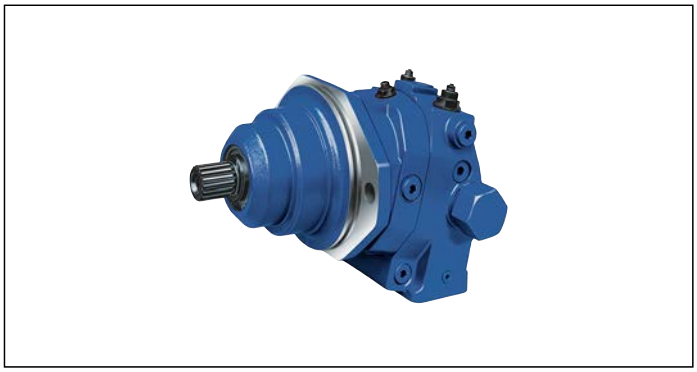
RE 91606/2020-12-15
Replaces: 06.2012

rexroth
A Bosch Company

Variable plug-in motor A6VE Series 63



- High pressure motor for integration in mechanical gearbox
- Applications: Crawler excavators
- Sizes 28 and 250
- Nominal pressure 400 bar (size 28)
- Nominal pressure 350 bar (size 250)
- Maximum pressure 450 bar (size 28)
- Maximum pressure 400 bar (size 250)
- Open and closed circuits

Features

- Variable plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- Far-reaching integration in mechanical gears due to recessed mounting flange located in the center of the case (extremely space-saving construction)
- Easy to install, simple to plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use preferably in mobile applications
- The displacement can be continuously changed from $V_{g\,max}$ to $V_{g\,min}$ = 0.
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed depends 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 sides and with increasing displacement.

Contents

Type code

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

Axial piston unit

01	Bent-axis design, variable	**A6V**

Operating mode

02	Plug-in motor	**E**

Size (NG)

03	Geometric displacement, see "Technical data" on page 7	**28**	**250**

Control device				**28**	**250**	
04	Proportional control, hydraulic		Δp_{St} = 10 bar	●	●	**HD1**
			Δp_{St} = 25 bar	●	●	**HD2**
	Proportional control, electric		U = 12 V	●	●	**EP1**
			U = 24 V	●	●	**EP2**
	Two-point control hydraulic			–	●	**HZ**
				●	–	**HZ1**
	Two-point control electric		U = 12 V	●	●	**EZ1**
			U = 24 V	●	●	**EZ2**
	Automatic control high-pressure-dependent	with minimum pressure increase	Δp ≤ approx. 10 bar	●	●	**HA1**
		with pressure increase	Δp = 100 bar	●	●	**HA2**
	Automatic control, speed related p_{St}/p_{HD} = 3/100, hydraulic travel direction valve			–	●	**DA**
	p_{St}/p_{HD} = 5/100, electric travel direction valve + electric $V_{g\,max}$ switching		U = 12 V	●	–	**DA3**

Pressure control (only for HD and EP)		**28 and 250**	
05	Without pressure control/override	●	●	
	Pressure control, fixed setting	●	●	**D**

Pressure control/override		**28 and 250**	
06	Without pressure control/override	●	●	
	Override of the HA1 and HA2 controls, hydraulic remote controlled, proportional	●	●	**T**

Series

07	Series 6, index 3	**63**

Direction of rotation

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

Setting range for displacement[1]			**28**	**250**	
09	$V_{g\,min}$ = 0 to 0.7 $V_{g\,max}$ (without code)		●	–	
	$V_{g\,min}$ = 0 to 0.4 $V_{g\,max}$	$V_{g\,max}$ = $V_{g\,max}$ to 0.8 $V_{g\,max}$	–	●	**1**
	$V_{g\,min}$ > 0.4 $V_{g\,max}$ to 0.8 $V_{g\,max}$	$V_{g\,max}$ = $V_{g\,max}$ to 0.8 $V_{g\,max}$	–	●	**2**

Sealing material		**28**	**250**	
10	FKM (fluoroelastomer) shaft seal	●	●	**V**

Drive shaft		**28**	**250**	
11	Splined shaft DIN 5480	●	–	**A**
		–	●	**Z**

● = Available o = On request – = Not available = Preferred program

1) Please specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... cm³, $V_{g\,max}$ = ... cm³

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

Mounting flange

			28	250	
12	Similar to ISO 3019-2	2-hole	●	–	**L**
		4-hole	–	●	**M**

Working port[2)]

				28	250	
13	SAE working ports **A** and **B** at side, opposite	**02**	**0**	●	●	**020**
			7	●	●	**027**
	Port plate for mounting a counterbalance valve, with 1-stage pressure relief valve (pilot operated)[3)]	**38**	**0**	–	●[4)]	**380**

Valves (see pages 29 to 30)

14	Without	**0**
	Flushing and boost-pressure valve, mounted	**7**
	Mounted counterbalance valve	**8**

Speed sensor (see page 31)

		28	250	
15	Without speed sensor	●	●	**0**
	Prepared for DSA speed sensor	○	●	**U**
	DSA speed sensor angebaut[5)]	○	●	**V**

Connector for solenoids[6)] (see page 28)

		28	250	
16	Without connector (without solenoid, only for hydraulic control) (Size 250 without code)	●	–	**0**
		–	●	
	DEUTSCH - molded connector, 2-pin, without suppressor diode	●	–	**P**
	HIRSCHMANN connector – without suppressor diode (without code)	–	●	

Beginning of control

			28	250	
17	Port plate 02, 38	at $V_{g\,min}$ (standard for HA)	●	●	**A**
		at $V_{g\,max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	**B**

Standard/ special version

18	Standard version (without symbol)	
	Standard version with installation variants, e.g. **T** ports open or closed, contrary to standard	**-Y**
	Special version	**-S**

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

Notice

- ▶ Note the project planning notes on page 34!
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.
- ▶ Please note that not all type code combinations are available although the individual functions are marked as being available.

2) Fastening thread, metric.
3) Only possible in combination with HD, EP and HA control
4) Counterbalance valve MHB32, please contact us.
5) Specify the type code separately for sensor in accordance with data sheet 95133 (DSA) and observe the requirements for the electronics.
6) Connectors for other electric components may deviate.

Hydraulic fluids

The axial piston unit is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluid selection, behavior during operation as well as disposal and environmental protection should be taken from the following data sheets before the start of project planning:

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

Selection of hydraulic fluid

Bosch Rexroth evaluates hydraulic fluids on the basis of the Fluid Rating according to the technical data sheet 90235. Hydraulic fluids with positive evaluation in the Fluid Rating are provided in the following technical data sheet:

- 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

Selection of hydraulic fluid shall make sure that the operating viscosity in the operating temperature range is within the optimum range (v_{opt}; see selection diagram).

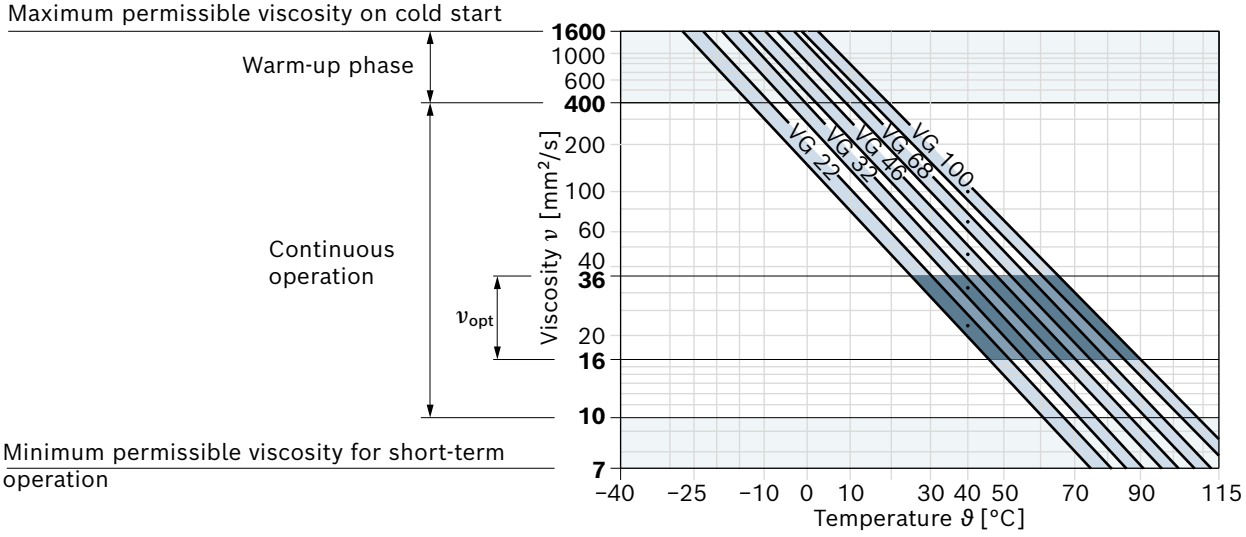
Notice
The axial piston unit is not suitable for operation with HFA hydraulic fluids.

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature[4]	Remarks
Cold start	v_{max} ≤ 1600 mm²/s	NBR[2]	ϑ_{St} ≥ −40°C	t ≤ 3min, without load (p ≤ 50 bar), n ≤ 1000 rpm Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
		FKM	ϑ_{St} ≥ −25°C	
Warm-up phase	v = 1600 ... 400 mm²/s			t ≤ 15min, p ≤ 0.7 × p_{nom} and n ≤ 0.5 × n_{nom}
Continuous operation	v = 400 ... 10 mm²/s[1]	NBR[2]	ϑ ≤ +78 °C	Measured at port **T**
		FKM	ϑ ≤ +103 °C	
	v_{opt} = 36 ... 16 mm²/s			Optimal operating viscosity and efficiency range
Short-term operation[3]	v_{min} = 10 ... 7 mm²/s	NBR[2]	ϑ ≤ +78 °C	t ≤ 3min, p ≤ 0.3 × p_{nom} , measured at port **T**
		FKM	ϑ ≤ +103 °C	

Notice: The maximum circuit temperature of +115 °C must not be exceeded at the working ports **A** and **B** complying with the permissible viscosity.

▼ **Selection diagram**



1) This corresponds, for example on the VG 46, to a temperature range of +4 °C to +85 °C (see selection diagram)
2) Special version, please contact us
3) Please contact us concerning size 250.
4) If the temperature at extreme operating parameters cannot be adhered to, please contact us.

