushing valve)

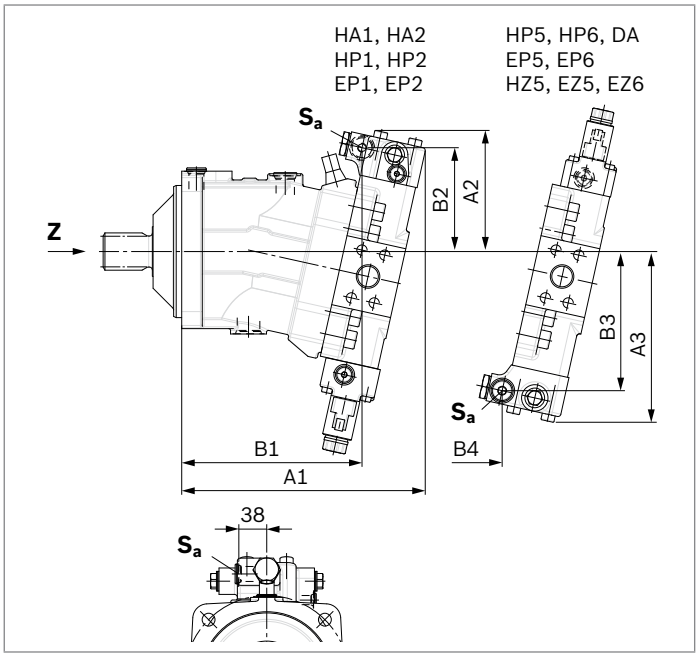


NG	A1	A2	A3	A4
60	245	137	183	236
85	273	142	194	254
115	287	143	202	269

▼ Dimensions of size 115 (medium flushing valve)



▼ Dimensions for sizes 115 to 215 (large flushing valve)



NG	A1	B1	A2	B2	A3	B3	B4	Sa[1)]
150	325	239	165	142	230	187	166	M22 × 1.5; 15.5 deep
170	332	246	165	142	233	190	172	M22 × 1.5; 15.5 deep
215	349	263	172	148	244	201	185	M22 × 1.5; 15.5 deep

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

Counterbalance valve BVD and BVE

Function

Counterbalance valves for travel drives and winches operations are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if, during braking, when driving 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 level specified for the relevant counterbalance valve, the counterbalance valve piston moves into the closed position.

The cross-sectional area of the counterbalance valve return duct is thenreduced, 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 is again as it should be for the given inlet flow.

Notes

- BVD available for sizes 60 to 215 and BVE available for sizes 115 to 215.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set.
  Ordering example: A6VM085HA1T30004A/71MWV0N4S 97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, control systems 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 parking brake.
- Observe the detailed notes on the BVD counterbalance valve in data sheet 95522 and on the BVE counterbalance valve in data sheet 95525!
- For the design of the brake release valve, we must know for the mechanical parking brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum travel (brake closed) and maximum travel (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

Permissible inlet flow or pressure when using DBV and BVD/BVE

Motor	Without valve		Limited values when using DBV and BVD/BVE							
			DBV[1]				BVD[2]/BVE[3]			
NG	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
60	450/500	276	22	350/420	240	7	20 (BVD)	350/420	220	7W
85		332								
115		410	32		400					
115		410				8	25 (BVD/BVE)		320	8W
150		494								
170		533								
215		628	On request							

1) Pressure-relief valve
2) Counterbalance valve, double-acting
3) Counterbalance valve, one-sided

