

# Variable Displacement Motor A6VM

for open and closed circuits

Sizes 28...1000

Series 6

Features 1

Nominal pressure 400 bar  
Ordering Code / Standard Program 2...3

Peak pressure 450 bar  
Technical Data 4...7

DA - Hydraulic Control, Speed Related 8...9

HA - Automatic Control, High Pressure Related 10...13

HD - Hydraulic Control, Pilot Pressure Related 14...17

HZ - Hydraulic Two-Position Control 18

EZ - Electrical Two-Position Control, with Switching 19

Solenoid

EP - Electrical Control, with Proportional Solenoid 20...22

Unit Dimensions Size 28 23

Unit Dimensions Size 55 24

Unit Dimensions Size 80 25

Unit Dimensions Size 107 26

Unit Dimensions Size 140 27

Unit Dimensions Size 160 28

Unit Dimensions Size 200 29

Unit Dimensions Size 250 30

Unit Dimensions Size 355 31

Unit Dimensions Size 500 32

Unit Dimensions Size 1000 33

Winch Motion Control Valve MHB...E, Simple 34

Function

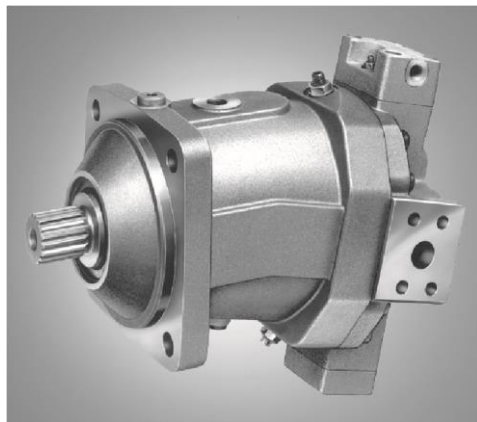
Drive Motion Control Valve MHB...R, Double 35

Function

Flushing and Boost Pressure Valve	36
Speed Sensor	37
Swivel Angle Indicator	38
Preference Types	39

- Variable displacement motor with axial piston rotary group of bent axis design, for hydrostatic drives in open and closed circuits. – The motor is suitable for both mobile and industrial applications.
- The wide control range of the variable displacement motor allows it to meet the requirements of high speed and high torque.
- The displacement is infinitely variable in the range  $V_{g \max}$  to  $V_{g \min} = 0$ .
- Output speed is proportional to flow and inversely proportional to displacement.
- The output torque increases with the pressure drop between the high and low pressure sides and with increasing displacement.
- Wide control range for hydrostatic drives
- Various control and regulating devices
- Cost saving through elimination of gearbox and possibility of using smaller motors
- Compact, robust bearing system with long service life
- Low unit power
- Good starting characteristics

- Low inertia
- Wide swivel range



RE 91 604/05.99  
replaces: 12.95

Index

Features

### Ordering Code / Standard Program

#### Hydraulic fluid

Mineral oil (no code)	
HF-fluids	sizes 28...200 (no code)
	sizes 250...1000 (only in connection with drive shaft bearings "L")
	E

#### Axial piston unit

Bent axis design, variable displacement	A6V
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#### Drive shaft bearings

	28...200	250...500	1000	
Mechanical bearings (no code)	●	●	—	
Long-Life bearings	—	●	●	L

#### Mode of operation

Motor (plug-in motor A6VE see RE 91606)	M
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#### Size

≅ Displacement $V_{g,max}$ (cm <sup>3</sup> )	28	55	80	107	140	160	200	250	355	500	1000
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Sizes 28...200: production plant Elchingen; Sizes 250...1000: production plant Horb

#### Control device

			28	55	80	107	140	160	200	250	355	500	1000	
Hydraulic control pilot pressure increase pilot pressure related	10 bar	HD1	●	●	●	●	●	●	●	●	●	●	●	HD1
	25 bar	HD2	●	●	●	●	●	●	●	●	●	●	●	HD2
	35 bar	HD3	—	—	—	—	—	—	—	●	○	○	○	HD3
Hydraulic two-position control		HZ	—	—	—	—	—	—	—	●	●	●	●	HZ
		HZ1	●	—	—	—	●	●	●	—	—	—	—	HZ1
		HZ3	—	●	●	●	—	—	—	—	—	—	—	HZ3
Electrical control, with proportional solenoid	control voltage	12 V	EP1	●	●	●	●	●	●	●	●	●	○	EP1
		24 V	EP2	●	●	●	●	●	●	●	●	●	○	EP2
Electrical two-position control, with switching solenoid	control voltage	12 V	EZ1	●	—	—	—	●	●	●	●	●	●	EZ1
		24 V	EZ2	●	—	—	—	●	●	●	●	●	●	EZ2
		12 V	EZ3	—	●	●	●	—	—	—	—	—	—	EZ3
		24 V	EZ4	—	●	●	●	—	—	—	—	—	—	EZ4
Automatic control, high pressure related	without pressure increase	HA1	●	●	●	●	●	●	●	●	●	●	○	HA1
	with pressure increase $\Delta p = 100$ bar	HA2	●	●	●	●	●	●	●	●	●	●	○	HA2
Hydraulic control, speed related		DA	—	—	—	—	—	—	—	●	●	●	○	DA
$p_{st}/p_{HD} = 5/100$ , hydraulic valve for travel direction		DA1	●	●	●	●	●	●	●	—	—	—	—	DA1
	electrical valve for travel direction	12 V	DA2	●	●	●	●	●	●	—	—	—	—	DA2
	+ electrical $V_{g,max}$ -switch	24 V	DA3	●	●	●	●	●	●	—	—	—	—	DA3
$p_{st}/p_{HD} = 8/100$ , hydraulic valve for travel direction		DA4	●	●	●	●	●	●	●	—	—	—	—	DA4
	electrical valve for travel direction	12 V	DA5	●	●	●	●	●	●	—	—	—	—	DA5
	+ electrical $V_{g,max}$ -switch	24 V	DA6	●	●	●	●	●	●	—	—	—	—	DA6

#### Pressure control (only for HD, EP)

	28	55	80	107	140	160	200	250	355	500	1000	
without pressure control (no code)	●	●	●	●	●	●	●	●	●	●	●	
Pressure control, direct control	●	●	●	●	●	●	●	●	●	●	●	D
direct control, with 2nd pressure setting	●	●	●	●	●	●	●	—	—	—	—	E
remote control	—	—	—	—	—	—	—	●	●	●	●	G

#### Override of HA-control (only for HA1, HA2)

	28	55	80	107	140	160	200	250	355	500	1000		
without override (no code)	●	●	●	●	●	●	●	●	●	●	○		
Hydraulic override	●	●	●	●	●	●	●	●	●	●	○	T	
Electrical override	control voltage	12 V	●	●	●	●	●	●	—	—	—	—	U1
		24 V	●	●	●	●	●	●	—	—	—	—	U2
Electrical override + el. valve for travel direction	control voltage	12 V	●	●	●	●	●	●	—	—	—	—	R1
		24 V	●	●	●	●	●	●	—	—	—	—	R2

#### Series

	6
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#### Index

	3
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	<b>A6V</b>	<b>M</b>		<b>/</b>	<b>6</b>	<b>3</b>	<b>W</b>	<b>-</b>	<b>V</b>											
Hydraulic fluid																				
Axial piston unit																				
Drive shaft bearings																				
Mode of operation																				
Size																				
Control device																				
Series																				
Index																				

**Direction of rotation**

viewed on shaft end	alternating	<b>W</b>
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**Setting range for displacement <sup>1)</sup>**

28...200 250...1000

$V_{g\ min} = 0$ to $0,8 V_{g\ max}$ (no code)	●	–	
$V_{g\ min} = 0$ to $0,4 V_{g\ max}$ $V_{g\ max} = V_{g\ max}$ to $0,8 V_{g\ max}$	–	●	<b>1</b>
$V_{g\ min} > 0,4 V_{g\ max}$ to $0,8 V_{g\ max}$ $V_{g\ max} = V_{g\ max}$ to $0,8 V_{g\ max}$	–	●	<b>2</b>

**Seals**

28 55 80 107 140 160 200 250 355 500 1000

FKM (fluor-caoutchouc)	●	●	●	●	●	●	●	●	●	●	●	●	<b>V</b>
------------------------	---	---	---	---	---	---	---	---	---	---	---	---	----------

**Shaft end**

Splined shaft DIN 5480	●	●	●	●	–	●	●	–	–	–	–	–	<b>A</b>
	●	●	●	●	●	●	–	●	●	●	●	●	<b>Z</b>
Parallel shaft with key DIN 6885	–	–	–	–	–	–	–	●	●	●	●	●	<b>P</b>

**Mounting flange**

ISO 4-hole	●	●	●	●	●	●	●	●	–	–	–	–	<b>B</b>
ISO 8-hole	–	–	–	–	–	–	–	–	●	●	●	●	<b>H</b>

**Service line connections**

28 55 80 107 140 160 200 250 355 500 1000

Ports A, B: SAE rear end (metric threads)	<b>01</b>	0	●	●	●	●	●	●	●	●	●	●	●	●	<b>010</b>
		7	●	●	●	●	●	●	●	●	●	●	●	○	<b>017</b>
Ports A, B: SAE on (opposite) sides (metric threads)	<b>02</b>	0	●	●	●	●	●	●	●	●	●	●	●	●	<b>020</b>
		7	●	●	●	●	●	●	●	●	●	●	○	<b>027</b>	
Port plate for mounting a motion control valve	<b>08</b>	0	–	–	–	–	–	–	–	●	–	–	–	<b>080</b>	
		8	–	–	–	–	–	–	–	●	–	–	–	<b>088</b>	
Ports A, B: SAE on (opposite) sides + rear end	<b>15</b>	0	–	–	–	–	–	–	–	●	○	●	○	<b>150</b>	
Port plate with pressure relief valve, for mounting a motion control valve <sup>2)</sup>	<b>37</b>	0	–	–	–	●	–	–	–	–	–	–	–	<b>370</b>	
		<b>38</b>	0	–	●	●	●	●	●	–	–	–	–	<b>380</b>	

**Valves**

without valve	<b>0</b>
with flushing and boost pressure valve	<b>7</b>
with built-on motion control valve (only for size 250)	<b>8</b>

**Speed sensor**

28 55 80 107 140 160 200 250 355 500 1000

without speed sensor (no code)	●	●	●	●	●	●	●	●	●	●	●	●	
suitable for fitting speed sensor	●	●	●	●	●	●	●	●	●	●	○		<b>D</b>

**Swivel angle indicator**

without swivel angle indicator (no code)	●	●	●	●	●	●	●	●	●	●	–	
with optical swivel angle indicator	–	–	–	–	–	–	–	●	●	●	●	<b>V</b>
with electronical swivel angle indicator	–	–	–	–	–	–	–	●	●	●	●	<b>E</b>

**Start of control**

at $V_{g\ min}$ (standard for HA)	●	●	●	●	●	●	●	●	●	●	●	●	<b>A</b>
at $V_{g\ max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	●	●	●	●	●	●	<b>B</b>

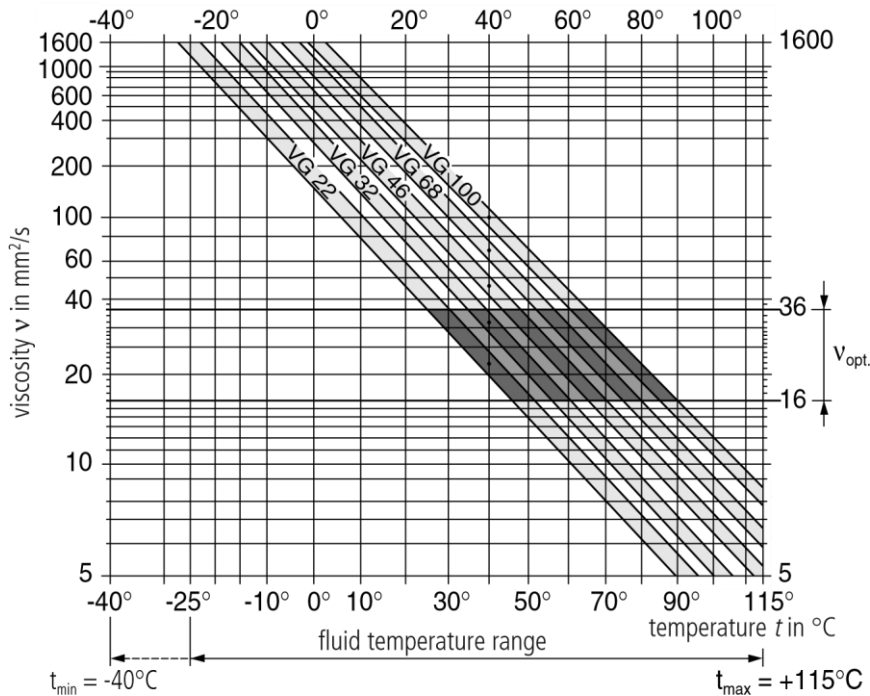
<sup>1)</sup> indicate in the order displacement setting in clear text:  $V_{g\ min} = \dots \text{ cm}^3$ ,  $V_{g\ max} = \dots \text{ cm}^3$

<sup>2)</sup> only possible in connection with controls HD, HA1, HA2, EP

● = available    ○ = in preparation    – = not available

**■** = Preferred program (preferred types see page 39)

short term at a max. permissible leakage oil temperature  $t_{max} =$



## Technical Data

### Fluid

We request that before starting a project detailed information about the choice of pressure fluids and application conditions are taken from our catalogue sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (fire resistance fluids, HF).