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 a hydraulic fluid viscosity of less than 10 mm²/s (e.g. due to high temperatures during short-term operation), a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

For example, a viscosity of 10 mm²/s corresponds to the following temperatures with the following media:

- HLP 32 a temperature of 73°C
- HLP 46 a temperature of 85°C

Flow direction

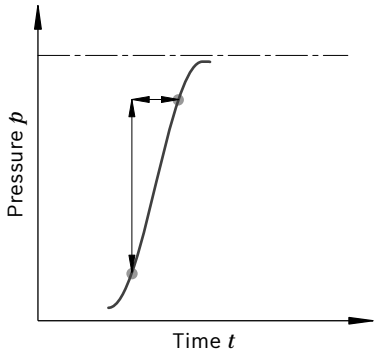
Direction of rotation, viewed on drive shaft	
clockwise	counter-clockwise
A to **B**	**B** to **A**

Working pressure range

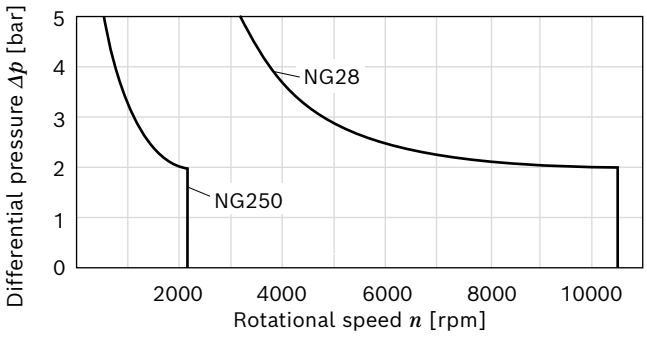
Pressure at working port A or B		Definition
Nominal pressure p_{nom}	400 bar (NG28) 350 bar (NG250)	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar (NG28)	The maximum pressure corresponds to the maximum working pressure within a single operating period. The sum of single operating periods must not exceed the total operating period. Within the total operating period of 300 h, a maximum pressure of 400 bar (NG250) to 450 bar (NG28) is permissible for a limited period of 50 h.
Single operating period	10 s	
Total operating period	300 h	
Maximum pressure p_{max}	400 bar (NG250)	
Single operating period	10 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** and **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure – operation as a pump (inlet)	See the diagram	To prevent damage to the axial piston motor during operation as a pump (change of the high-pressure side with constant direction of rotation, e.g. during brake applications) a minimum pressure has to be ensured at the working port (inlet). The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Summation pressure p_{Su} (pressure A + pressure B)	700 bar	The summation pressure is the sum of the pressures at both working ports (**A** and **B**).
Rate of pressure change $R_{A\,max}$		Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
with integrated pressure relief valve	9000 bar/s	
without pressure relief valve	16000 bar/s	
Case pressure at port T		
Continuous differential pressure $\Delta p_{T\,cont}$	2 bar	Maximum, averaged differential pressure at the shaft seal (housing to ambient pressure)
Maximum differential pressure $\Delta p_{T\,max}$	See the diagram	Permissible differential pressure at the shaft seal (housing to ambient pressure)
Pressure peaks $p_{T\,peak}$	10 bar	t < 0.1 s, maximum 1000 pressure peaks permissible

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

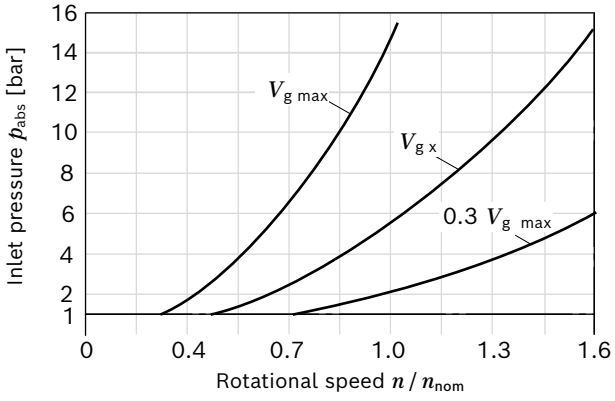
▼ **Rate of pressure change $R_{A\,max}$**



▼ **Maximum differential pressure at the shaft seal**

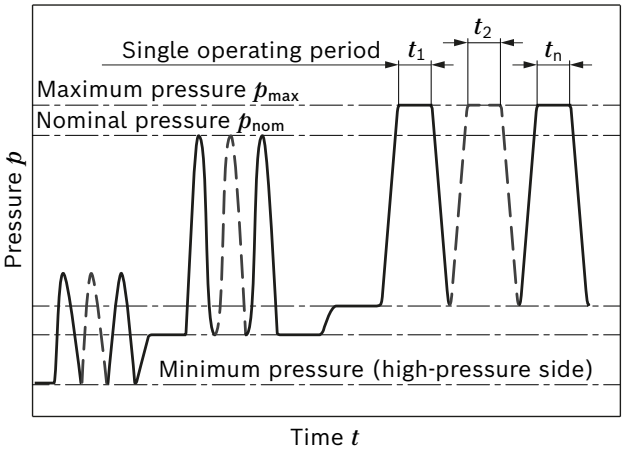


▼ **Minimum pressure – operation as a pump (inlet)**



This diagram is only valid for the optimum viscosity range of v_{opt} = 36 to 16 mm²/s.
If the above-mentioned conditions cannot be ensured, please contact us.

▼ **Pressure definition**



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

Notice

- Working pressure range applies when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.
- In addition to the hydraulic fluid and the temperature, the service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the case pressure.
- The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
- The case pressure must be greater than the external pressure (ambient pressure) at the shaft seal.

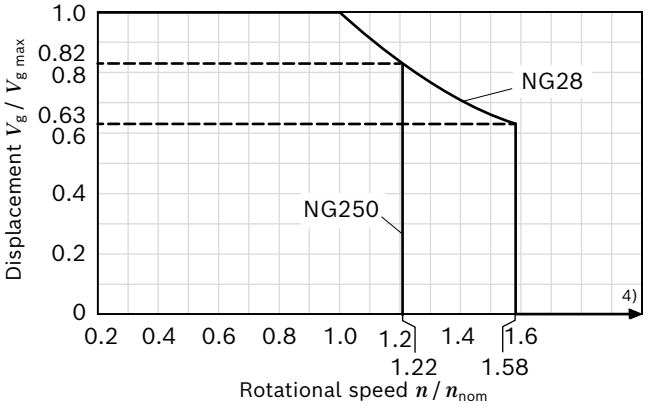
Effect of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options: HD, HA.T (NG28): increase
HD, EP, HA.T (NG250): increase
DA: decrease
With the following control options, an increase in case pressure will have no effect on the beginning of control: EP, HA (NG28)
The factory settings for the beginning of control are made at
p_{abs} = 2 bar case pressure (size 28) or
p_{abs} = 1 bar case pressure (size 250).

Technical data

Size		NG		28	250
Geometric displacement, per revolution[1]		$V_{g\,max}$	cm³	28.1	250
		$V_{g\,min}$	cm³	0	0
		$V_{g\,x}$	cm³	18	205
Maximum rotational speed[2] (in compliance with maximum permissible inlet flow)	at $V_{g\,max}$	n_{nom}	rpm	5550	2700
	at $V_g < V_{g\,x}$ (see diagram)	n_{max}	rpm	8750	3300
	at $V_{g\,0}$	n_{max}	rpm	10450	3300
Inlet flow	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	l/min	156	675
Torque[3]	at $V_{g\,max}$ and Δp = 400 bar	M	Nm	179	–
	at $V_{g\,max}$ and Δp = 350 bar	M	Nm	157	1391
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	6	60
	$V_g/2$ to 0 (interpolated)	c_{min}	kNm/rad	18	181
Moment of inertia of the rotary group		J_{TW}	kgm²	0.0014	0,061
Case volume		V	l	0.5	3.0
Weight approx.	with port plate 02, 38	m	kg	16	110[5]

▼ **Permissible displacement depending on the rotational speed**



Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

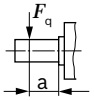
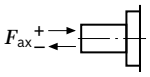
Determination of the characteristics			
Inlet flow	$q_v = \frac{V_g \times n}{1000 \times \eta_v}$		[l/min]
Rotational speed	$n = \frac{q_v \times 1000 \times \eta_v}{V_g}$		[rpm]
Torque	$M = \frac{V_g \times \Delta p \times \eta_{hm}}{20 \times \pi}$		[Nm]
Power	$P = \frac{2\pi \times M \times n}{60000}$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

Key

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

1) The minimum and maximum displacement can be steplessly varied, see Ordering code on page 2. (Standard setting size 250 if not specified when ordering: $V_{g\,min} = 0.2 \times V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).
2) The values are applicable:
   – for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   – with hydraulic fluid based on mineral oils
3) Torque without radial force, with radial force see page 8.
4) Values in this range on request
5) Port plate 02

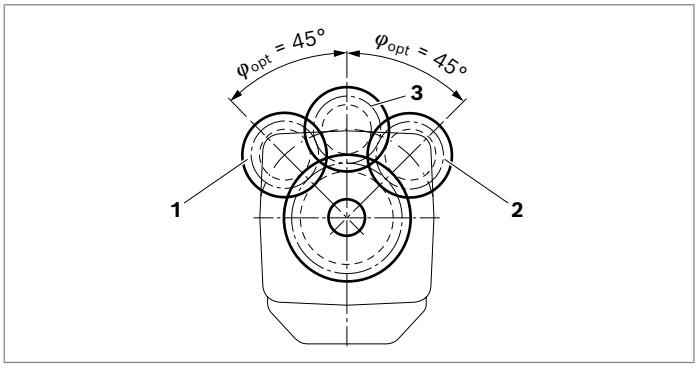
Permissible radial and axial loading on the drive shafts

Size	NG		28	250
Drive shaft			W30	W50
Maximum radial force[1] at distance a (to the shaft collar) 	$F_{q\,max}$	N	4838	1200[2]
	a	mm	17.5	41
Maximum torque at $F_{q\,max}$	$T_{q\,max}$	Nm	179	[3]
Maximum differential pressure at V_{gmax} and $F_{q\,max}$	$\Delta p_{q\,max}$	bar	400	[3]
Maximum axial force, at standstill or pressure-free operation 	$+F_{ax\,max}$	N	0	0
	$-F_{ax\,max}$	N	315	1200
Permissible axial force per bar working pressure	$+F_{ax\,perm/bar}$	N/bar	4.6	[3]

Effect of radial force F_q on bearing service life

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 bearing service life. Recommended position of mating gear is dependent on the direction of rotation. Examples:

▼ **Gear output drive**



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

Notice

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

1) With intermittent operation
2) When at standstill or when axial piston unit working in depressurized conditions. Higher forces are permissible under pressure, please contact us.
3) Please contact us.

HD – Proportional control, hydraulic

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

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

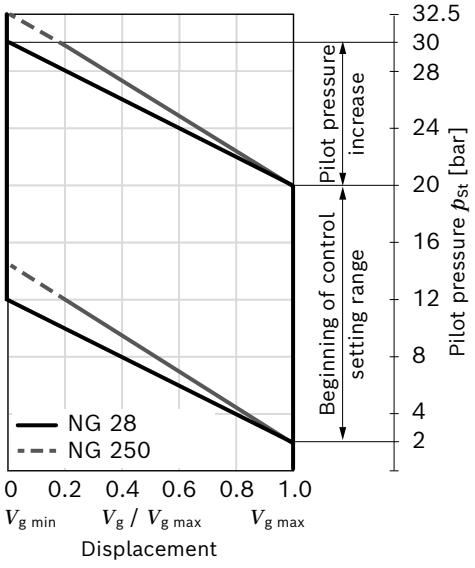
Notice

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control oil is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Bear in mind that pressures up to 450 bar can occur at port **G**.
- Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 10 bar.
- The beginning of control and the HD-characteristic curve are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel displacement of the characteristic curve.
- A leakage flow of maximum 0.3 l/min can occur at port **X** due to internal leakage (working pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

HD1 – pilot pressure increase Δp_{St} = 10 bar

A pilot pressure increase of 10 bar at port **X** will cause a reduction in displacement from $V_{g\,max}$ to 0 cm³ (size 28) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).
Beginning of control, setting range 2 to 20 bar
Standard setting:
beginning of control at 3 bar (end of control at 13 bar)