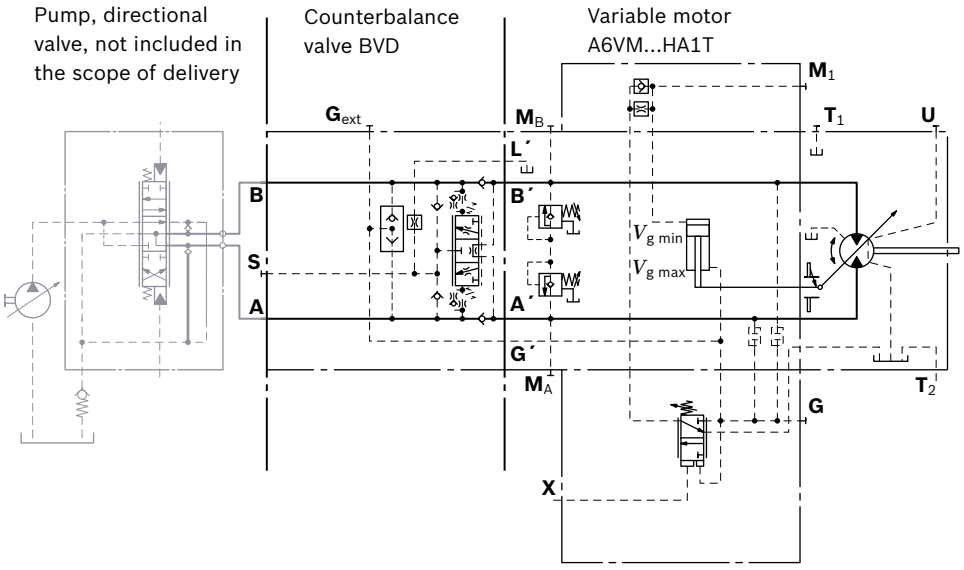
Counterbalance valve for travel drive BVD...F

Application option

- Travel drive for wheeled excavators (BVD and BVE)

▼ **Example schematic for travel drive on wheeled excavators**

A6VM085HA1T30004A/71MWV0N4S97W0-0 + BVD20F27S/41B–V03K16D0400S12



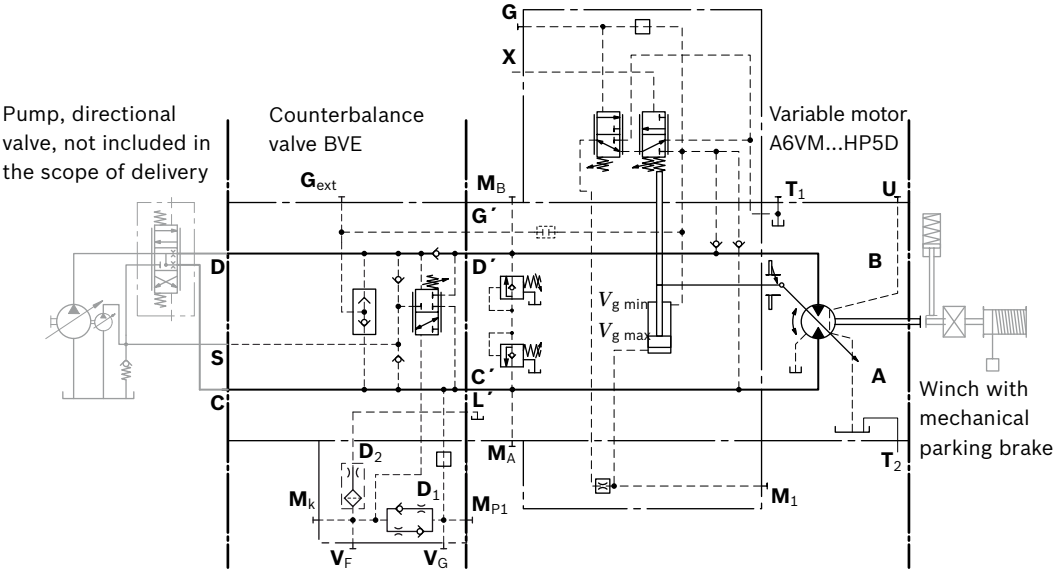
Counterbalance valve for winches and track drives BVD...W and BVE