When using HF- or environmentally acceptable hydraulic fluids possible limitations for the technical data have to be taken into consideration. If necessary please consult our technical department (please indicate type of the hydraulic fluid used for your application on the order sheet).

### Operating viscosity range

In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range:

$$v_{opt} = \text{operating viscosity } 16 \dots 36 \text{ mm}^2/\text{s}$$

referred to the loop temperature (closed circuit) or tank temperature (open circuit).

### Viscosity limits

The limiting values for viscosity are as follows:

Sizes 28...200  $v_{min} = 5 \text{ mm}^2/\text{s}$ , short term at a max. permissible temperature  $t_{max} = 115^\circ\text{C}$

$v_{max} = 1600 \text{ mm}^2/\text{s}$ ,

short term on cold start ( $t_{min} = -40^\circ\text{C}$ )

Sizes 250...1000

$v_{min} = 10 \text{ mm}^2/\text{s}$ ,

$v_{max} = 1000 \text{ mm}^2/\text{s}$ ,

short term on cold start ( $t_{min} = -25^\circ\text{C}$ )

### Selection diagram

Please note that the max. fluid temperature of  $115^\circ\text{C}$  is also not exceeded in certain areas (for instance bearing area).

At temperatures of  $-25^\circ\text{C}$  up to  $-40^\circ\text{C}$  special measures may be required for certain installation positions. Please contact us for further information.

### Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the loop (closed circuit) or the tank temperature (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity lies within the optimum range ( $v_{opt}$ ) (see shaded section of the selection diagram). We recommend that the highest possible viscosity range should be chosen in each case.

Example: At an ambient temperature of  $X^\circ\text{C}$  the operating temperature is  $60^\circ\text{C}$ . Within the operating viscosity range ( $v_{opt}$ ; shaded area), this corresponds to viscosity ranges VG 46 or VG 68. VG 68 should be selected.

**Important:** The leakage oil (case drain oil) temperature is influenced by pressure and motor speed and is always higher than the circuit temperature. However, at no point in the circuit may the temperature exceed  $115^\circ\text{C}$  for sizes 28...200 or  $90^\circ\text{C}$  for sizes 250...1000.

$90^\circ\text{C}$

If it is not possible to comply with the above condition because of extreme operating parameters or high ambient temperatures we recommend housing flushing via port U or use of a flushing valve (see page 36). Please consult us.

**Technical Data**

**Filtration**

The finer the filtration the better the achieved purity grade of the pressure fluid and the longer the life of the axial piston unit. To ensure the functioning of the axial piston unit a minimum purity grade of:

- 9 to NAS 1638
- 18/15 to ISO/DIS 4406 is necessary.

At very high temperatures of the hydraulic fluid (90°C to max. 115°C, not perm. for sizes 250...1000) at least cleanless class

- 8 to NAS 1638
- 17/14 to ISO/DIS 4406 is necessary.

If above mentioned grades cannot be maintained please consult supplier.

**Operating pressure range**

Maximum pressure at port A or B (pressure data to DIN 24312)

Sizes 28...200

Nominal pressure $p_N$	400 bar
Peak pressure $p_{max}$	450 bar*

\*) Attention: shaft end **Z** with drives of radial force loads at the drive shaft (pinion V-belt drives) necessitate reduction of the nominal pressure to  $p_N = 315$  bar (please contact us).

Sizes 250...1000

Nominal pressure $p_N$	350 bar
Peak pressure $p_{max}$	400 bar

With pulsating loads above 315 bar we recommend using the model with splined shaft A (sizes 28...200) or with splined shaft Z (sizes 250...1000).

The summ of the pressures at ports A and B may not exceed 700 bar.

**Direction of flow**

clockwise rotation    anti-clockwise rotation

**A to B**

**B to A**

**Speed range**

There is no limitation on minimum speed  $n_{min}$ . If uniformity of rotation is required, however, speed  $n_{min}$  should not be allowed to fall below 50 rpm. See table on page 6 for max. permissible speeds.

**Installation position**

Optional. The motor housing must be filled with fluid prior the commissioning, and must remain full whenever it is operating.

For extensive information on installation position, please consult our data sheet RE 90 270 before completing your design work.

**Long-Life-bearings (sizes 250...1000)**

(for high life expectancy and use of HF-fluids)

The outer dimensions of the axial piston motors are identical to standard design (without long life bearings). The change from standard design to long life bearing system is possible. We recommend to apply bearing flushing at port U.

**Case Drain Pressure**

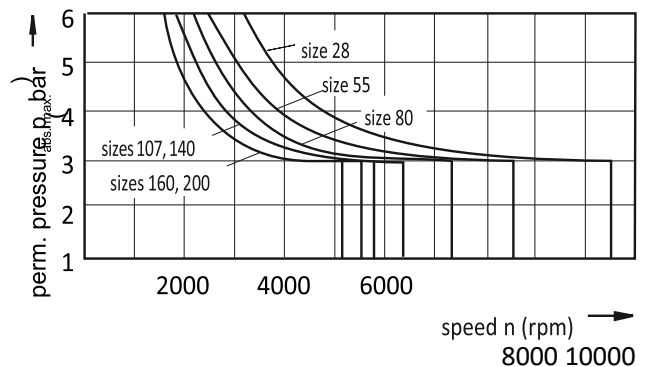
Shaft seal ring **FKM** (fluor-caoutchouc)

The lower the speed and the case drain pressure the higher the life expectation of the shaft seal ring. The values shown in the diagram are permissible loads of the seal ring and shall not be exceeded.

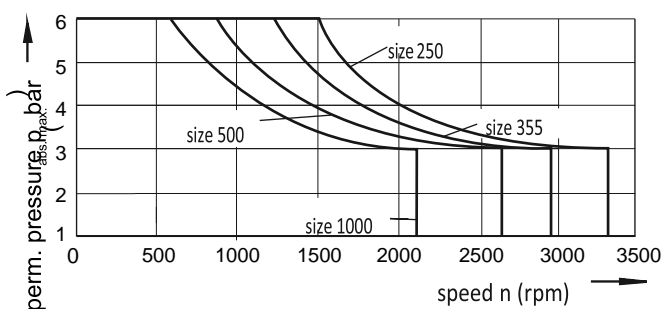
At stationary pressure loads in the range of the max. admissible leakage pressure a reduction of the life experience of the seal ring will result.

For a short period ( $t < 5$  min.) pressure loads up to 5 bar independent from rotational speeds are permissible respectively for sizes 28...200.

Sizes 28...200



Sizes 250...1000



Special operation conditions may require limitations of these values.

Note:

- max. permissible motor speeds are given in the table on page 6.

## Technical Data

**Table of values** (theoretical values, without considering  $\eta_{mh}$  and  $\eta_v$ ; values rounded)

Size			28	55	80	107	140	160	200	250	355	500	1000
Displacement <sup>1)</sup>	$V_{g,max}$	cm <sup>3</sup>	28,1	54,8	80	107	140	160	200	250	355	500	1000
	$V_{g,0}$	cm <sup>3</sup>	0	0	0	0	0	0	0	0	0	0	0
Max. speed (at max. permitted flow)	$n_{max}$ at $V_{g,max}$	rpm	5550	4450	3900	3550	3250	3100	2900	2500	2240	2000	1600
	$n_{max}$ at $V_g < V_{g,1}$	rpm	8750	7000	6150	5600	5150	4900	4600	3300	2950	2650	2100
	$V_{g,1}$	cm <sup>3</sup>	18	35	51	68	88	101	126	190	270	385	762
	$n_{max}$ at $V_{g,0}$	rpm	10450	8350	7350	6300	5750	5500	5100	3300	2950	2650	2100
Max. perm. flow	$q_{V,max}$	L/min	156	244	312	380	455	469	580	625	795	1000	1600
Torque constants	$T_k$ at $V_{g,max}$	Nm/bar	0,446	0,87	1,27	1,70	2,23	2,54	3,18	3,98	5,65	7,96	15,92
Max. torque	$T_{max}$ at $V_{g,max}$ <sup>2)</sup>	Nm	179	349	509	681	891	1019	1273	1391	1978	2785	5571
Case volume		L	0,5	0,75	1,2	1,5	1,8	2,4	2,7	3,0	5,0	7,0	16,0
Moment of inertia about drive axis	J	kgm <sup>2</sup>	0,0014 0,061	0,0042	0,0080	0,0127	0,0207	0,0253	0,0353		0,102	0,178	0,550
Weight (approx.)	m	kg	16	26	34	47	60	64	80	90	170	210	430

<sup>1)</sup> The minimum and maximum displacement are infinitely adjustable, see ordering code page 3

(note for sizes 250...1000:  $V_{g,min} = 0,2 \cdot V_{g,max}$ ,  $V_{g,max} = V_{g,max}$ , when there is no indication in the order!)

<sup>2)</sup> sizes 28...200:  $\Delta p = 400$  bar; sizes 250...1000:  $\Delta p = 350$  bar

- max. permissible housing pressure  $p_{abs,max}$  \_\_\_\_\_ 6 bar  
The pressure in the housing must be the same as or greater than the external pressure on the shaft seal.

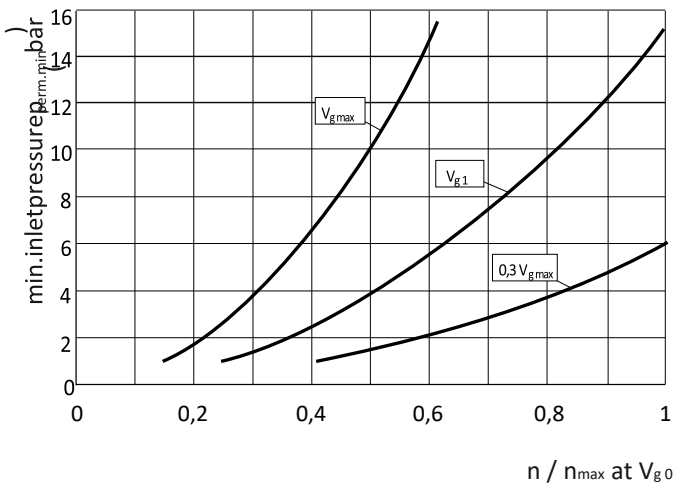
### Influence housing pressure to start of control

The housing pressure influences the start of control of the variable motor for the following controls: An increase of the housing pressure leads to an increase of the start of control for the HA control (only sizes 250...1000), HA.T and HD. For the DA control a lowering of the start of control is effected.