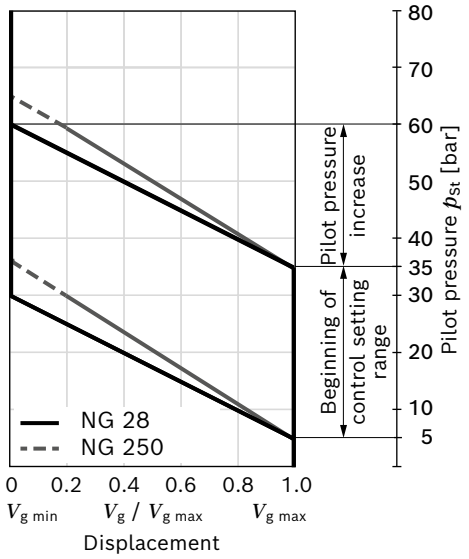
▼ **Characteristic curve**



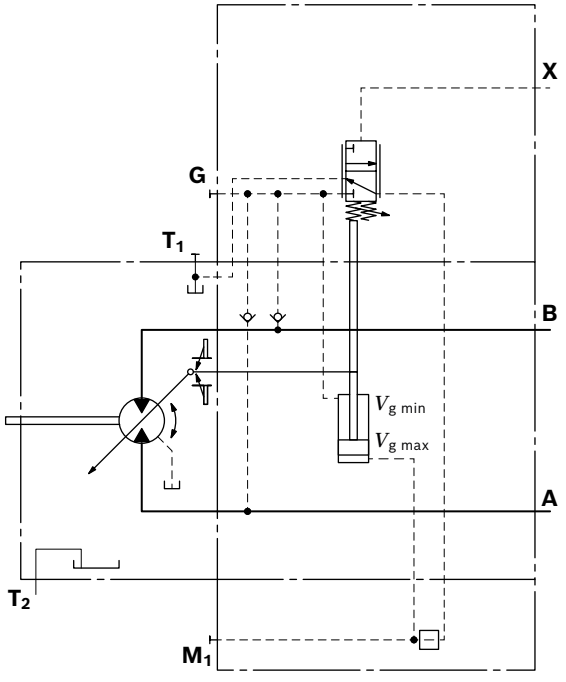
HD2 – pilot pressure increase Δp_{St} = 25 bar

A pilot pressure increase of 25 bar at port **X** will cause a reduction in displacement from $V_{g\,max}$ to 0 cm³ (size 28) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).
Beginning of control, setting range 5 to 35 bar
Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

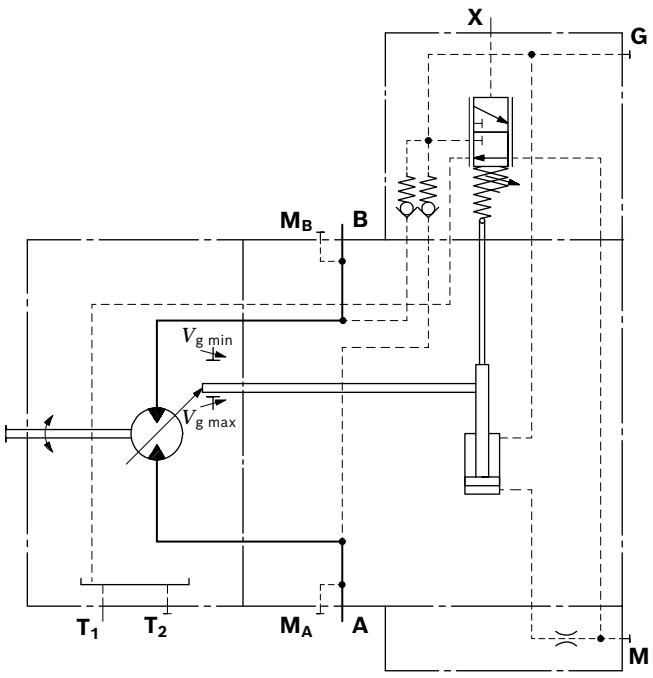
▼ **Characteristic curve**



▼ **Circuit diagram HD1, HD2 size 28**



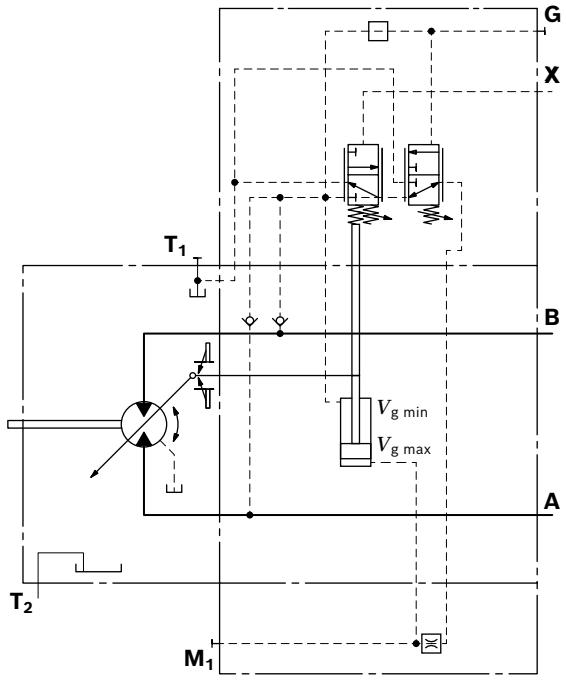
▼ **Circuit diagram HD1, HD2 size 250**



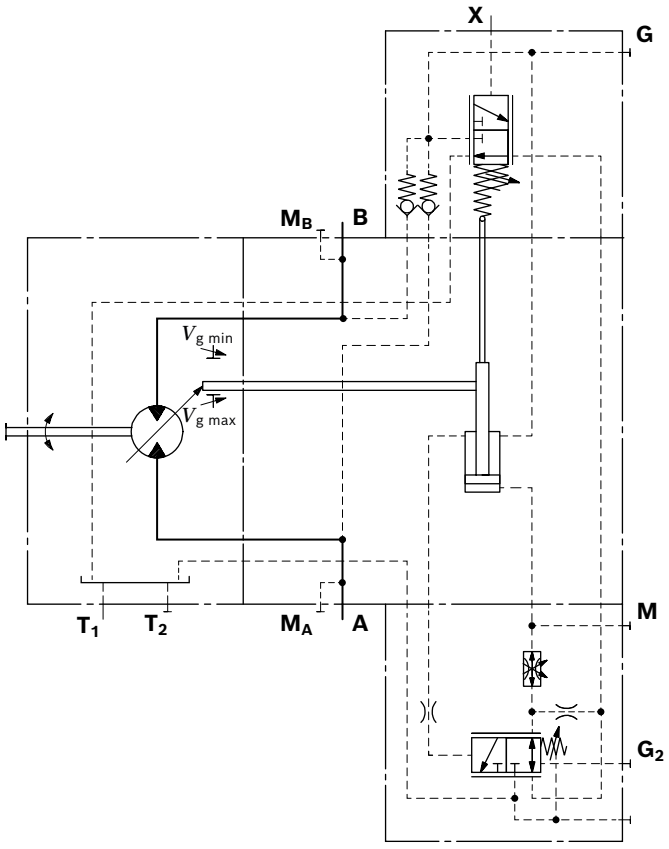
HD.D Pressure control, fixed setting

The pressure control overrides the HD control function.
If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control, the motor will swivel towards a larger displacement.
The increase in displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor provides more torque, while the pressure remains constant.
Setting range at pressure control valve 80 to 400 bar with size 28 and 80 to 350 bar with size 250.

▼ **Circuit diagram HD.D size 28**



▼ **Circuit diagram HD.D size 250**



EP – Proportional control, electric

The electric proportional control with proportional solenoid (size 28) or proportional valve (size 250) enable the displacement to be steplessly varied. Control is proportional to the electric control current applied to the solenoid.

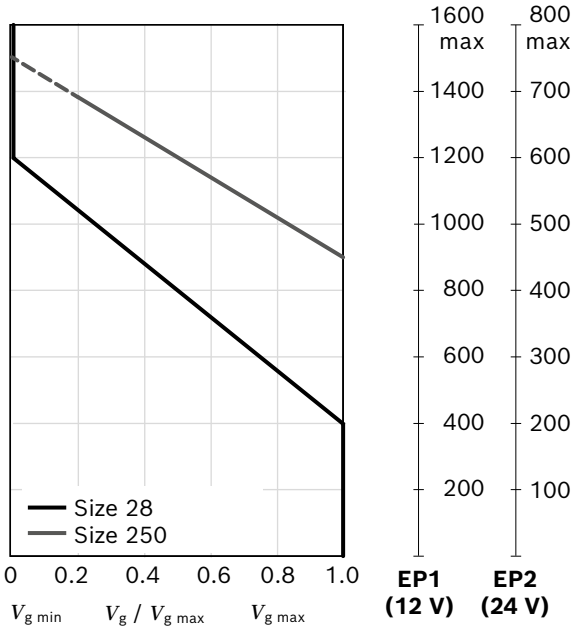
With size 250, the pilot oil supply requires an external pressure of p_{min} = 30 bar (p_{max} = 100 bar) at port **P**.

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

Notice

- The control oil is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us.
  Bear in mind that pressures up to 450 bar can occur at port **G**.
- The following only needs to be noted for size 250:
  The beginning of control and the EP characteristic curve are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel displacement of the characteristic curve.

▼ **Characteristic curve EP**



▼ **Technical data, solenoid, size 28**

Technical data, solenoid		EP1	EP2
Voltage		12 V (±20%)	24 V (±20%)
Control current	Start of control	400 mA	200 mA
	End of control	1200 mA	600 mA
Current limit		1.54 A	0.77 A
Nominal resistance (at 20 °C)		5.5 Ω	22.7 Ω
Dither	frequency	100 Hz	100 Hz
	minimum oscillation range[1)]	240 mA	120 mA
Duty cycle		100%	100%
Type of protection: see connector version on page 28			

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.

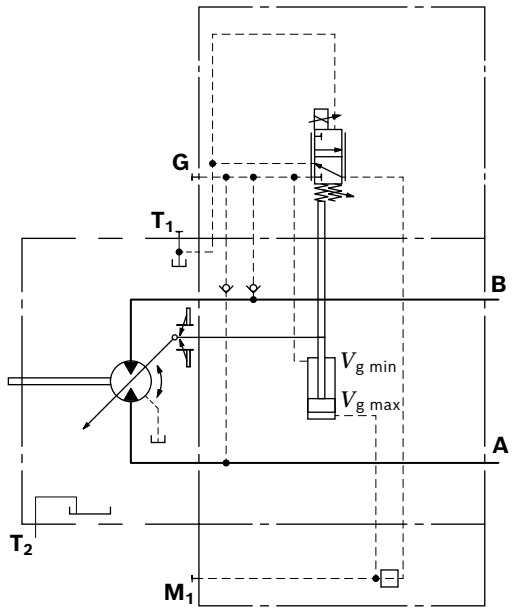
▼ **Technical data, proportional valve, size 250**

Technical data, solenoid	EP1	EP2
Voltage	12 V (±20%)	24 V (±20%)
Start of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Current limit	2.2 A	1.00 A
Nominal resistance (at 20 °C)	2.4 Ω	12 Ω
Duty cycle	100%	100%
Type of protection: see connector version on page 28		

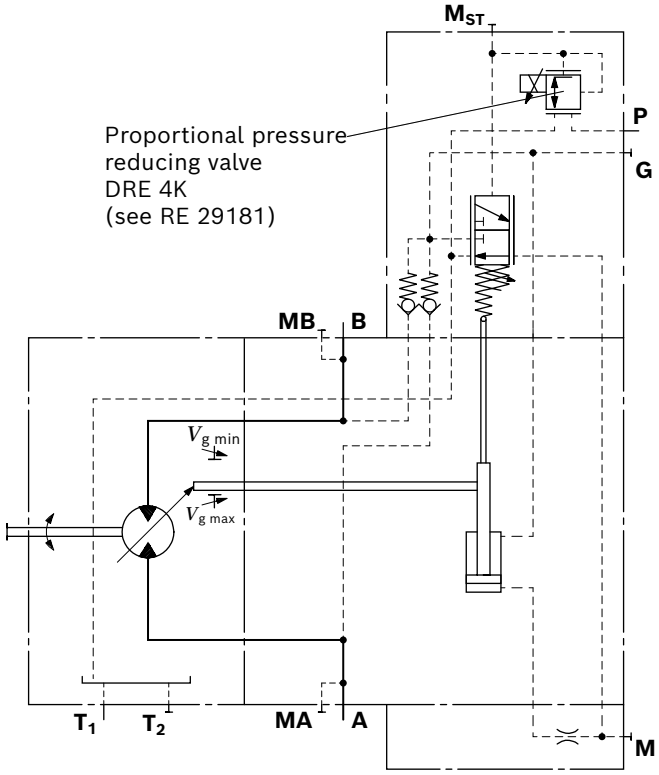
See also proportional pressure reducing valve DRE 4K (RE 29181).