Application option

- Winch drives in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

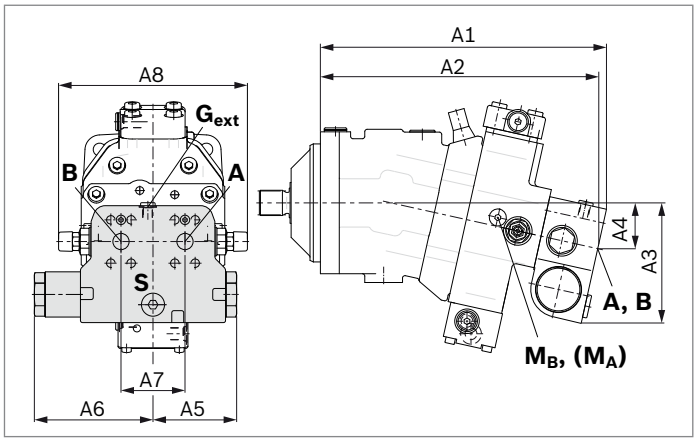
▼ **Example schematic for winch drive in cranes**

A6VM085HP5D10001A/71MWV0N4S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0

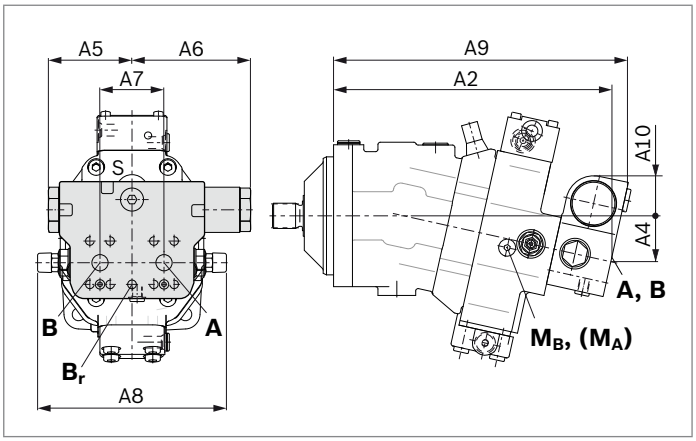


Dimensions

▼ **A6VM...HA, HP1, HP2 and EP1, EP2**



▼ **A6VM...HP5, HP6 and EP5, EP6**[1)]



A6VM	Counterbalance valve											
NG...plate	Type	Ports	Dimensions									
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	311	302	143	50	98	139	75	222	326	50
85...7	BVD20...27	1 in	340	331	148	55	98	139	75	222	355	46
115...7	BVD20...28	1 in	362	353	152	59	98	139	84	234	377	41
115...8	BVD25...38	1 1/4 in	380	370	165	63	120.5	175	84	238	395	56
150...8	BVD25...38	1 1/4 in	411	401	168	67	120.5	175	84	238	426	53
170...8	BVD25...38	1 1/4 in	417	407	170	68	120.5	175	84	238	432	51
215...8	BVD25...38	1 1/4 in	448	438	176	74	120.5	175	84	299	463	46
115...8	BVE25...38	1 1/4 in	380	370	171	63	137	214	84	238	397	63
150...8	BVE25...38	1 1/4 in	411	401	175	67	137	214	84	238	423	59
170...8	BVE25...38	1 1/4 in	417	407	176	68	137	214	84	238	432	59
215...8	BVE25...38	1 1/4 in	448	438	182	74	137	214	84	299	463	52

Ports		Version	A6VM plate	Standard	Size[2)]	$P_{max\ perm}$ [bar][3)]	Status[5)]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 × 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 × 2; 16 deep	30	X
B_r	Brake release, reduced high pressure	L	7	DIN 3852[4)]	M12 × 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 × 1.5; 12 deep	30	O
G_{ext}	Brake release, high pressure	S		DIN 3852[4)]	M12 × 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 × 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations **A** and **B** on the counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!