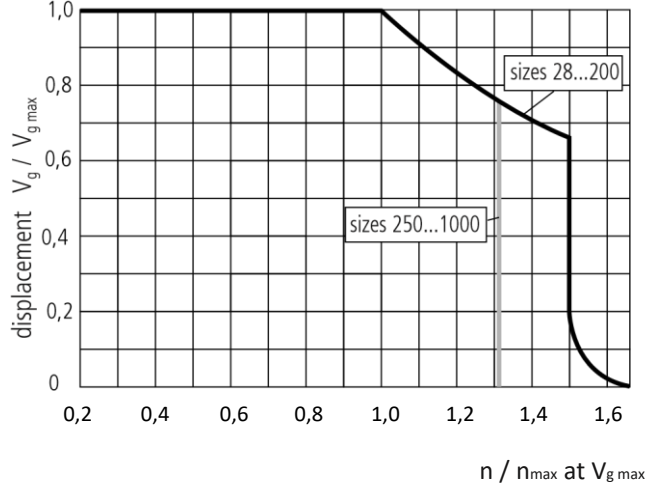
The setting on the test bench in the factory prior to delivery is  $p_{abs} = 1$  bar (sizes 250...1000) respectively  $p_{abs} = 2$  bar housing pressure (sizes 28...200).



Minimum inlet pressure at port A (B)



Permissible displacement, speed related



In order to avoid damage of the variable motor a minimum inlet pressure at the inlet zone must be assured. The minimum inlet pressure is related to the rotational speed and swivel angle (displacement) of the variable motor.

**Technical Data**

**Output drive**

Permissible axial and radial loading on drive shaft.

The values given are maximum values and not permissible for continuous operation.

Size		28	55	80	107	140	160	200	250	355	500	1000	
a	mm	12,5	15	17,5	20	22,5	22,5	25	41	52,5	52,5	67,5	
$F_{q\ max}$	N	5696	10440	13114	15278	17808	20320	22896	1200 <sup>1)</sup>	1500 <sup>1)</sup>	1900 <sup>1)</sup>	2600 <sup>1)</sup>	
$\pm F_{ax\ max}$	N	+ $F_{ax\ max}$	315	500	710	900	1030	1120	1250	4000	5000	6250	10000
		- $F_{ax\ max}$	315	500	710	900	1030	1120	1250	1200	1500	1900	2600
$\pm F_{ax\ perm.}/bar$	N/bar		4,6	7,5	9,6	11,3	13,3	15,1	17,0	2)	2)	2)	2)

<sup>1)</sup> Axial piston unit in stationary or in bypass operation, please contact us when appearing higher forces!

<sup>2)</sup> Please contact us!

**Code explanation** a = distance of  $F_q$  from shaft shoulder

$F_{q\ max}$  = max. perm. radial force at distance a

(at intermittent operation)

in kW

$\pm F_{ax\ max}$  = max. perm. axial force when stationary or when axial piston unit is running at zero pressure

$\pm F_{ax\ perm./bar}$  = perm. axial force/bar operating pressure

The direction of the max. axial force must be noted by sizes 28...200

-  $F_{ax\ max}$  = increased bearing life

+  $F_{ax\ max}$  = reduced bearing life (avoid if possible)

**Optimal force direction of  $F_q$**  (valid for sizes 28...200)

By means of appropriate force directions of  $F_q$  the bearing load caused by inside rotary group forces can be reduced. An optimal life expectation of the bearing can be reached.

Flow  $q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v}$

Output speed  $n = \frac{1000 \cdot \eta_v \cdot q_v}{1000 \cdot \eta_v}$

Output torque  $T = \frac{V_g}{20 \cdot p}$   
 or  $T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot p}$

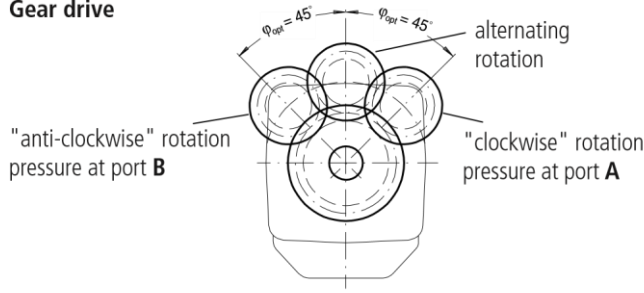
Output power  $P = \frac{1,59 \cdot V_g \cdot \Delta p \cdot \eta_{mh}}{100}$   
 $\frac{T_k \cdot \Delta p \cdot \eta_{mh}}{2 \cdot p \cdot T \cdot n} = \frac{T \cdot n}{60\ 000}$   
 $q \cdot \Delta p$

in rpm

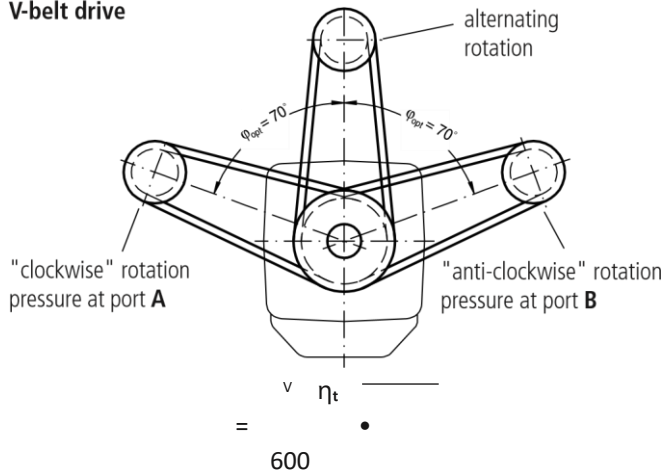
in Nm  
in Nm

**Calculation of size**

**Gear drive**



**V-belt drive**



$V_g$  = geometric displacement per rev. in  $cm^3$   
 $T$  = torque in  $Nm$

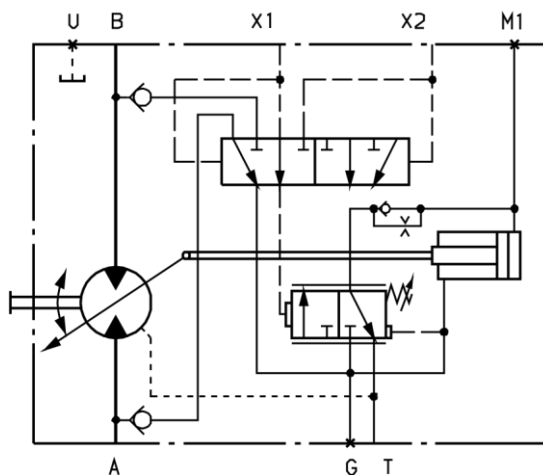
$\Delta p$  = pressure differential in bar  $n$  = speed in rpm

$T_K$  = torque constants in  $Nm/bar$   $\eta_v$  = volumetric efficiency  $\eta_{mh}$  = mech.-hyd. efficiency  $\eta_t$  = overall efficiency

direction). direction of rotation operation pressure in control pressure in

clockwise	<b>A</b>	<b>X<sub>1</sub></b>
anti-clockwise	<b>B</b>	<b>X<sub>2</sub></b>

**Hydraulic control, speed related DA1, DA4**  
 Sizes 28...200



**DA Hydraulic Control, Speed Related**

The A6VM variable motor with speed related hydraulic control is particularly suitable for use in hydrostatic transmissions in conjunction with variable pump A4VG with DA control.

The swivel angle of the hydraulic motor is controlled by means of the pilot pressure determined by the input speed of the A4VG variable pump and by the operating pressure.

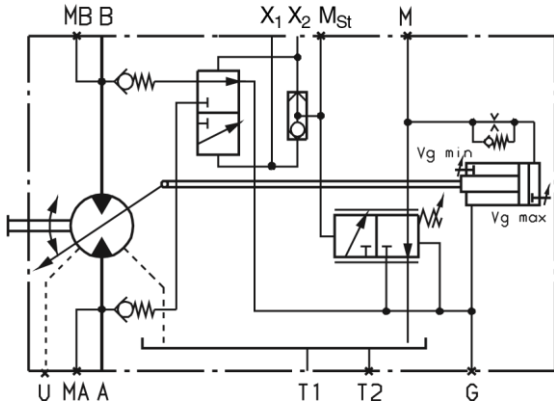
An increase in the pump input speed and thus in the pilot pressure causes the motor, in relation to the existing operating pressure, to swivel towards a lower displacement volume (lower torque, higher speed).

**DA, DA1, DA4 Hydraulic control, speed related with hydraulic valve for travel direction**

Through the control pressure  $X_1$  or  $X_2$  this valve is switched on/off dependent on the direction of rotation (travel

**Hydraulic control, speed related DA**

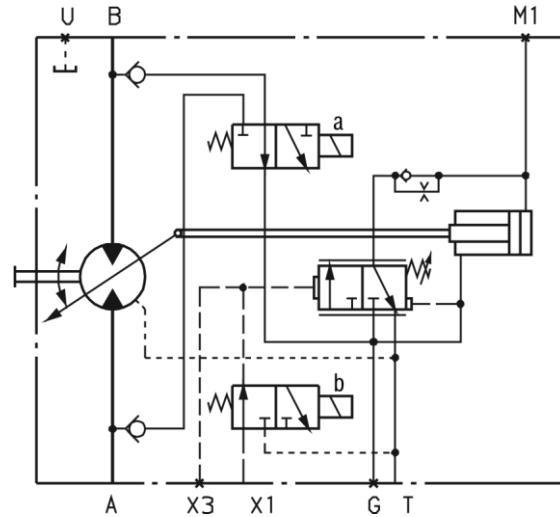
Sizes 250...1000



If operating pressure should rise above the value set with the pressure control, the motor is then swivelled towards a higher displacement volume (higher torque, lower speed).

When designing a drive using DA control, note also the technical data of variable pump A4VG with DA control.

A computer program is available at Brueninghaus Hydromatik to help you with the design of your drive. Full details from our Mobile Sales Division on request.



**DA2, DA3, DA5, DA6 Hydraulic control, speed related with el. valve for travel direction + el.  $V_{g\ max}$ -switching process**

The electrical valve is operated by the pressure spring or switch solenoid (a) dependent on the rotational direction (travel direction).

Through connection of the electric current at the switch solenoid (b) override of the control is possible and the motor is switched to max. swivel angle (high torque, low speed) (el.  $V_{g\ max}$ -switching process).

DA2, DA5	switching solenoid a, b 12 V DC; 1,6 A
(min.) DA3, DA6	switching solenoid a, b 24 V DC; 0,8 A
(min.)	

direction of rotation	operating pressure	in switching solenoid
a		
clockwise	A	energised
anti-clockwise	B	de-energised

**Hydraulic control, speed related DA2, DA3, DA5, DA6**

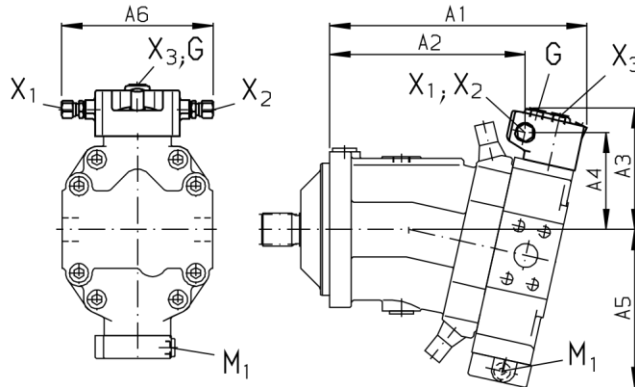
Sizes 28...200

### Unit Dimensions DA

Before finalising your design, please request a certified drawing.