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

▼ **Circuit diagram EP size 28**



▼ **Circuit diagram EP size 250**



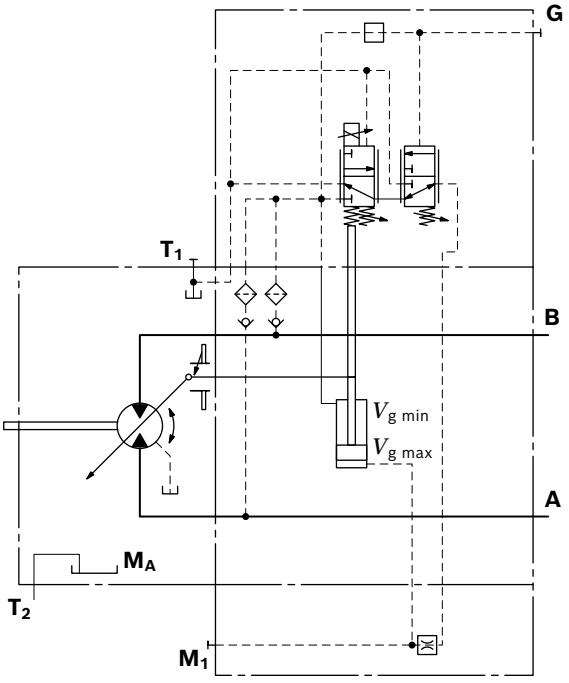
EP.D pressure control, fixed setting

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

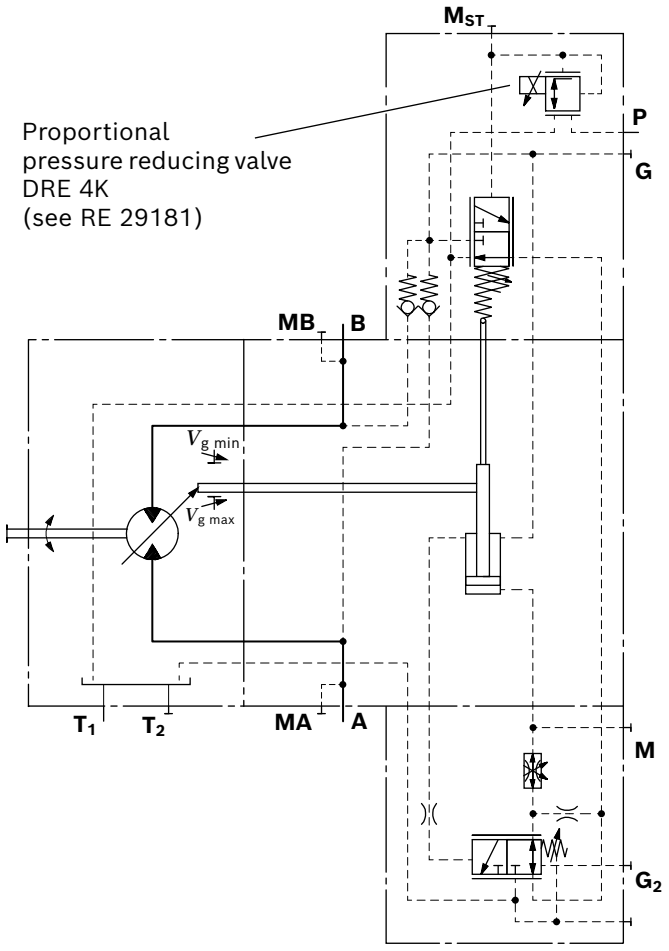
The increase in displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor provides more torque, while the pressure remains constant.

Setting range at pressure control valve 80 to 400 bar with size 28 or 80 to 350 bar with size 250.

▼ **Circuit diagram EP.D size 28**



▼ **Circuit diagram EP.D size 250**

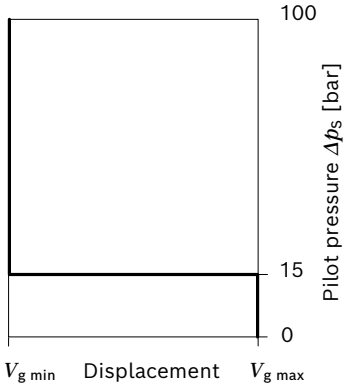


HZ – Two-point control, hydraulic

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

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

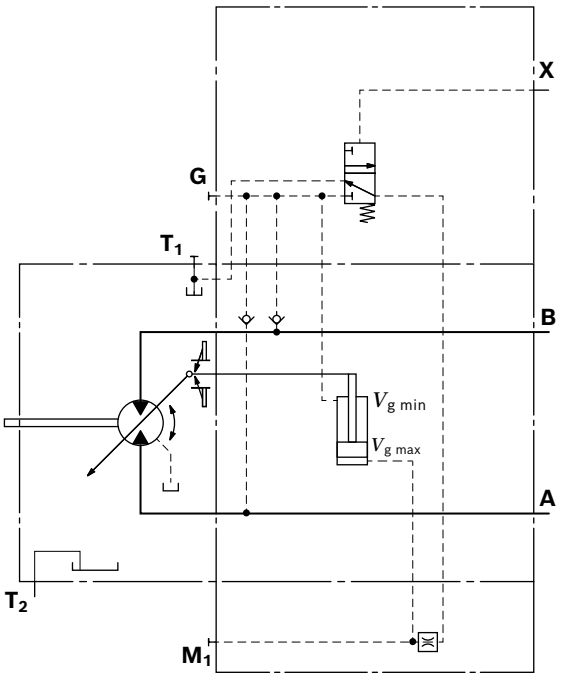
▼ **Characteristic curve HZ**



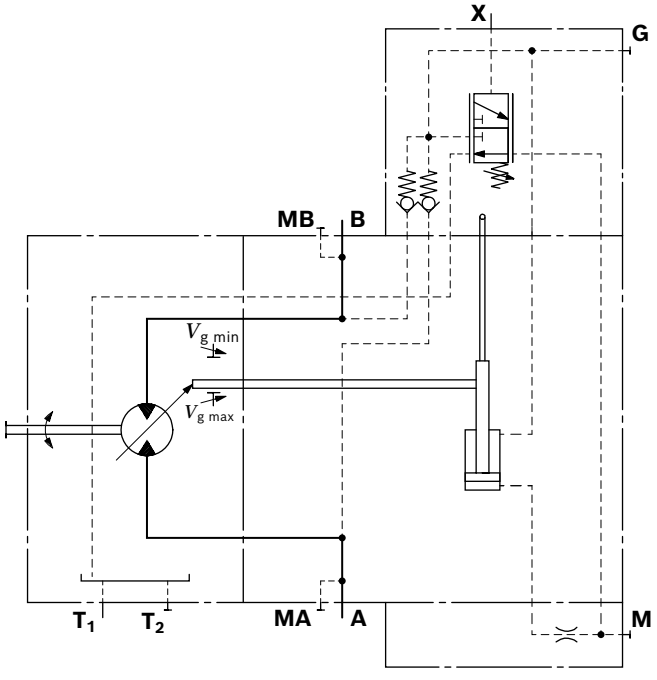
Notice

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Bear in mind that pressures up to 500 bar can occur at port **G**.
- A leakage flow of maximum 0.3 l/min occurs at port **X** (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure must be relieved from port **X** to the reservoir.

▼ **Circuit diagram HZ1 size 28**



▼ **Circuit diagram HZ size 250**



EZ – Two-point control, electric

The electric two-point control with switching solenoid (size 28) or on/off valve (size 250) enables the displacement to be adjusted to $V_{g\,min}$ or $V_{g\,max}$ by applying or canceling the electric current at the switching solenoid or control valve.

Notice

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

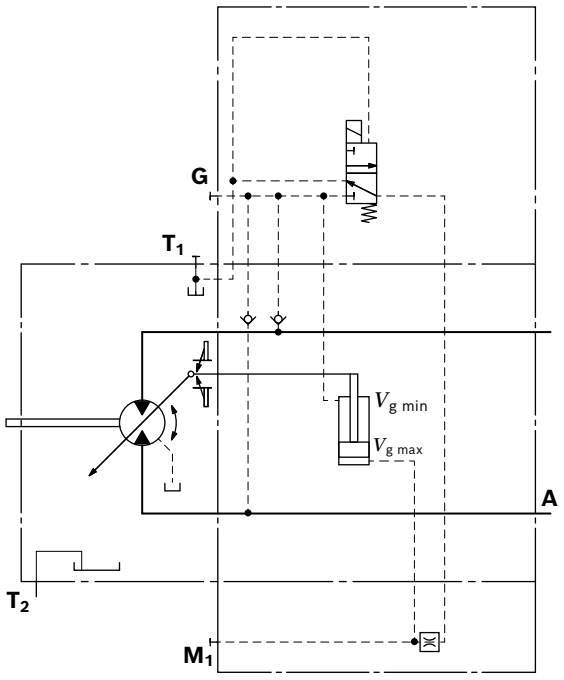
▼ **Technical data, solenoid, size 28**

Technical data, solenoid with ø37	EZ1	EZ2
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 28		

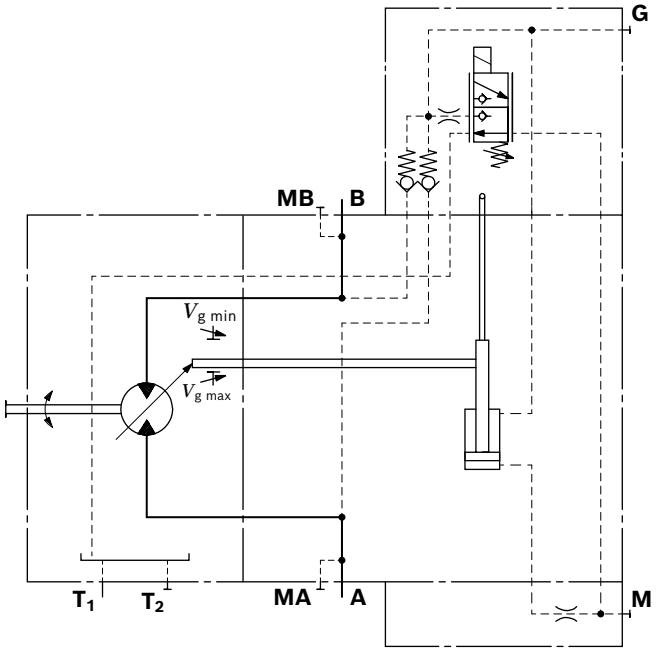
▼ **Technical data, on/off valve, size 250**

Technical data, on/off valve	EZ1	EZ2
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)	6 Ω	23 Ω
Nominal power	26 W	26 W
Minimum required active current	2 A	1.04 A
Duty cycle	100%	100%
Type of protection: see connector version on page 28		

▼ **Circuit diagram EZ1, EZ2 size 28**



▼ **Circuit diagram EZ1, EZ2 size 250**



HA – Automatic control, high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the working pressure.
The beginning of control of the A6VE motor with HA control is $V_{g\,min}$ (maximum rotational speed and minimum torque). The control device internally measures the working pressure at **A** or **B** (no control line required) and, when the specified beginning of control is reached, the controller swivels the motor with increasing working pressure from $V_{g\,min}$ to $V_{g\,max}$. The displacement is controlled between $V_{g\,min}$ and $V_{g\,max}$ depending on the load.