2) For notes on tightening torques, see instruction manual

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)

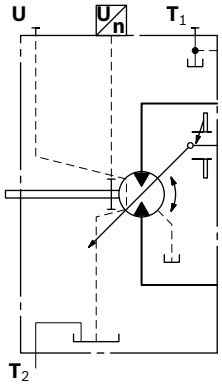
Mounting the counterbalance valve

When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport lock). 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 final mounting of the counterbalance valve on the motor is done with screw fitting of the SAE flange.
The screws to be used and the procedure mounting can be found in the instruction manual.

Speed sensor

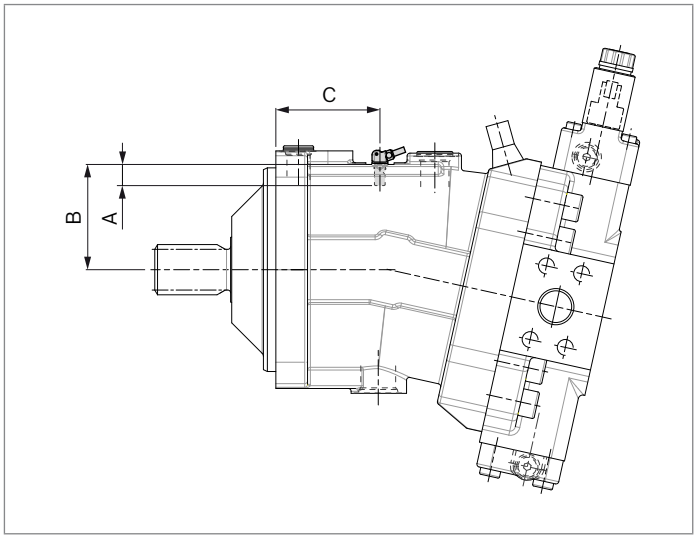
Version A6VM...U ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
A signal proportional to motor speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor registers the speed and direction of rotation.
Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (95132 for DSM, 95133 for DSA).
The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.
We recommend ordering the A6VM variable motor complete with mounted sensor.

▼ **Schematic EP**



▼ **Dimensions**

"V" design with mounted speed sensor



Size		**60**	**85**	**115**	**150**	**170**	**215**
Number of teeth		54	58	67	72	75	80
A	Insertion depth (tolerance -0.25)	18.4	18.4	18.4	18.4	18.4	18.4
B	Contact surface	75	79	88	93	96	101
C		66.2	75.2	77.2	91.2	91.7	95.2

Setting range for displacement

	60				85				115			
	$V_{g\,max}$ (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	62.0	62.0	0.0	15.0	85.2	85.2	0.0	31.5	115.6	115.6	0.0	24.0
	without screw		M10 × 60 R909154690		without screw		M12 × 70 R909085976		without screw		M12 × 70 R909085976	
B	62.0	62.0	> 15.0	30.5	85.2	85.2	> 31.5	52.0	115.6	115.6	> 24.0	47.5
	without screw		M10 × 70 R909153779		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
C	62.0	62.0	> 30.5	43.0	85.2	85.2	> 52.0	59.0	115.6	115.6	> 47.5	71.0
	without screw		M10 × 80 R909154058		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
D	x		x		x		x		115.6	115.6	> 71.0	80.0
									without screw		M12 × 100 R909153975	
E	< 62.0	47.5	0.0	15.0	< 85.2	55.5	0.0	31.5	< 115.6	93.5	0.0	24.0
	M10 × 60 R909154690		M10 × 60 R909154690		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976		M12 × 70 R909085976	
F	< 62.0	47.5	> 15.0	30.5	< 85.2	55.5	> 31.5	52.0	< 115.6	93.5	> 24.0	47.5
	M10 × 60 R909154690		M10 × 70 R909153779		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909085976	
G	< 62.0	47.5	> 30.5	43.0	< 85.2	55.5	> 52.0	59.0	< 115.6	93.5	> 47.5	71
	M10 × 60 R909154690		M10 × 80 R909154058		M12 × 70 R909085976		M12 × 90 R909154041		M12 × 70 R909085976		M12 × 90 R909154041	
H	x		x		x		×		< 115.6	93.5	> 71.0	80.0
									M12 × 70 R909085976		M12 × 100 R909153975	
J	< 47.5	33.0	0.0	15.0	< 55.5	35.0	0.0	31.5	< 93.5	71.0	0.0	24.0
	M10 × 70 R909153779		M10 × 60 R909154690		M12 × 80 R909153075		M12 × 70 R909085976		M12 × 80 R909153075		M12 × 70 R909085976	
K	< 47.5	33.0	> 15.0	30.5	< 55.5	35.0	> 31.5	52.0	< 93.5	71.0	> 24.0	47.5
	M10 × 70 R909153779		M10 × 70 R909153779		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
L	< 47.5	33.0	> 30.5	43.0	< 55.5	35.0	> 52.0	59.0	< 93.5	71.0	> 47.5	71.0
	M10 × 70 R909153779		M10 × 80 R909154058		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
M	x		x		x		x		< 93.5	71.0	> 71.0	80.0
									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.