#### Unit dimensions DA1, DA4

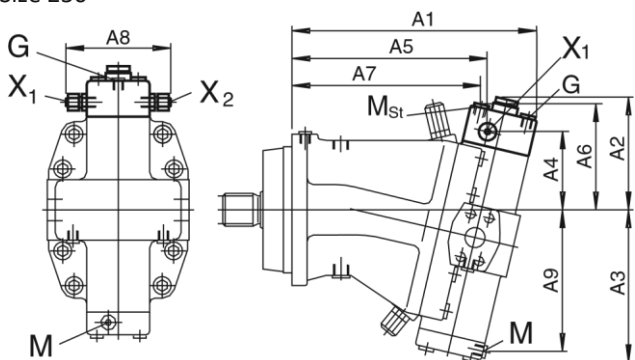
Sizes 28...200



Size	A1	A2	A3	A4	A5	A6	ports X <sub>1</sub> , X <sub>2</sub>
28	216	152	120	93	136	160	locking GE-8LM
55	242	179	122	94	151	160	locking GE-8LM
80	271	207	127	100	167	160	locking GE-8LM
107	291	216	134	107	175	174	locking GE-8LM
140	322	247	141	115	195	174	locking GE-8LM
160	329	254	141	115	197	174	locking GE-8LM
200	346	271	146	119	209	174	locking GE-8LM

#### Unit dimensions DA

Size 250

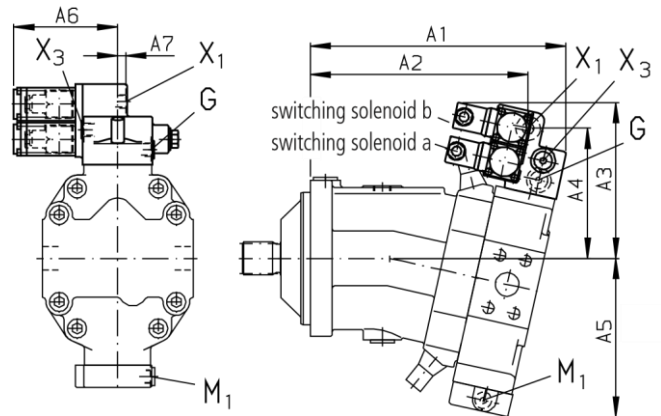


Size	A1	A2	A3	A4	A5	A6	A7	A8	A9
250	385	188 (max)	248	126	307	161	296	159	227

ports X<sub>1</sub>, X<sub>2</sub>: locking B0-GEV 8L/M14x1,5-WD

#### Unit dimensions DA2, DA3, DA5, DA6

Sizes 28...200

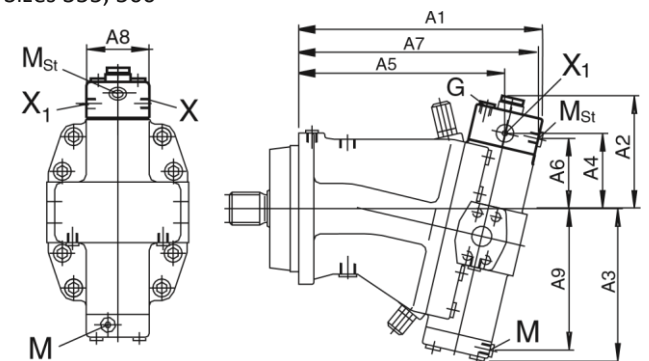


Size	A1	A2	A3	A4	A5	A6	A7	port X <sub>1</sub>
28	218	175	158	130	136	110	8,5	M14x1,5
55	245	202	159	132	151	110	8,5	M14x1,5
80	271	230	162	138	167	110	8,5	M14x1,5
107	292	239	173	146	175	112	8,5	M14x1,5
140	323	270	181	154	195	112	8,5	M14x1,5
160	330	277	181	153	197	112	8,5	M14x1,5
200	347	294	185	158	209	112	8,5	M14x1,5

X<sub>1</sub>: pilot pressure port

#### Unit dimensions DA

Sizes 355, 500



Size	A1	A2	A3	A4	A5	A6	A7	A8	A9
355	432	203 (max)	279	140	327	123	422	108	257
500	490	215 (max)	306	151	423	137	481	123	284

ports X<sub>1</sub>, X<sub>2</sub>: M14x1,5

## HA Automatic Control, High Pressure Related

With the automatic, high pressure related control, setting of the displacement is effected automatically as a function of the operating pressure.

This control device measures the operating pressure at A or B internally (no pilot line required) and swivels from  $V_{g, \min}$  with increasing working pressure to  $V_{g, \max}$  once the pressure setting of the control is reached.

Standard version HA1, HA2:

Start of control at  $V_{g, \min}$  (min. torque, max. perm. speed)

End of control at  $V_{g, \max}$  (max. torque, min. speed)

### HA1: Virtually no pressure increase

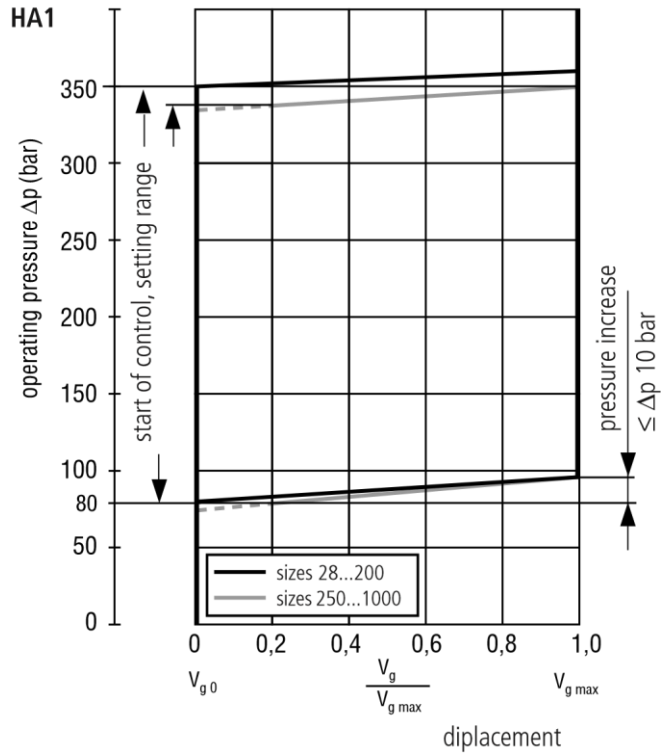
An working pressure increase of  $\Delta p \leq 10$  bar results in an increase of the displacement from 0  $\text{cm}^3$  to  $V_{g, \max}$  (sizes 28...200) respectively from  $0,2 V_{g, \max}$  to  $V_{g, \max}$  (sizes 250...1000).

Start of control, setting range

sizes 28...200 \_\_\_\_\_ 80 – 350 bar

sizes 250...10000 \_\_\_\_\_ 80 – 340 bar

When ordering please state required start of control in clear text, e.g.: start of control at 300 bar

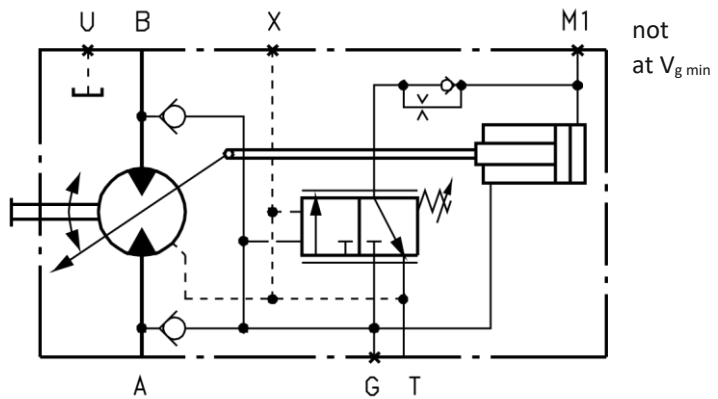


### Automatic control, high pressure related HA1

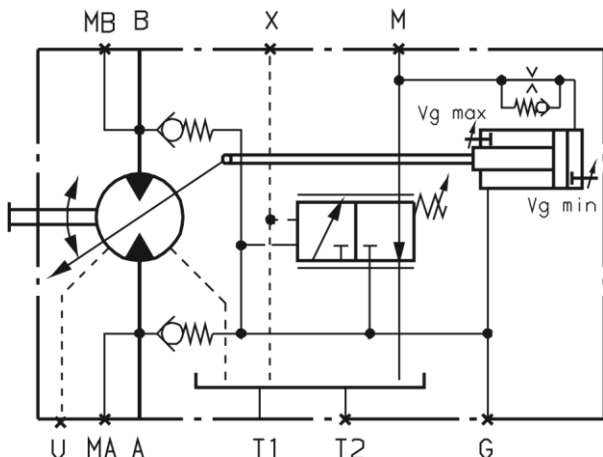
**Note:**

- Because of safety reasons hoist winch drives are allowed with control devices with start of control (standard design with HA)!

Sizes 28...200



Sizes 250...1000



Automatic control, high pressure related HA1

## HA Automatic Control, High Pressure Related

### HA2: Pressure increase $\Delta p = 100$ bar

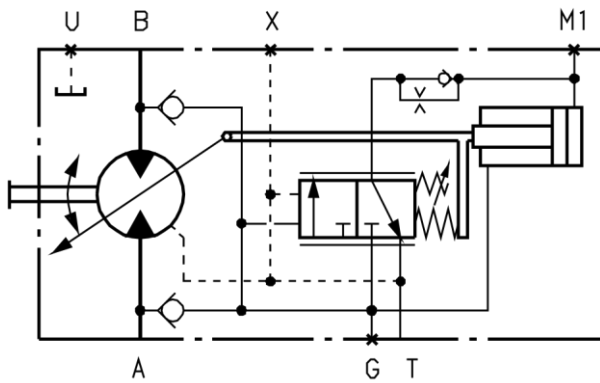
An working pressure increase from  $\Delta p = 100$  bar results in an increase of the displacement from  $0 \text{ cm}^3$  to  $V_{g \text{ max}}$  (sizes 28...200) respectively from  $0,2 V_{g \text{ max}}$  to  $V_{g \text{ max}}$  (sizes 250...1000).

Start of control, setting range

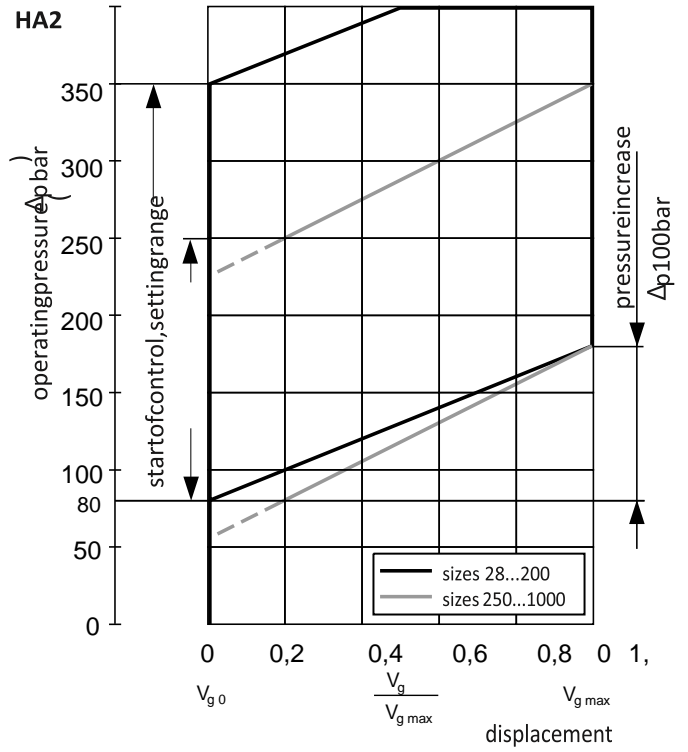
sizes 28...200 \_\_\_\_\_ 80 – 350 bar  
 sizes 250...1000 \_\_\_\_\_ 80 – 250 bar

When ordering please state required start of control in clear text, e.g.: start of control at 200 bar

Sizes 28...200

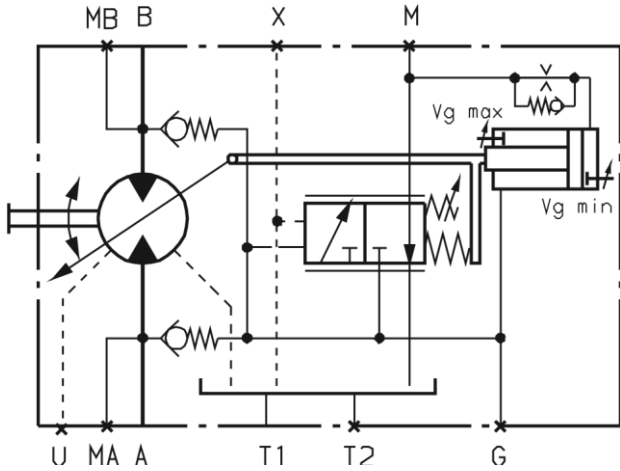


Automatic control, high pressure related HA2



**Automatic control, high pressure related HA2**

Sizes 250...1000



**HA Automatic Control, High Pressure Related (Override)**

**U1, U2 Electrical override of pressure setting**

On version HA1 the high pressure related control can be overridden by means of an electrical signal to a switching solenoid. The override causes the motor to swivel to its maximum angle.