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

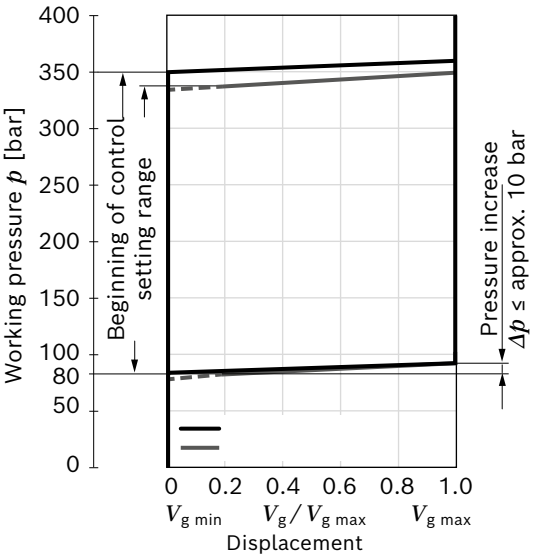
Notice

- For safety reasons, lifting winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control oil is internally taken out of the high-pressure passage of the motor (**A** or **B**). For reliable control, a working pressure of at least 30 bar is required in **A** (**B**). If a control operation is performed at a working pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port **G** using an external check valve. For lower pressures, please contact us. Bear in mind that pressures up to 450 bar can occur at port **G**.
- The beginning of control and the HA characteristic curve are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel displacement of the characteristic curve. Only for HA1T (size 28) and HA1, HA2, HA.T (size 250).
- A leakage flow of maximum 0.3 l/min occurs at port **X** (working pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure must be relieved from port **X** to the reservoir. Only for HA.T control.

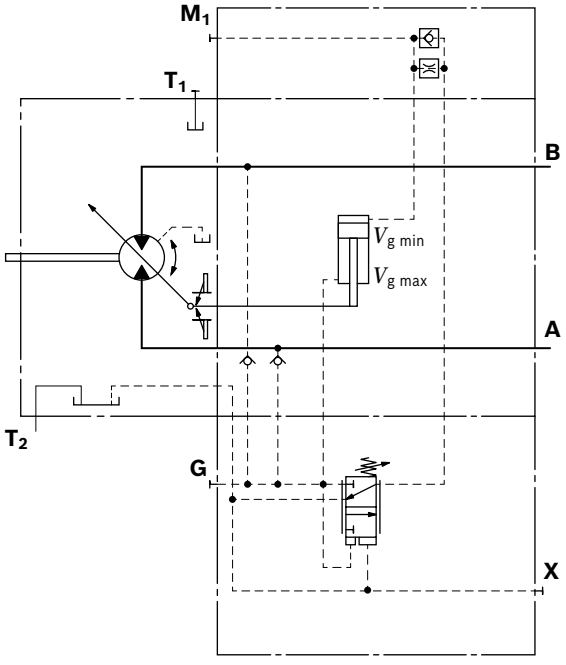
HA1 with minimum pressure increase

A working pressure of Δp ≤ approx. 10 bar will cause an increase in displacement from 0 cm³ to $V_{g\,max}$ (size 28) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).
Beginning of control, setting range 80 to 350 bar with size 28 or 80 to 340 bar with size 250.
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 300 bar.

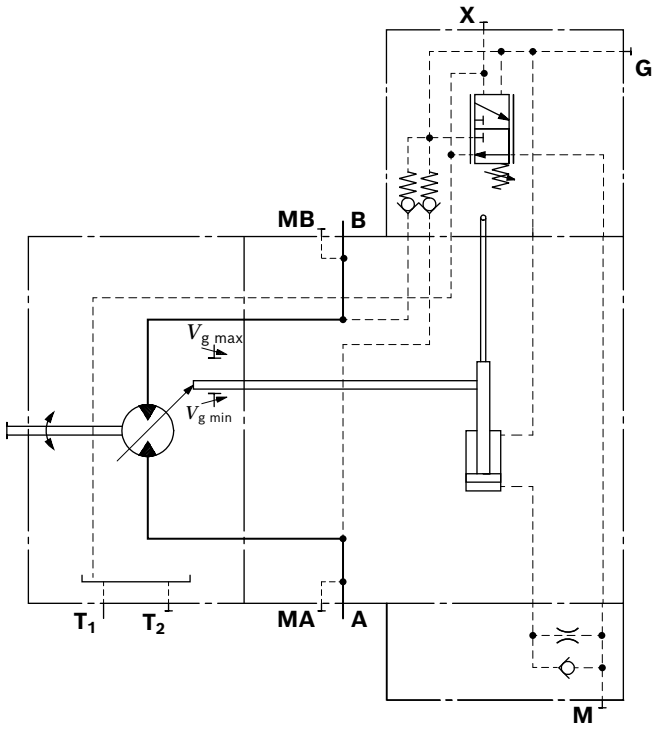
▼ **Characteristic curve HA1**



▼ **Circuit diagram HA1 size 28**



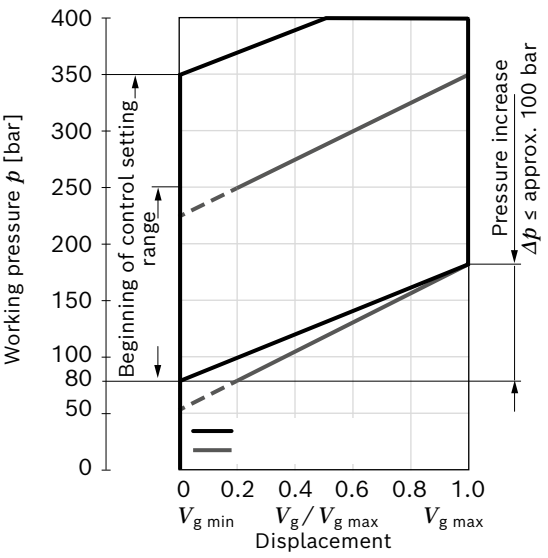
▼ **Circuit diagram HA1 size 250**



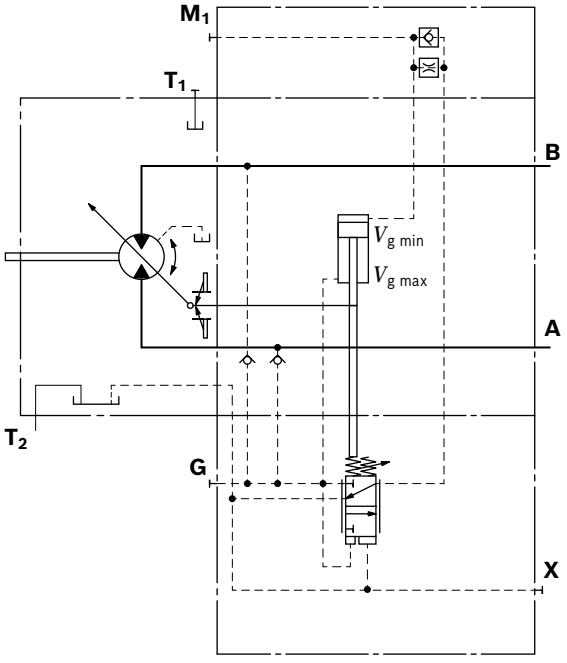
HA2 with pressure increase

A working pressure of Δp ≤ approx. 100 bar will cause an increase in displacement from 0 cm³ to $V_{g\,max}$ (size 28) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).
Beginning of control, setting range 80 to 350 bar with size 28 or 80 to 250 bar with size 250.
Specify the desired beginning of control in plain text when ordering, e.g. beginning of control at 200 bar.

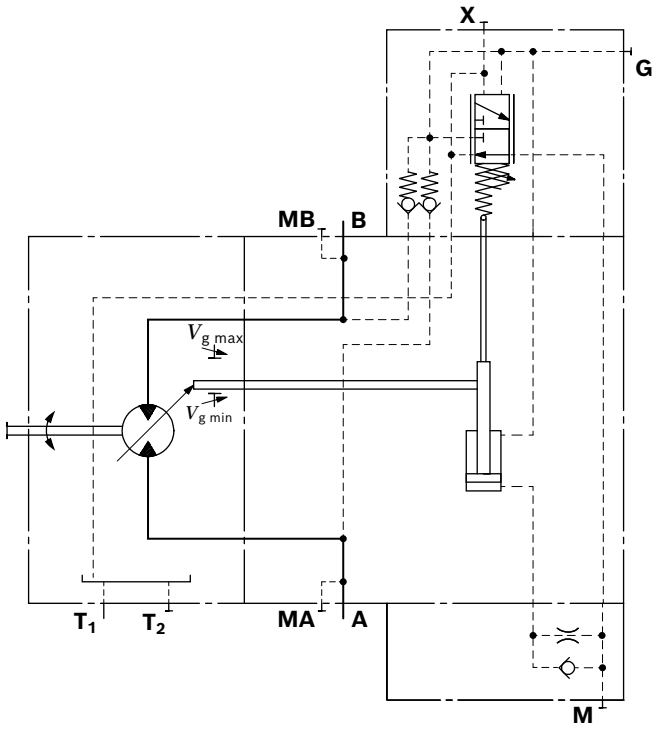
▼ **Characteristic curve HA2**



▼ **Circuit diagram HA2 size 28**



▼ **Circuit diagram HA2 size 250**



HA.T Hydraulic override, remote controlled, proportional

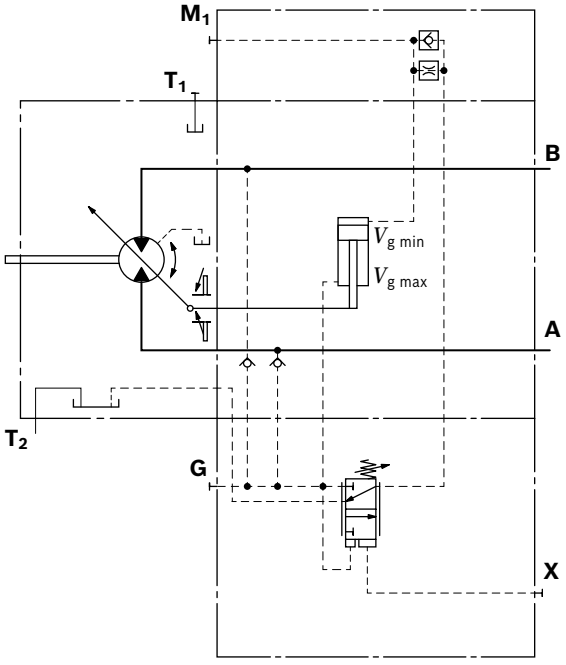
With the HA.T control, the beginning of control can be influenced by applying a pilot pressure to port **X**.
For every 1 bar pilot pressure, the beginning of control is reduced by 17 bar (size 28) or 8 bar (size 250).

Beginning of control setting	**NG28** **300 bar**	 **300 bar**
Pilot pressure at port **X**	0 bar	10 bar
Beginning of control at	300 bar	130 bar

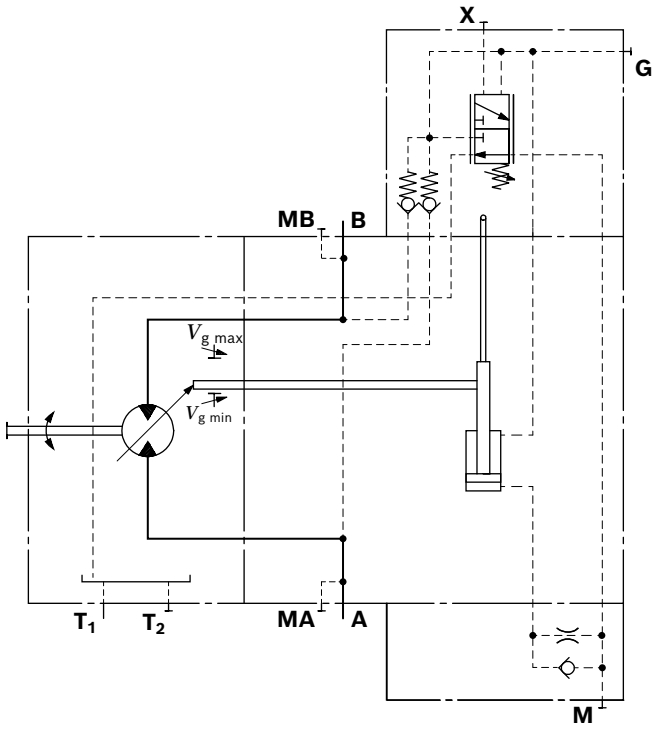
Notice

Maximum permissible pilot pressure 100 bar.