	150				170				215			
	$V_{g\,max}$ (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	152.1	152.1	0.0	44.0	171.8	171.8	0.0	35.0	216.5	216.5	0.0	44.5
	without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075		without screw		M12 × 80 R909153075	
B	152.1	152.1	> 44.0	69.0	171.8	171.8	> 35.0	63.5	216.5	216.5	> 44.5	80.0
	without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041		without screw		M12 × 90 R909154041	
C	152.1	152.1	> 69.0	99.0	171.8	171.8	> 63.5	98.0	216.5	216.5	> 80.0	115.0
	without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975		without screw		M12 × 100 R909153975	
D	152.1	152.1	> 99.0	106.0	171.8	171.8	> 98.0	120.0	216.5	216.5	> 115.0	150.0
	without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212		without screw		M12 × 110 R909154212	
E	< 152.1	111.0	0.0	44.0	< 171.8	139.0	0.0	35.0	< 216.5	175.0	0.0	44.5
	M12 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075		M10 × 80 R909153075		M12 × 80 R909153075		M12 × 80 R909153075	
F	< 152.1	111.0	> 44.0	69.0	< 171.8	139.0	> 35.0	63.5	< 216.5	175.0	> 44.5	80.0
	M12 × 80 R909153075		M12 × 90 R909085976		M12 × 80 R909153075		M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041	
G	< 152.1	111.0	> 69.0	99.0	< 171.8	139.0	> 63.5	98.0	< 216.5	175.0	> 80.0	115.0
	M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975		M12 × 80 R909153075		M12 × 100 R909153975	
H	< 152.1	111.0	> 99.0	106.0	< 171.8	139.0	> 98.0	120.0	< 216.5	175.0	> 115.0	150.0
	M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212		M12 × 80 R909153075		M12 × 110 R909154212	
J	< 111.0	87.0	0.0	44.0	< 139.0	112.0	0.0	35.0	< 175.0	141.0	0.0	44.5
	M12 × 90 R909154041		M12 × 80 R909153075		M12 × 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 111.0	87.0	> 44.0	69.0	< 139.0	112.0	> 35.0	63.5	< 175.0	141.0	> 44.5	80.0
	M12 × 90 R909154041		M12 × 90 R909154041		M12 x 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041		M12 × 90 R909154041	
L	< 111.0	87.0	> 69.0	99.0	< 139.0	112.0	> 63.5	98.0	< 175.0	141.0	> 80.0	115.0
	M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975		M12 × 90 R909154041		M12 × 100 R909153975	
M	< 111.0	87.0	> 99.0	106.0	< 139.0	112.0	> 98.0	120.0	< 175.0	141.0	> 115.0	150.0
	M12 × 90 R909154041		M12 × 110 R909154212		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

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 fluid from the axial piston unit may drain back to the reservoir via the hydraulic lines.
Particularly in the installation position "drive shaft upwards" filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.
The leakage in the motor housing must be directed to the reservoir via the highest available drain port (**T_1**, **T_2**).
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.