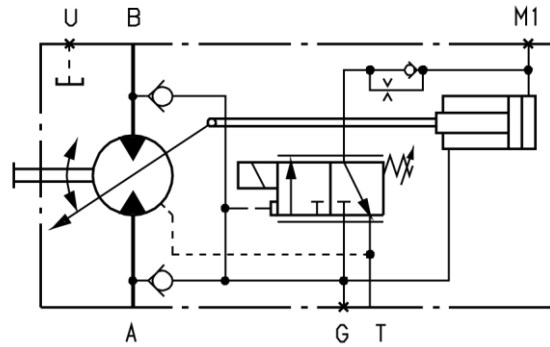
Switching solenoid de-energised  $\hat{=}$  energised no override  
 Switching solenoid energised  $\hat{=}$  energised motor set to  $V_g$   
 max

**U1** switching solenoid 12 V DC, 1,6 A (min.)

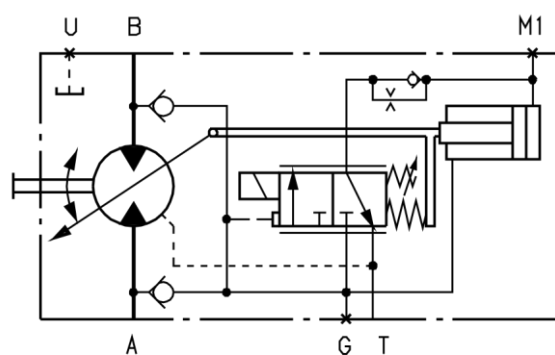
**U2** switching solenoid 24 V DC, 0,8 A (min.)

Start of control adjustable between 80 and 300 bar  
 (state required setting in clear text when ordering)

**HA1U1, HA1U2**



**HA2U1, HA2U2**





**R1, R2 Electrical override of pressure setting, with electrical valve for travel direction**

On the HA control version the high pressure related control can be overridden by a electrical signal to a switching solenoid b. The override swivels the variable to a max. swivel angle. switching solenoid b  $\hat{=}$  de-energisedno override switching solenoid b  $\hat{=}$  energisedmotor set to  $V_{g \max}$

The travel directional valve assures that the preselected pressure side of the variable motor always controls the swivel angle even at a change of the high pressure side (for instance travel drive down hill). The swivel of the variable motor to a bigger displacement can be avoided.

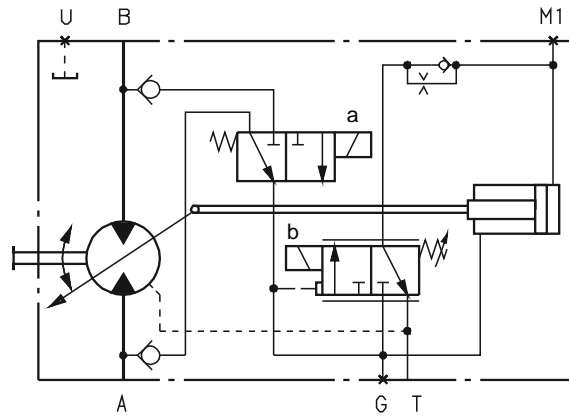
In relation of a change of direction (travel direction) the travel directional valve is actuated through the pressure spring or the switch solenoid a. direction of rotation operating pressure in switching solenoid a

clockwise	<b>A</b>	<b>de-energised</b>
anti-clockwise	<b>B</b>	<b>energised</b>

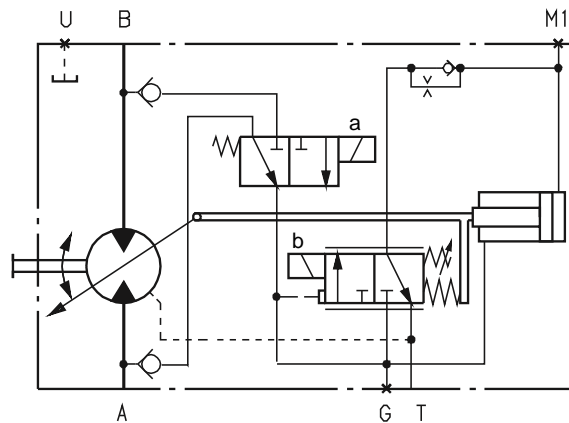
**R1** switching solenoid a, b 12 V DC 1,6 A (min.)

**R2** switching solenoid a, b 24 V DC 0,8 A (min.)

**HA1R1, HA1R2**



**HA2R1, HA2R2**



**T Hydraulic override of pressure setting**

For the HA control the start of control can be influenced by applying a pilot pressure at port X.

1 bar control pressure lowers the start of control by 17 bar (sizes 28...200) or 8 bar (sizes 250...1000).

Example (sizes 28...200):

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

If the override is only required to set the max displacement (motor swivel to  $V_{g \max}$ ), a pilot pressure of up to 100 bar max. is permissible.

(Circuit diagram and unit dimensions see control HA1, HA2, port X open, at sizes 250...1000 no connection from X to T)

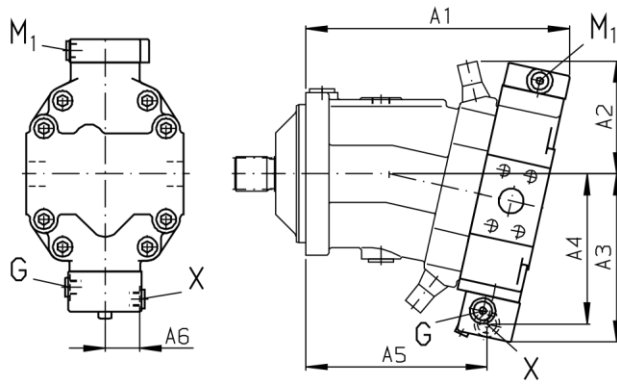
**Unit Dimensions HA**

**Unit dimensions HA1, HA2, HA1T, HA2T**  
 Sizes 28...200

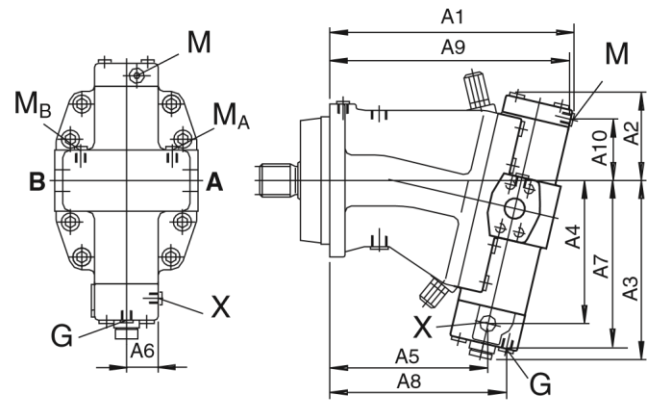
**Unit dimensions HA1, HA2, HA1T, HA2T**  
 Sizes 250...1000

Before finalising your design, please request a certified drawing.

<b>28</b>	209	97	151	133	134	34,5
<b>55</b>	237	104	159	142	159	33,4
<b>80</b>	268	114	171	152	183	34,5
<b>107</b>	290	122	183	164	199	40,5
<b>140</b>	316	132	198	178	225	40,5
<b>160</b>	323	137	200	181	232	40,5
<b>200</b>	339	143	209	190	245	40,5



Size    A1    A2    A3    A4    A5    A6



Size    A1    A2    A3    A4    A5    A6    A7    A8    A9    A10

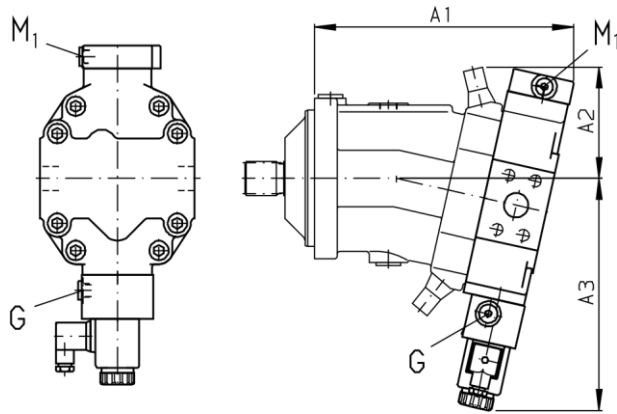
port X: M 14x1,5 (plugged, open for design HA.T)

<b>250</b>	384	161	275	210	248	48,5	248	278	377	116
<b>355</b>	432	181	300	234	279	54	275	315	425	132
<b>500</b>	489	196	325	258	322	61,5	300	359	483	144
<b>1000</b>										

port X: M 14x1,5 (plugged, open for design HA.T)

**Unit dimensions HA.U1, HA.U2**

Sizes 28...200

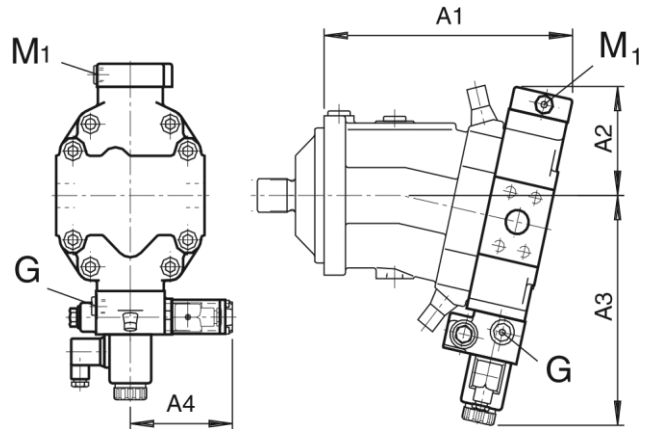


Size    A1    A2    A3

<b>28</b>	209	97	216
<b>55</b>	237	104	224
<b>80</b>	268	114	238
<b>107</b>	282	122	249
<b>140</b>	316	132	263
<b>160</b>	323	137	266
<b>200</b>	339	143	275

**Unit dimensions HA.R1, HA.R2**

Sizes 28...200



Size    A1    A2    A3    A4

<b>28</b>	209	97	216	110
<b>55</b>	237	104	224	110
<b>80</b>	268	114	238	110
<b>107</b>	282	122	249	112
<b>140</b>	316	132	263	112
<b>160</b>	323	137	266	112
<b>200</b>	339	143	275	112

### HD Hydraulic Control, Pilot Pressure Related

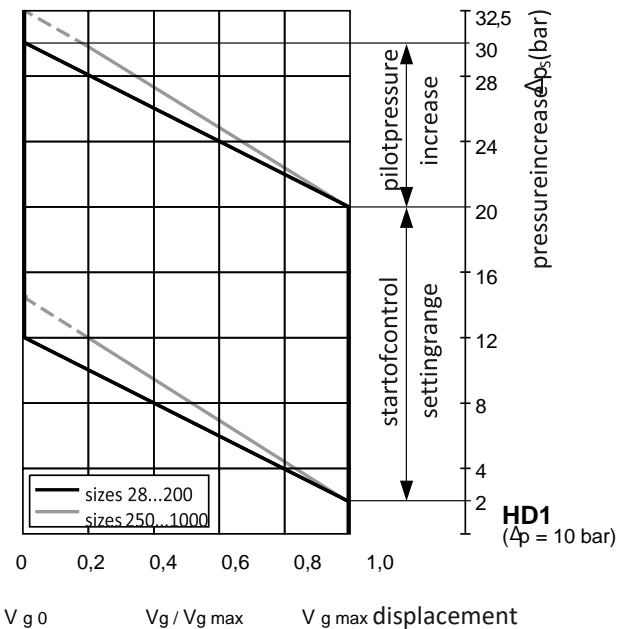
The pilot pressure related hydraulic control allows infinite variation of the motor displacement in relation to a pilot pressure signal. The control function is proportional to the pilot pressure applied at port X.