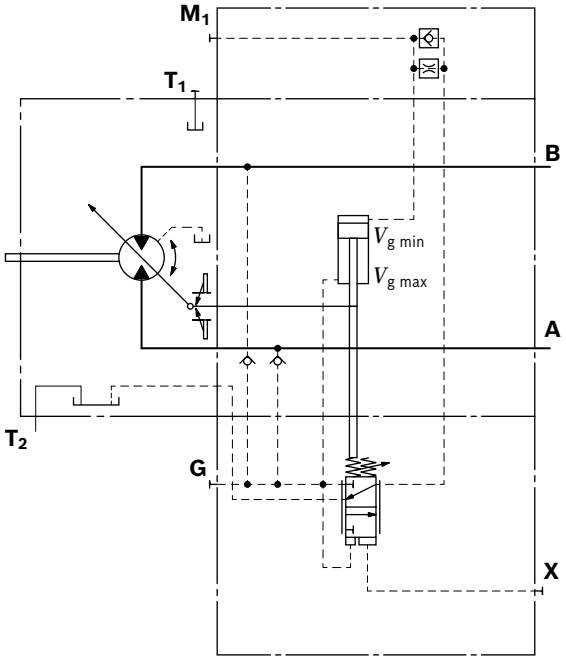
▼ **Circuit diagram HA1.T size 28**



▼ **Circuit diagram HA1.T size 250**



▼ **Circuit diagram HA2.T size 28**



DA – Automatic control, speed related

The variable motor A6VM with automatic speed-related control is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control. A drive speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the working pressure, regulates the swivel angle of the hydraulic motor.
Increasing drive speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher rotational speed), depending on the working pressure.
If the working pressure exceeds the pressure command value of the controller, the variable motor swivels to a larger displacement (higher torque, lower rotational speed).

- Pressure ratio p_{St}/p_{HD} = 3/100 (size 250), 5/100 (size 28)

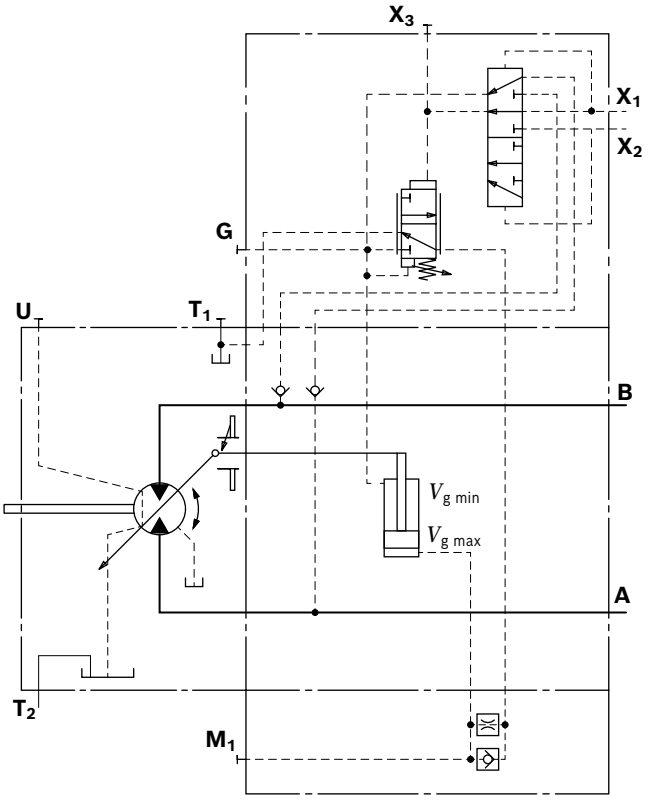
DA control is only suitable for certain types of travel drive systems and requires review of the motor and vehicle parameters to ensure that the motor is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.
Our Sales department will provide you detailed information.

Notice
The beginning of control and the DA characteristic curve are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 5) and thus a parallel shift of the characteristic curve.

DA hydraulic travel direction valve
Depending on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressure ports **X**$_1$ or **X**$_2$.

Direction of rotation	Working pressure in	Pilot pressure in
clockwise	**A**	**X**$_1$
counter-clockwise	**B**	**X**$_2$

▼ **Circuit diagram DA size 250**



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

Depending on the direction of rotation (direction of travel), the travel direction valve is actuated through the compression spring or the switching solenoid **a**.
When switching solenoid **b** is energized, the control can be overridden and the motor can be swiveled to maximum displacement (high torque, lower rotational speed) (electric $V_{g\,max}$ switching).

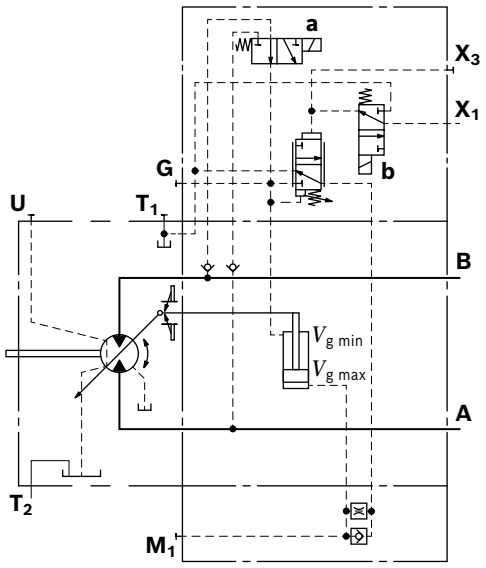
Travel direction valve, electric

Technical data, solenoid a with ø37		DA3
Voltage		24 V (±20%)
Direction of rotation	Working pressure in	
counter-clockwise	**B**	de-energized
clockwise	**A**	Energized
Nominal resistance (at 20 °C)		21.7 Ω
Nominal power		26.5 W
Minimum required active current		0.67 A
Duty cycle		100%
Type of protection: see connector version on page 28		

Electric override

Technical data, solenoid b with ø37	DA3
Voltage	24 V (±20%)
No override	de-energized
Position $V_{g\,max}$	Energized
Nominal resistance (at 20 °C)	21.7 Ω
Nominal power	26.5 W
Minimum required active current	0.67 A
Duty cycle	100%
Type of protection: see connector version on page 28	

▼ **Circuit diagram DA3 size 28**



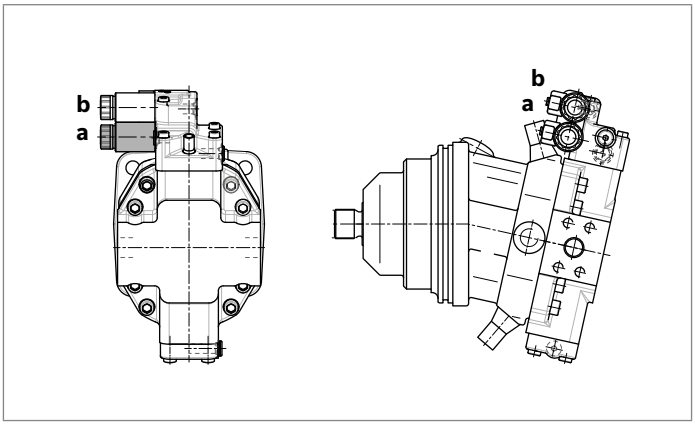
Electric travel direction valve (for DA, HA.R)

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

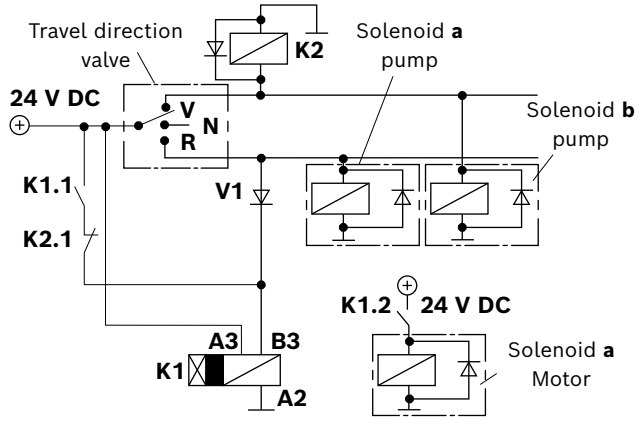
- Neutral position,
  the electrical circuitry, which must be logically coordinated with the pump control, causes the previous signal on the travel direction valve on the motor to be retained.
- Reversing,
  the electrical circuitry, which must be logically coordinated with the pump control, causes the 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.

Control DA1, DA



▼ **Circuit diagram, electric travel direction valve**



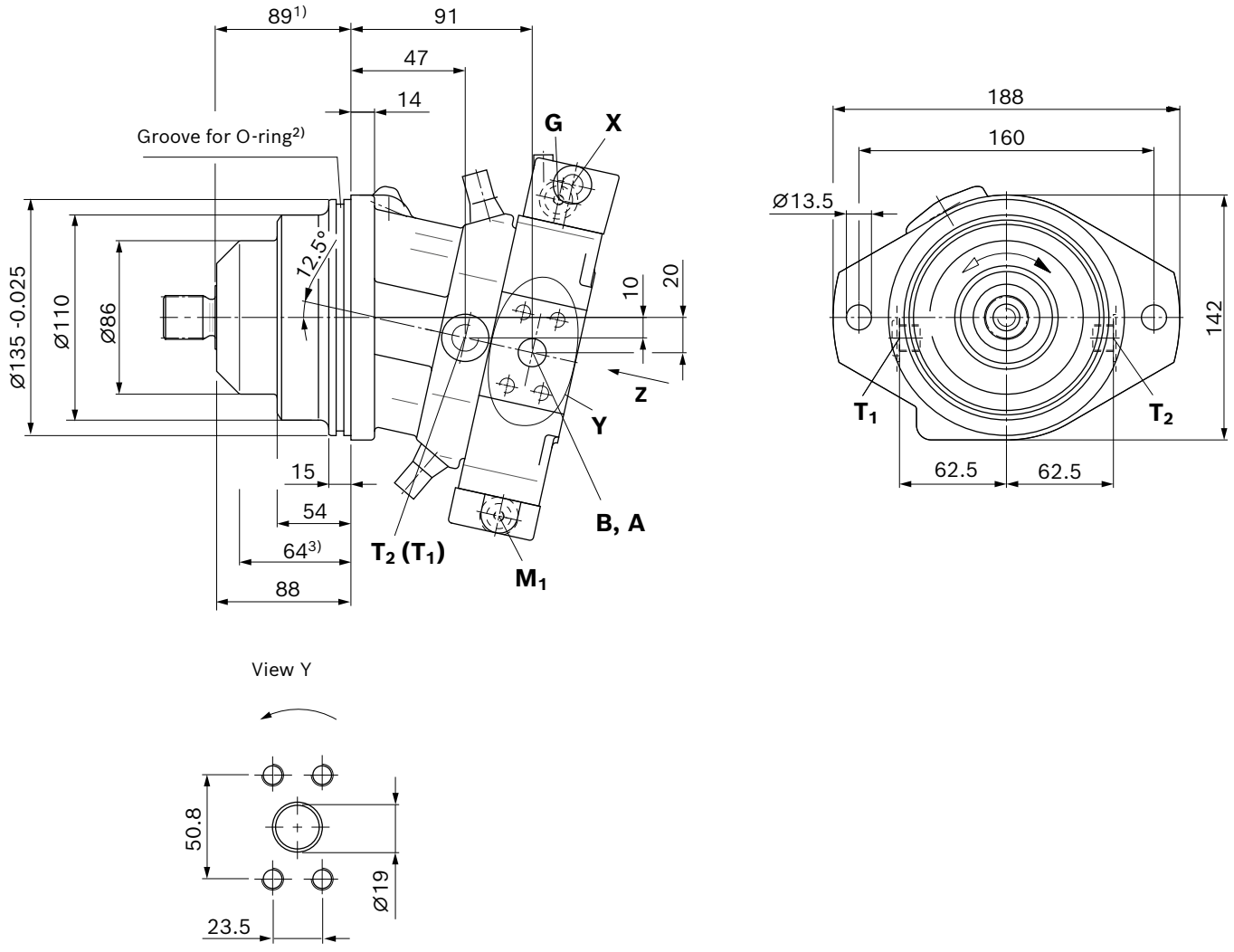
Notice
The shown diodes and relays are not included in the scope of delivery of the motor.