Note

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

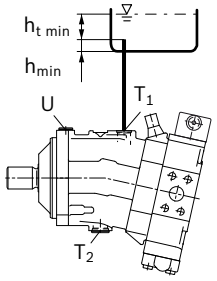
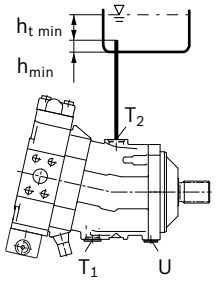
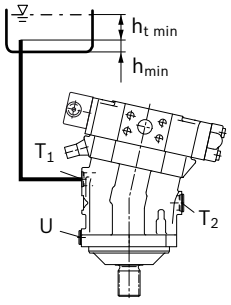
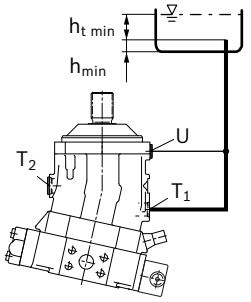
Key	
U	Bearing flushing / air bleed port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

Installation position

See examples **1** to **8** below.
Additional installation positions are available upon request.
Recommended installation position: **1** and **2**

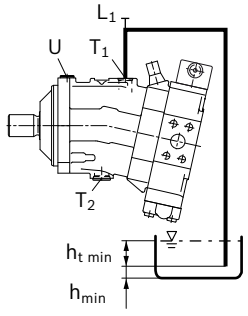
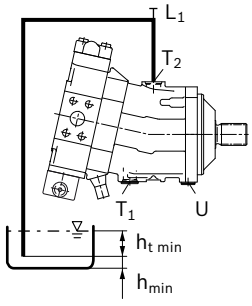
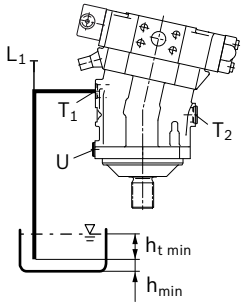
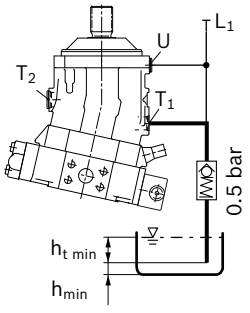
Below-reservoir installation (standard)

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

Installation position	Air bleed	Filling
1 		**T_1**
2 		**T_2**
3 		**T_1**
4 	**U**	**T_1**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.
Recommendation for installation position 8 (drive shaft upward):
A check valve in the drain line (cracking pressure 0.5 bar) can prevent draining of the motor housing.

Installation position	Air bleed	Filling
5 	**U** (**L1**)	**T1** (**L1**)
6 	**L1**	**T2** (**L1**)
7 	**L1**	**T1** (**L1**)
8 	**U**	**T1** (**L1**)

Note

Port **L1** is not part of the motor and can be made available by the customer for straightforward filling and air bleeding.

Project planning note

- The motor A6VM 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 person.
- 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, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
- For safety reasons, control systems 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 (operating pressure, fluid temperature), the characteristic curve may shift.
- Not all variants of the product are approved for use in safety functions 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.
- 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 can only be used to accommodate hydraulic lines.

Safety instructions

- 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).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely minimize 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.
- If the axial piston motor is used in winch drives, make sure that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is subjected to external overload (e.g. by exceeding the maximum permissible rotational speeds when lifting anchor while the ship is in motion), this could cause damage to the rotary group and in unfavorable cases to the axial piston motor bursting. If necessary, additional measures up to an including encapsulation are to be implemented by the machine/system manufacturer

Bosch Rexroth AG
Mobile Applications
Glockeraustraße 4
89275 Elchingen, Germany
Tel.: +49-7308-82-0
info.ma@boschrexroth.de
www.boschrexroth.com

Bosch Rexroth AG
Mobile Applications
Glockeraustraße 4
89275 Elchingen, Germany
Tel.: +49-7308-82-0
info.ma@boschrexroth.de
www.boschrexroth.com