#### HD1: Pilot pressure increase $\Delta p_s = 10$ bar

A pilot pressure increase of 10 bar at port X results in a decrease of the displacement from  $V_{g \max}$  to  $0 \text{ cm}^3$  (sizes 28...200) respectively from  $V_{g \max}$  to  $0,2 V_{g \max}$  (sizes 250...1000).

Start of control, setting range \_\_\_\_\_ 2 – 20 bar

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



#### HD2: Pilot pressure increase $\Delta p_s = 25$ bar

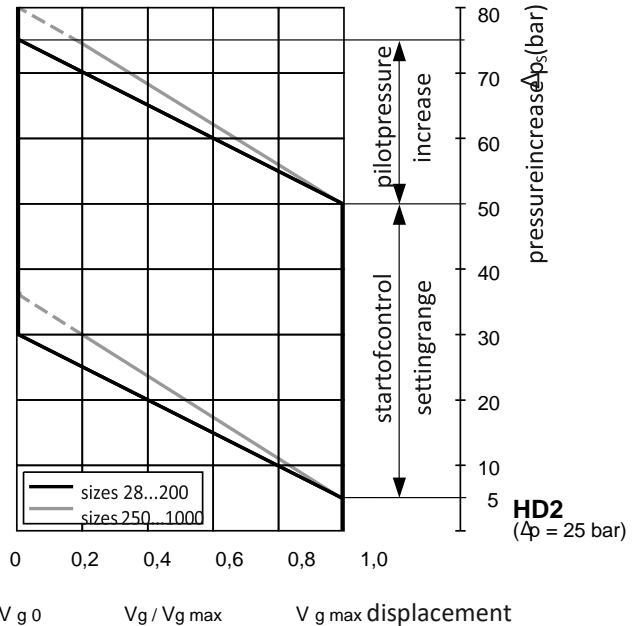
A pilot pressure increase of 25 bar at port X results in a decrease of the displacement from  $V_{g \max}$  to  $0 \text{ cm}^3$  (sizes 28...200) respectively from  $V_{g \max}$  to  $0,2 V_{g \max}$  (sizes 250...1000).

Start of control, setting range \_\_\_\_\_ 5 – 50 bar

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



- The start of control and the HD curve is influenced by the housing pressure. An increase of the housing pressure



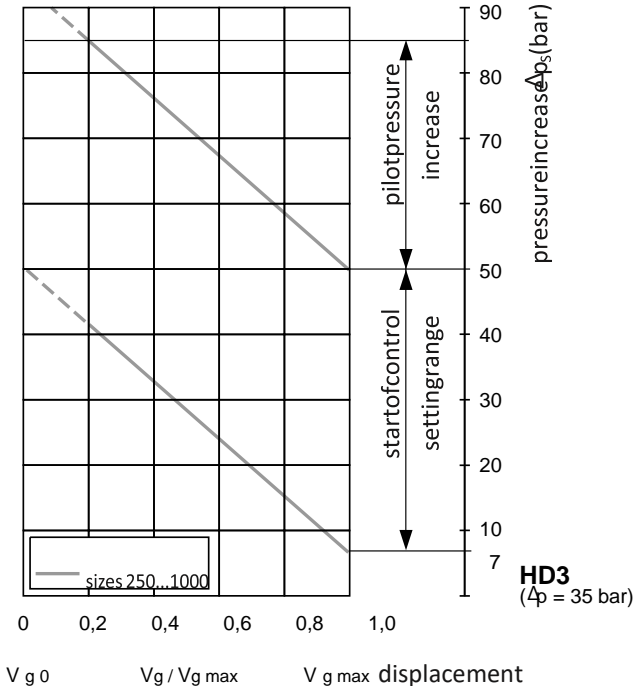
$V_{g0}$   $V_g / V_{g \max}$   $V_{g \max}$  displacement

- Standard version:
- start of control at  $V_{g \max}$  (max. torque, min. speed)
  - end of control at  $V_{g \min}$  (min. torque, max. perm. speed)

#### HD3: Pilot pressure increase $\Delta p_s = 35$ bar

A pilot pressure increase of 35 bar at port X results in a decrease of the displacement from  $V_{g \max}$  to  $0,2 V_{g \max}$  (sizes 250...1000).

Start of control, setting range \_\_\_\_\_ 7 – 50 bar Standard setting: start of control at 10 bar (end of control at 45 bar) Note:



$V_{g0}$   $V_g / V_{g \max}$   $V_{g \max}$  displacement

causes an increase of the start of control and thus a parallel displacement of the curve characteristic (see page 5).

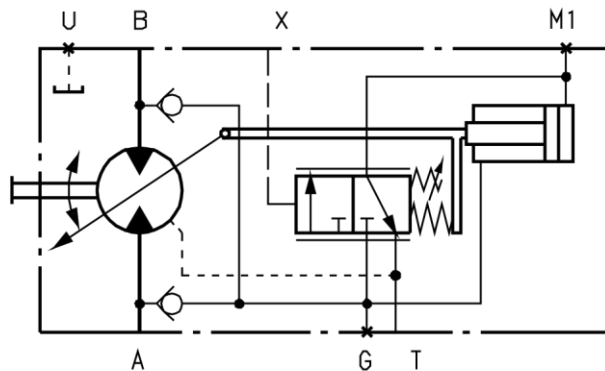
- The required control oil is taken from the high pressure side; for this, a minimum operating pressure of 15 bar is necessary. If it is necessary to operate the control at an operating pressure of <15 bar, a boost pressure of min. 15 bar must be applied at port G via an external check valve (max. perm. pilot pressure 100 bar).
- Due to internal leakage a leakage flow of approx. 0,3 L/min occurs at port X. In order to avoid the influence of the curve characteristic the leakage flow must be led out through the control module into the tank.
- When ordering please state required start of control in clear text, e.g.: start of control at 10 bar

**Unit dimensions control HD, see pages 23...33**

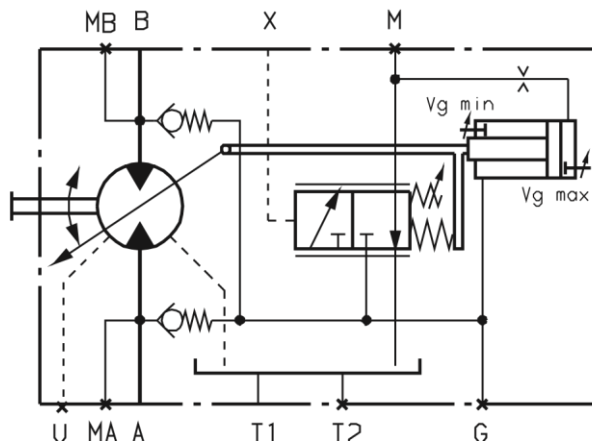
## HD Hydraulic Control, Pilot Pressure Related

### Hydraulic control, pilot pressure related HD1, HD2, HD3

Sizes 28...200



Sizes 250...1000



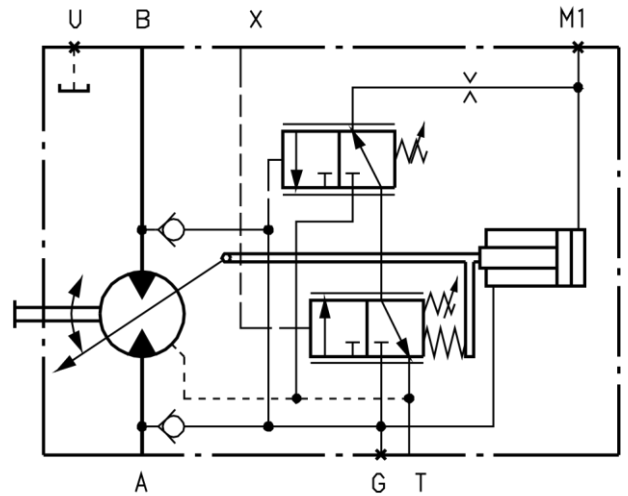
#### Variation: Constant pressure control (HD.D)

The constant pressure control is superimposed on the HD function. Should system pressure rise as a result of the load torque or reduction of the motor swivel angle, when the setting of the constant pressure control is reached the motor is swivelled out to a higher angle.

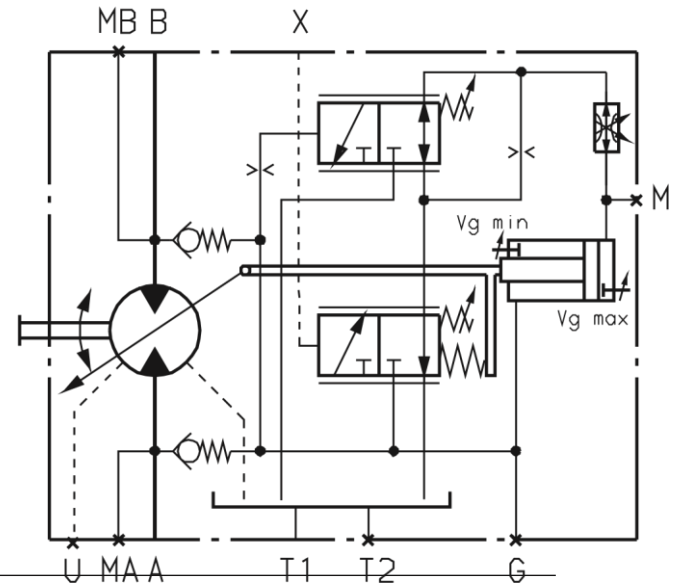
As a result of the increased displacement and consequent pressure reduction, the control deviation is eliminated. By increasing the displacement the motor produces a higher torque at a constant pressure.

Setting range of constant pressure control valve: sizes 28...200 \_\_\_\_\_ 80 - 400 bar  
 sizes 250...1000 \_\_\_\_\_ 80 - 350 bar

Sizes 28...200 (HD.D)



Sizes 250...1000 (HD.D)

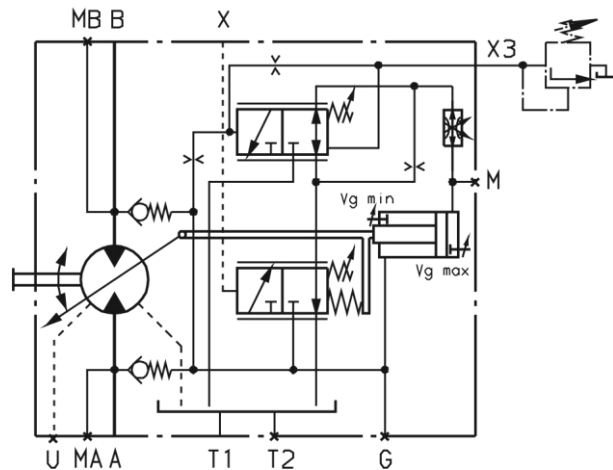


DBD 6 (hydraulic) to RE 25402

The max. line length should not exceed

2 m.