Dimensions

Size 28

HD1, HD2 – Proportional control, hydraulic

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



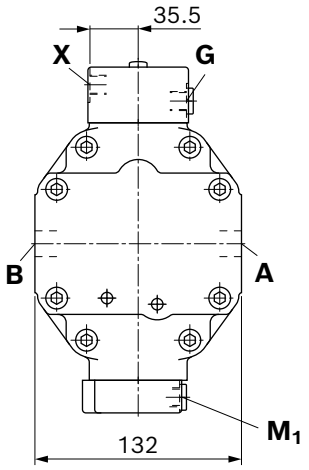
1) To shaft collar
2) The O-ring is not included in the scope of delivery
3) Difference in dimension of mounting flange A6VM to A6VE

Notice

Dimensions of the control devices, see data sheet 91604.

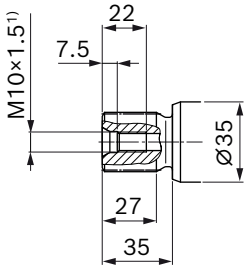
▼ **Location of working ports on the port plates** (View **Z**)

2 SAE working ports **A** and **B** at side, opposite



▼ **Drive shaft**

Z – W30×2×14×9g



Ports		Standard	Size[2]	p_{max} [bar][3]	State[7]
A, B	Working port Fastening thread A/B	SAE J518[4] DIN 13	3/4 in M10 × 1.75; 17 deep	450	O
T_1	Drain port	ISO 6149[6]	M18 × 1.5; 12 deep	3	X[5]
T_2	Drain port	ISO 6149[6]	M18 × 1.5; 12 deep	3	O[5]
G	Synchronous control	ISO 6149[6]	M14 × 1.5; 12 deep	450	X
X	Pilot pressure port (HD, HZ, HA1T, HA2T)	ISO 6149[6]	M14 × 1.5; 12 deep	100	O
X	Pilot pressure port (HA1, HA2)	ISO 6149[6]	M14 × 1.5; 12 deep	3	X
X_1, X_3	Pilot pressure port (DA3)	ISO 6149[6]	M14 × 1.5; 12 deep	40	X
M_1	Control pressure measuring port	ISO 6149[6]	M14 × 1.5; 12 deep	450	X

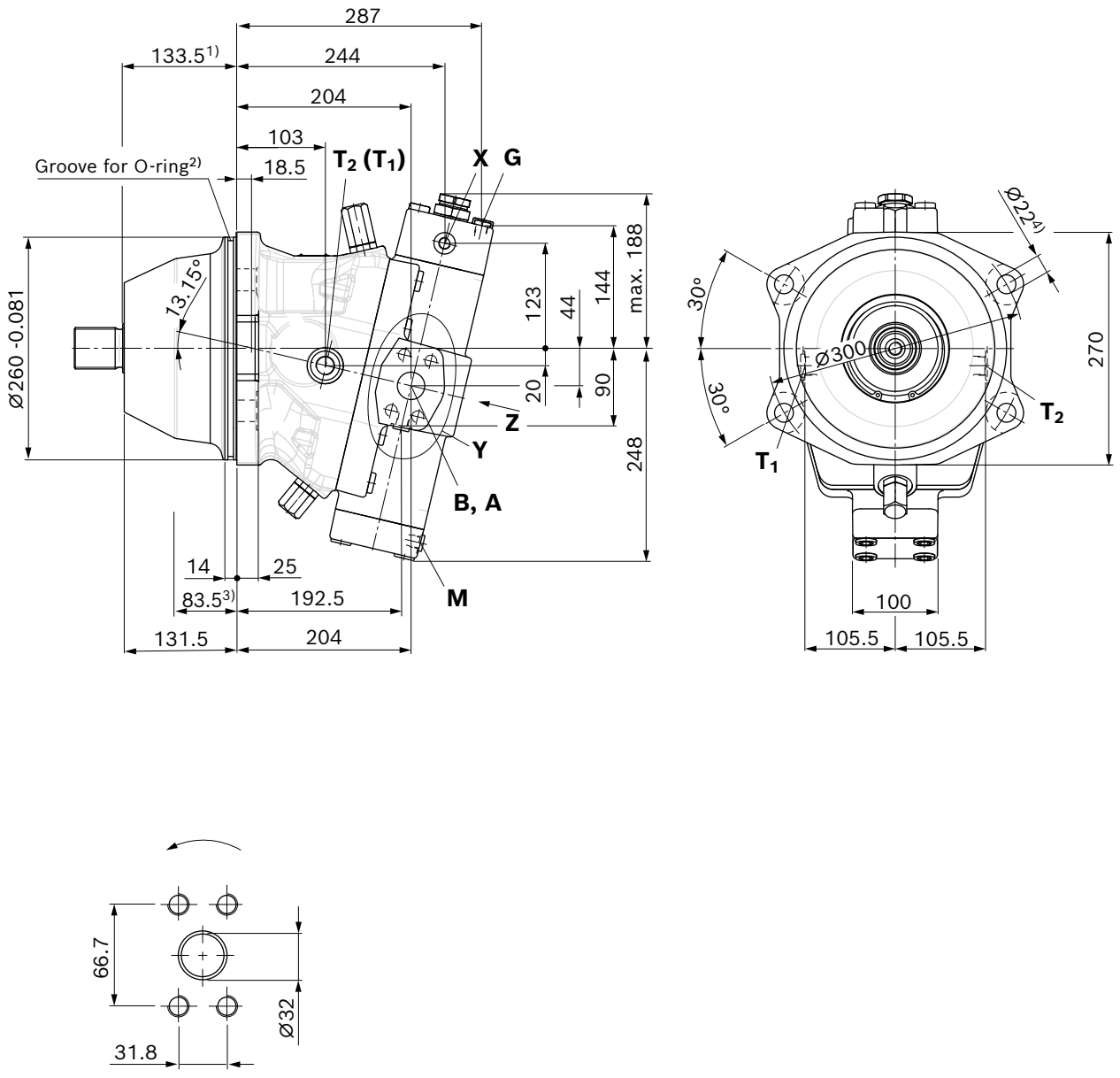
1) Center bore according to DIN 332 (thread according to DIN 13)
2) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
3) Center bore according to DIN 332 (thread according to DIN 13)
4) The countersink may be deeper than specified in the standard.
5) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 32).
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions

Size 250

HD1, HD2 – Proportional control, hydraulic

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



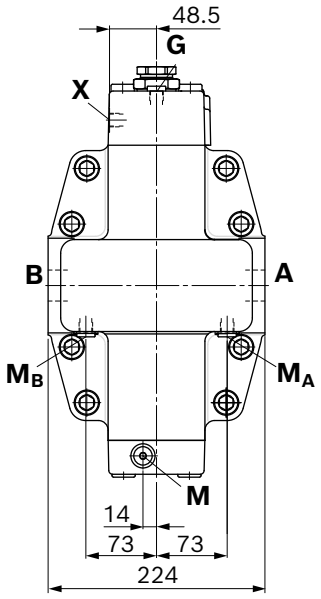
1) To shaft collar
2) The O-ring is not included in the scope of delivery
3) Difference in dimension of mounting flange A6VM to A6VE
4) Holes Ø22 with countersink Ø39.5, 2 deep

Notice

Dimensions of the control devices, see data sheet 91604.

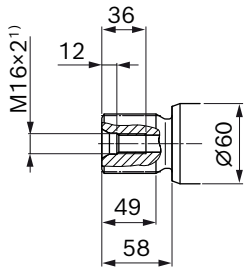
▼ **Location of working ports on the port plates** (View **Z**)

2 SAE working ports **A** and **B** at side, opposite



▼ **Drive shaft**

Z – W50×2×24×9g



Ports		**Standard**	**Size**[2)]	p_{max} **[bar]**[3)]	**State**[6)]
A, B	Working port Fastening thread A/B	SAE J518[4)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	O
T_1	Drain port	ISO 6149[6)]	M22 × 1.5; 15.5 deep	3	X[5)]
T_2	Drain port	ISO 6149[6)]	M22 × 1.5; 15.5 deep	3	O[5)]
G	Synchronous control	ISO 6149[6)]	M14 × 1.5; 12 deep	400	X
X	Pilot pressure port (HD, HZ, HA1T, HA2T)	ISO 6149[6)]	M14 × 1.5; 12 deep	100	O
X	Pilot pressure port (HA1, HA2)	ISO 6149[6)]	M14 × 1.5; 12 deep	3	X
X_1, X_3	Pilot pressure port (DA)	DIN 2353-CL	8B-ST	40	O
M	Control pressure measuring port	ISO 6149[6)]	M14 × 1.5; 12 deep	400	X
M_A M_B	Working pressure measuring port	ISO 6149[6)]	M14 × 1.5; 12 deep	400	X

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
3) Center bore according to DIN 332 (thread according to DIN 13)
4) The countersink may be deeper than specified in the standard.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 32).
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

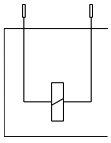
DEUTSCH DT04-2P-EP04

Size 28

Molded, 2-pin, without bidirectional suppressor diode
There is the following type of protection with mounted mating connector:

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

▼ **Switching symbol**



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

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

The mating connector is not included in the scope of delivery.
This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

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

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

Size 250

Without bidirectional suppressor diode
Type of protection:

- IP65 (DIN/EN 60529)

The seal ring in the cable fitting is suitable for lines of diameter 4.5mm to 10mm.
The mating connector is included in the scope of delivery.