Sizes 250...1000 (HD.G)



## HD Hydraulic Control, Pilot Pressure Related

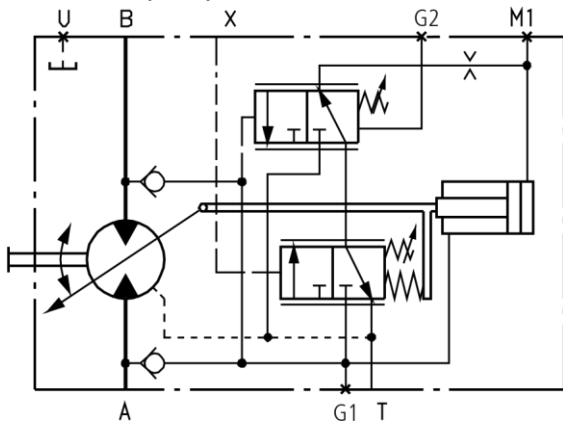
### Variation: Remote constant pressure control (HD.G)

The remote pressure control controls the motor when reaching the set pressure command signal continuously until it reaches the max. displacement  $V_{g \text{ max}}$ . A pressure relief valve (not supplied), which is separate to the motor, is responsible for the control of the internal pressure cut-off valve. As long as the pressure command signal has not been obtained, the valve is, in addition to the spring force, pressurised from both sides, and is held closed. The pressure command signal is between 80 bar and 350 bar. On reaching the pressure command signal at the separate pressure relief valve, this opens, whereby the pressure on the spring side is allowed to flow to tank. The internal pilot valve operates and the motor swivels to maximum displacement  $V_{g \text{ max}}$ . The pressure difference at the pilot valve is set as standard to 25 bar. We recommend the following as a separate pressure relief valve:

**Variation: pressure control with 2nd pressure setting (HD.E)**

Through input of an external control pressure at port G2 the setting of the pressure regulator can be overridden and a 2nd pressure setting can be realised. The pressure signal at port G2 must be between 20 and 50 bar (when ordering please state the 2nd pressure setting in clear text).

Sizes 28..200 (HD.E)

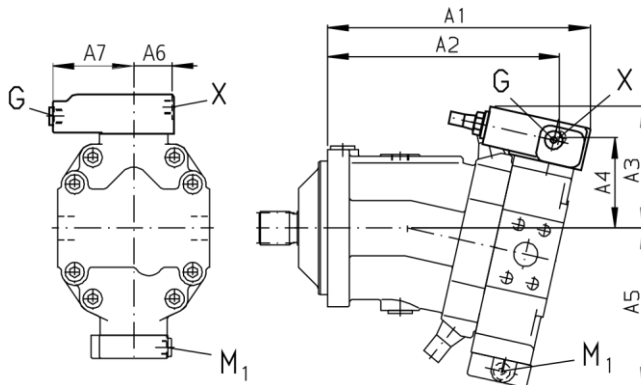


### Unit Dimensions HD

Before finalising your design, please request a certified drawing.

#### Unit dimensions HD.D

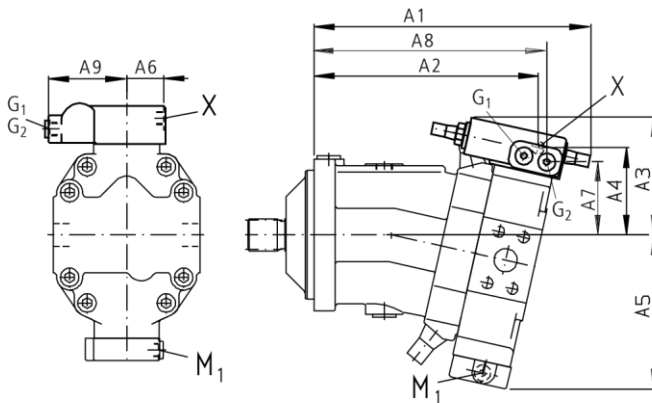
Sizes 28...200



Size	A1	A2	A3	A4	A5	A6	A7
28	214	189	119	87	136	35,5	88,5
55	241	216	120	89	151	35,5	88,5
80	269	244	126	95	167	35,5	88,5
107	291	258	133	101	175	40,5	88,5
140	323	290	141	108	195	40,5	88,5
160	329	297	141	108	197	40,5	88,5
200	346	313	145	112	209	40,5	88,5

#### Unit dimensions HD.E

Sizes 28...200



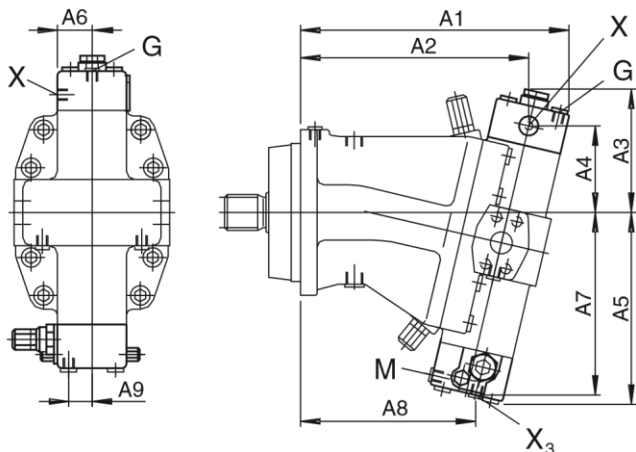
Size	A1	A2	A3	A4	A5	A6	A7	A8	A9
28									
55	272	216	126	89	151	35,5	76	232	88,5
80	301	244	129	95	167	35,5	79	259	88,5
107	311	258	136	101	175	40,5	86	270	88,5
140									
160	349	297	144	108	197	40,5	93	309	88,5
200	369	313	147	112	209	40,5	98	324	88,5

G1: port for synchronous control of a number of units and for remote control pressure  
M 14x1,5 (plugged)

G2: port for 2nd pressure setting  
M 14x1,5 (plugged)

#### Unit dimensions HD.D, HD.G

Sizes 250...1000



Size	A1	A2	A3	A4	A5	A6	A7	A8	A9
250	385	327	188	123	272	48,5	256	276	35
355	432	366	203	137	288	54	271	287	33
500	490	417	215	148	306	61,5	287	314	23
1000	618	537	274	189	388	70	373	420	51

pilot pressure port X<sub>3</sub>: M 14x1,5 (open at HD.G, plugged at HD.D)



Unit dimensions of control HD1 and HD2: see pages 22...32

### HZ Hydraulic Two-Position Control

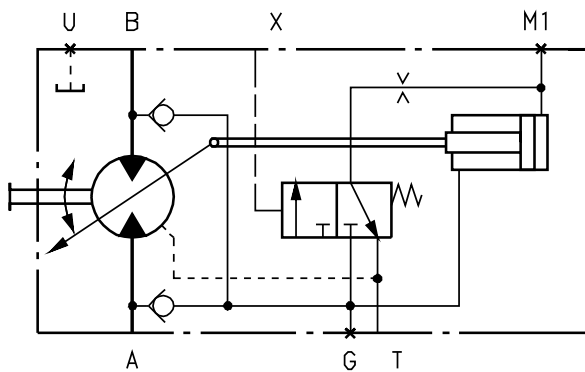
The hydraulic two-position control allows the displacement to be set to  $V_{g \text{ min}}$  or  $V_{g \text{ max}}$  by application or non-application of pilot pressure to port X.

without control pressure motor set  $\cong$  to  $V_{g \text{ max}}$  with control pressure ( $> 10 \text{ bar}$ ) motor set to  $V_{g \text{ min}}$

The required control oil is taken from the high pressure side; for this, a minimum operating pressure of 15 bar is necessary. If it is necessary to operate the control at an operating pressure of  $< 15 \text{ bar}$ , a boost pressure of min. 15 bar must be applied at port G via an external check valve.

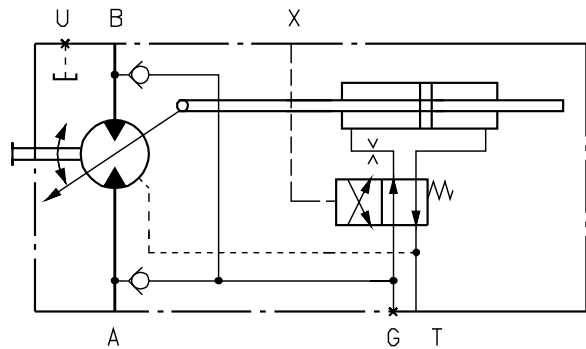
#### Hydraulic two-position control HZ1

Sizes 28, 140, 160, 200



#### Hydraulic two-position control HZ3

Sizes 55, 80, 107

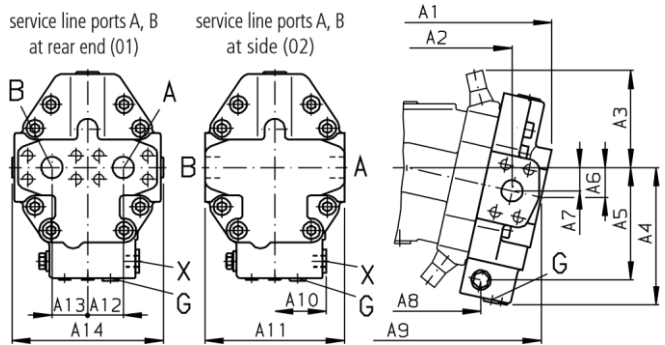


#### Hydraulic two-position control HZ

Before finalising your design, please request a certified drawing.

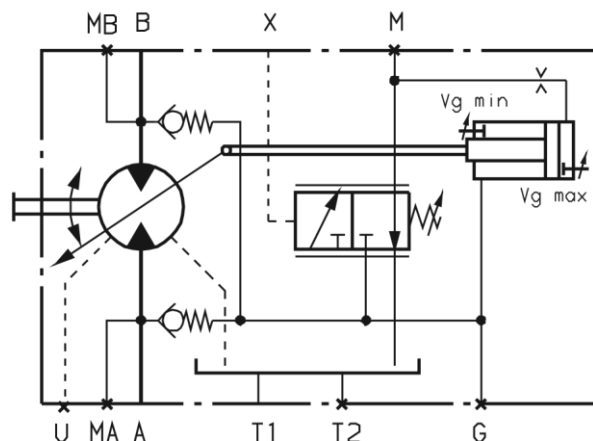
#### Unit dimensions HZ3 \*)

Sizes 55, 80, 107



Size	A1	A2	A3	A4	A5	A6	A7	A8	A9
55	227	183	100	146	117	31	24	151	215
80	255	208	114	161	132	35	27	172	242
107	270	220	122	173	143	38	30	182	256

Sizes 250...1000

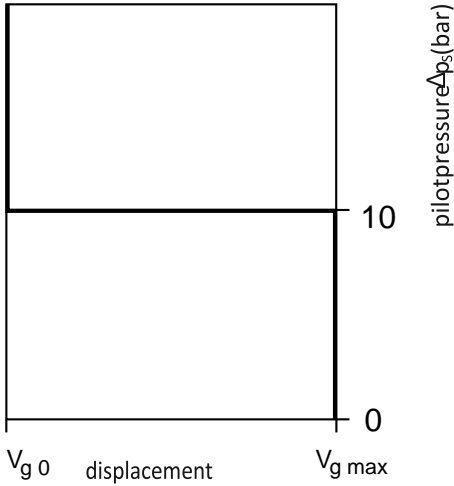


Size	A10	A11	A12	A13	A14	ports A, B	port X
55	61	152	37,5	37,5	160	SAE 3/4"	M14x1,5
80	61	164	42	42	172	SAE 1	M14x1,5
107	61	180	42	42	188	SAE 1	M14x1,5

\*) unit dimensions of control HZ (sizes 250...1000) and HZ1 (sizes 28, 140, 160, 200) see pages 22-32

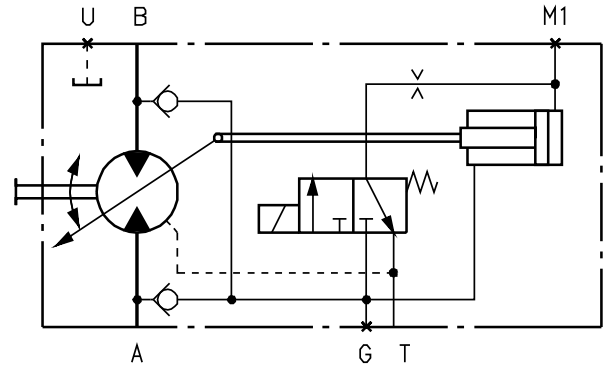
Standard version:

- start of control at  $V_{g \text{ max}}$  (max. torque, min. speed)
- end of control at  $V_{g \text{ min}}$  (min. torque, max. perm. speed)



**Electrical two-position control EZ1, EZ2**

Sizes 28, 140, 160, 200



**Electrical two-position**

**EZ Electrical Two-Position Control with Switching Solenoid**

The electrical two-position control with switching solenoid allows the displacement to be set to  $V_{g\ max}$  or  $V_{g\ min}$  by energising or deenergising the solenoid.