Flushing and boost-pressure valve

The flushing and boost-pressure valve is used to remove heat from the hydraulic circuit.
In a closed circuit, it is used for flushing the housing and safeguarding the minimum boost pressure.
Hydraulic fluid is directed from the respective low-pressure side into the motor housing. This is then fed into the reservoir, together with the leakage. In the closed circuit, the removed hydraulic fluid must be replaced by cooled hydraulic fluid supplied by the boost pump.
The valve is mounted on the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retention valve
(observe when setting the primary valve)

- fixed setting 15 bar

Switching pressure of flushing spool Δp

- 8±1 bar

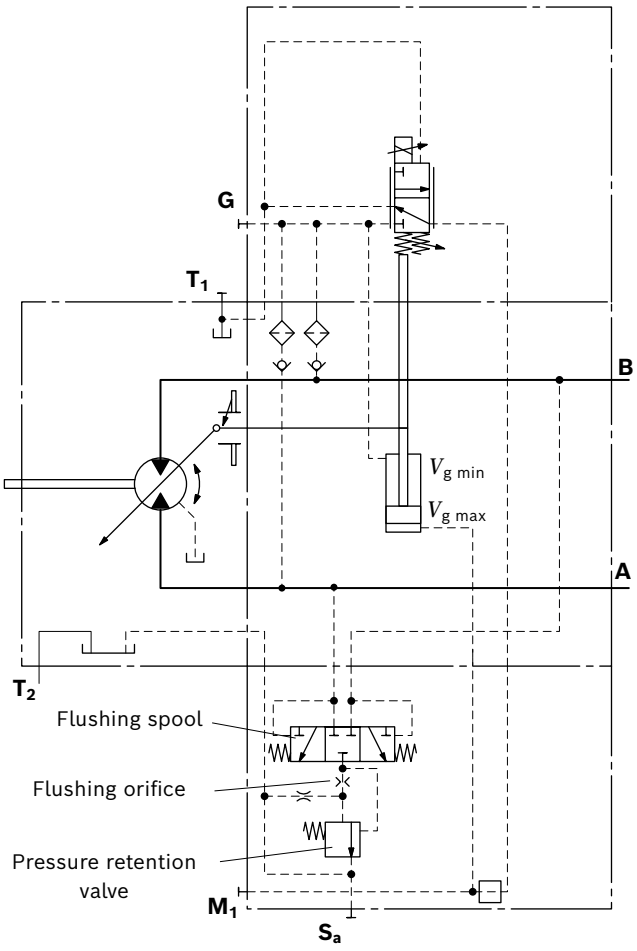
Flushing flow q_v
Orifices can be used to adjust the flushing flows as required. The following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G$ = 25 bar ad ν = 10 mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Size	Material number of orifice	⌀ [mm]	q_v [l/min]
28	R909651766	1.2	3.5
250	R909419697	2.0	10

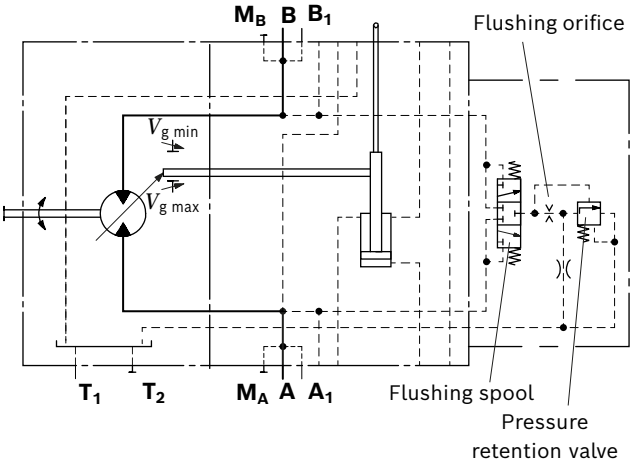
Notice

- With size 28, orifices can be supplied for flushing flows from 3.5to 10 l/min. For other flushing flows, please state the required flushing flow when ordering.

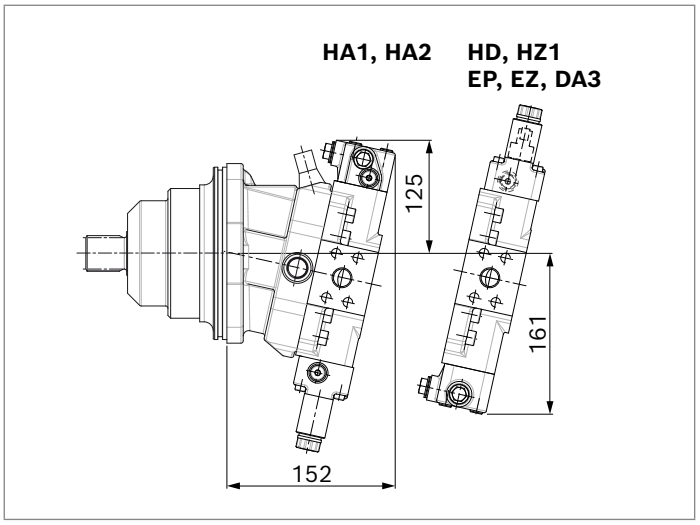
▼ **Circuit diagram size 28**



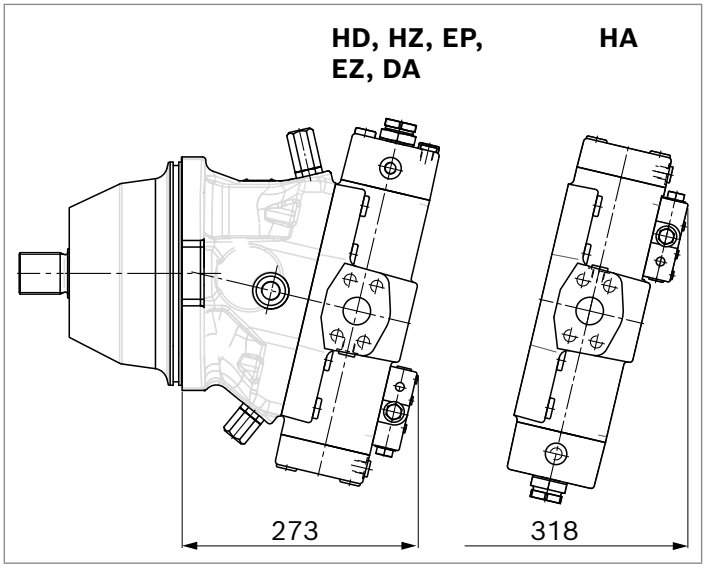
▼ **Circuit diagram size 250**



▼ **Dimensions size 28**



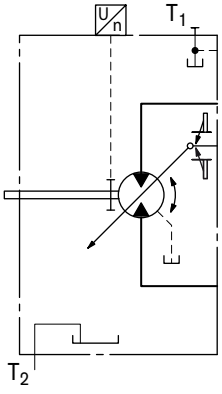
▼ **Dimensions size 250**



Speed sensor

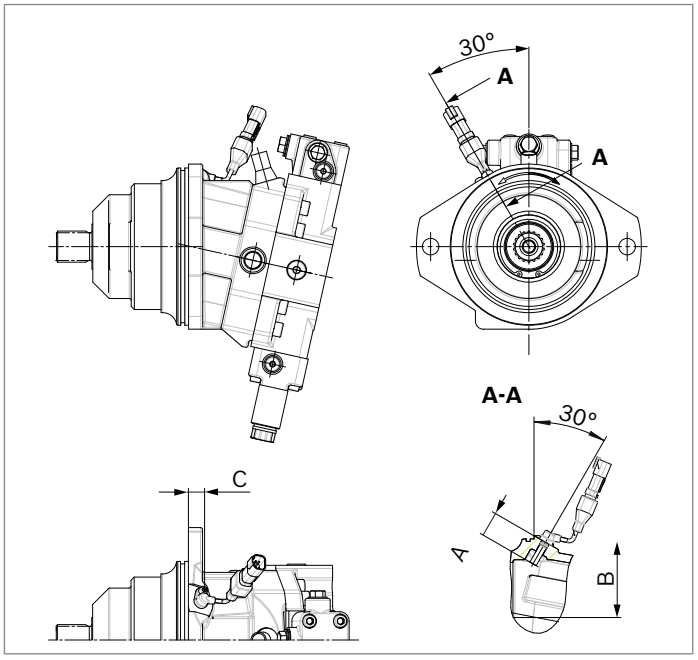
The A6VE...U version ("prepared for speed sensor", i.e. without sensor) is equipped with a spline on the rotary group.
On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.
A signal proportional to the rotational speed of the motor can be generated with the mounted DSA speed sensor.
The DSA sensor registers the rotational speed and direction of rotation.
Type code, technical data, dimensions and details on the connector plus safety instructions about the sensor can be found in the relevant data sheet 95133 (DSA).
The sensor is mounted on the port provided for this purpose with a mounting bolt. On deliveries without sensor, the port is plugged with a pressure-resistant cover.
We recommend ordering the A6VE variable motor complete with mounted sensor.

▼ **Circuit diagram EP**



▼ **Dimensions**

Version "V" with mounted speed sensor



Size		28	250
Number of teeth		40	78
A	Insertion depth (tolerance - -0.25)	32	32
B	Contact surface	69.3	105.4
C		20.4	32

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
The leakage in the housing area must be directed to the reservoir via the highest drain port (**T_1**, **T_2**).
If a shared drain line is used for several units, make sure that the respective case pressure in each unit is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating condition, particularly at cold start. If this is not possible, separate drain line must be laid, if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
Under all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

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

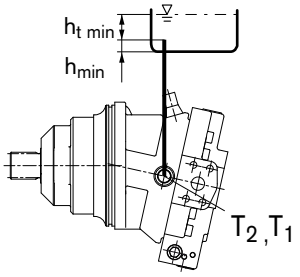
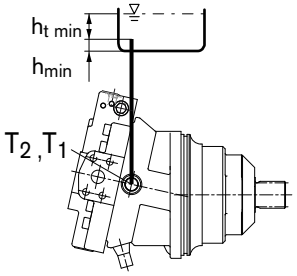
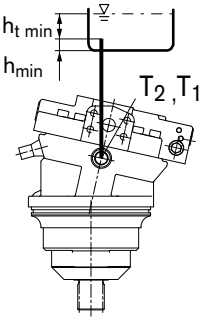
Key	
F	Filling/air bleeding
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)

Installation position

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

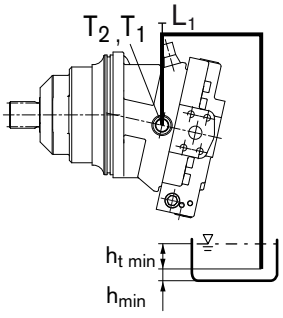
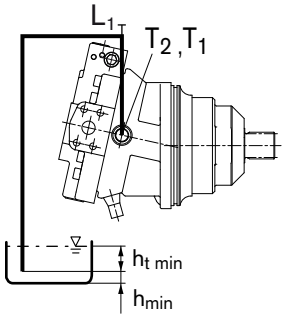
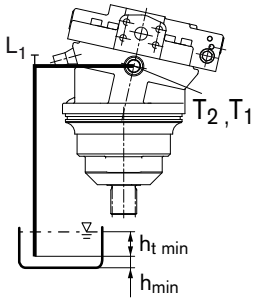
Below-reservoir installation (standard)

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

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

Above-reservoir installation

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

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

Notice

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

Project planning notes

- The motor A6VE is designed to be used in open and closed circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- For safety reasons, controls with beginning of control at $V_{g\,min}$ (e.g., HA) are not permissible for winch drives, e.g. anchor winches!
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservation protection for a maximum of 12 months. If longer preservation protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_D$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Applying a direct voltage signal (DC) to solenoids does not create electromagnetic interference (EMI) nor is the solenoid affected by EMI. Electromagnetic interference (EMI) potential exists when operating and controlling a solenoid with a modulated direct voltage signal (e.g. PWM signal) Appropriate testing and measures should be taken by the machine manufacturer to ensure other components or operators (e.g. with pacemaker) are not affected by this potential.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. contaminated hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk.
  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.
- In certain conditions, moving parts in high pressure relief valves might get stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). This can result in restriction or loss of load-holding functions in lifting winches.
  Therefore it is the machine and/or system manufacturers responsibility to make sure that the load can always be put in a safe mode if needed. Also, he needs to ensure that these measures are properly implemented.
- When using the axial piston motor in winch drives, make certain that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is extremely overloaded (e.g. if the maximum permissible rotational speeds are exceeded during weighing of the anchor while the ship is in motion), the rotary group may be damaged and, in the worst case, the axial piston motor may burst. The machine manufacturer/system manufacturer is to undertake additional measures, up to and including encapsulation.

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