- Solenoid de-energised     motor set to  $V_{g\ max}$
- Solenoid energised        motor set to  $V_{g\ min}$

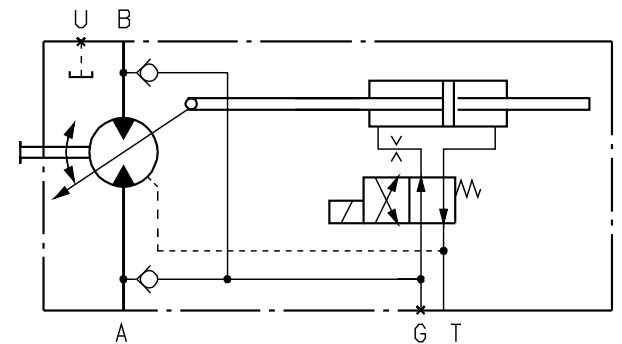
EZ1, EZ3     switching solenoid 12 V DC, 26W (EZ1) 30W (EZ3)

EZ2, EZ4     switching solenoid 24 V DC, 26W (EZ2) 30W (EZ4)

The required control oil is taken from the high pressure side; for this, a minimum operating pressure of 15 bar is necessary. If it is necessary to operate the control at an operating pressure of <15 bar, a boost pressure of min. 15 bar must be applied at port G via an external check valve.

**control EZ3, EZ4**

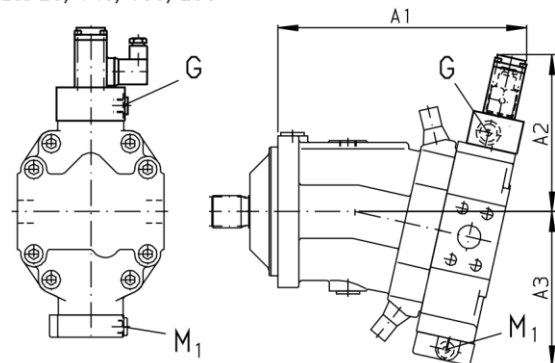
Sizes 55, 80, 107



**Electrical two-position control EZ1, EZ2**

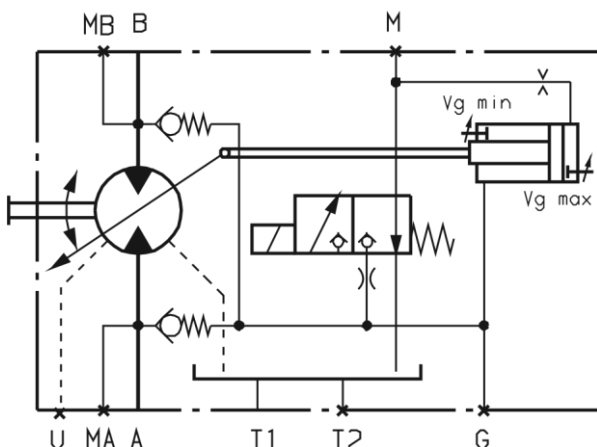
**Unit dimensions EZ1, EZ2**

Sizes 28, 140, 160, 200



Size	A1	A2	A3
28	216	163	136
140	321	184	195
160	328	184	197
200	344	188	209

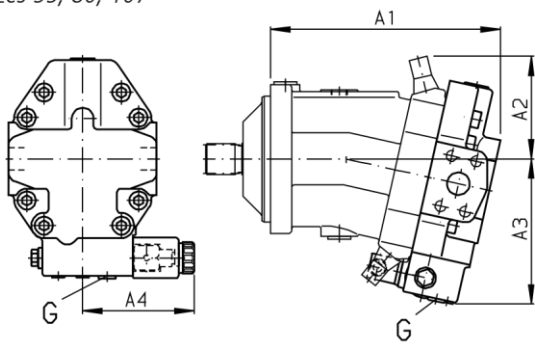
Sizes 250...1000



250	385	171	248	125
355	432	182	279	128,5
500	490	197	306	135,5
1000				

**Unit dimensions EZ3, EZ4**

Sizes 55, 80, 107

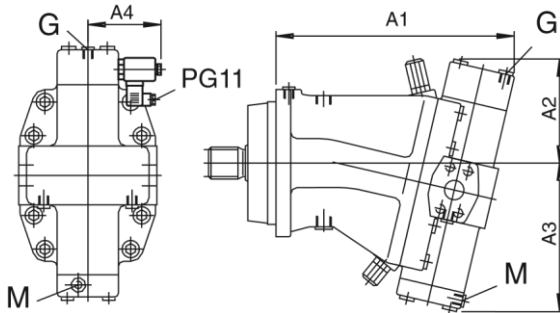


Size	A1	A2	A3	A4
55	227	100	146	124
80	255	114	161	124
107	270	122	173	124

(additional dimensions of the port plate see page 18, HZ3-control)

**Unit dimensions EZ1, EZ2**

Sizes 250...1000



Size	A1	A2	A3	A4
------	----	----	----	----

**EP Electrical Control, with Proportional Solenoid**

The electrical control with proportional solenoid or proportional valve (sizes 250...1000) allows infinite variation of the motor displacement in relation to an electrical signal.

The control function is proportional to the electrical control current applied.

For the sizes 250...1000 an external pressure of  $p_{min} = 30$  bar is necessary ( $p_{max} = 100$  bar) at port P for the control oil supply.

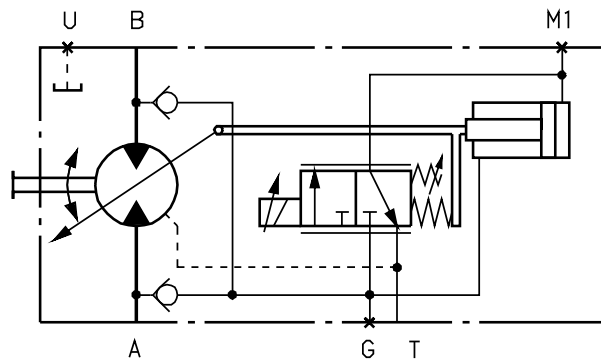
Sizes 28...200		control current	
control voltage (DC)		start of control ( $V_{g,max}$ )	end of control ( $V_{g,min} = 0$ )
EP1	12 V	400 mA	1200 mA
EP2	24 V	200 mA	600 mA

Sizes 250...1000		control current	
control voltage (DC)		start of control ( $V_{g,max}$ )	end of control ( $V_{g,min} = 0,2 V_{g,max}$ )

EP1	12 V	900 mA	1400 mA
EP2	24 V	450 mA	700 mA

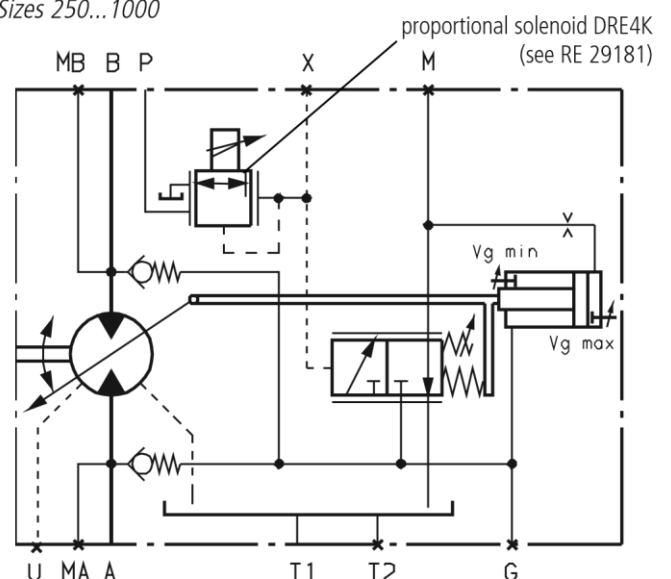
**Electrical control with proportional solenoid EP1, EP2**

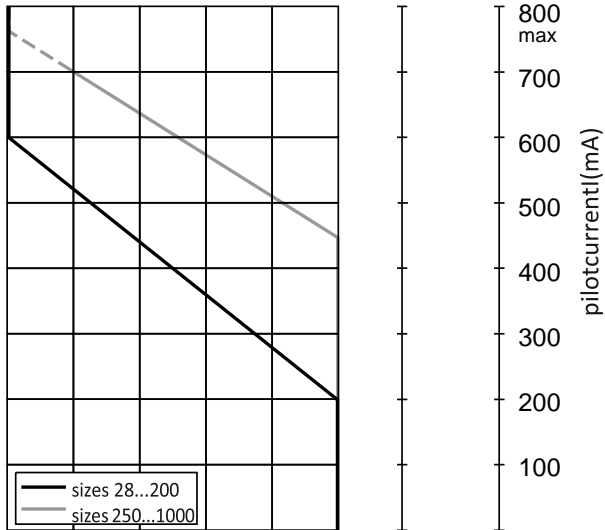
Sizes 28...200



**Electrical control with proportional solenoid EP1, EP2**

Sizes 250...1000





Chopper amplifier CV \_\_\_\_\_ see RE 95029  
 Electrical amplifier 2014/15 \_\_\_\_\_  
 see RE 95027

Electrical amplifier VT 2000, series 40 \_\_\_\_\_ see RE 29908

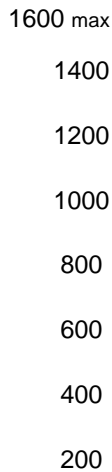
**Variation: Direct constant pressure control (EP.D)**

The constant pressure control is superimposed on the EP function. Should system pressure rise as a result of the load torque or reduction of the motor swivel angle, when the setting of the constant pressure control is reached the motor is swivelled out to a higher angle.

As a result of the increased displacement and consequent pressure reduction, the control deviation is eliminated. By increasing the displacement the motor produces a higher torque at a constant pressure.

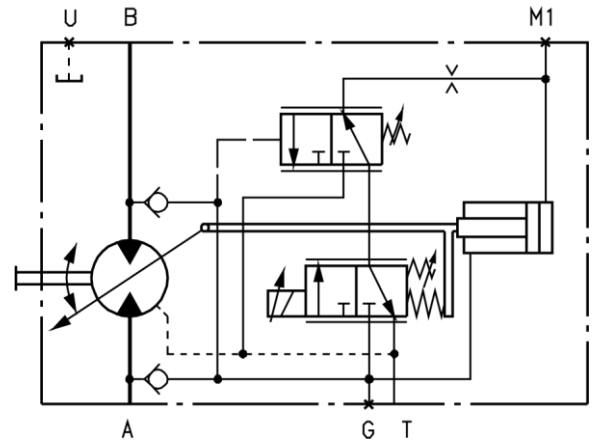
Setting range of constant pressure control valve:

**EP Electrical Control, with Proportional Solenoid**

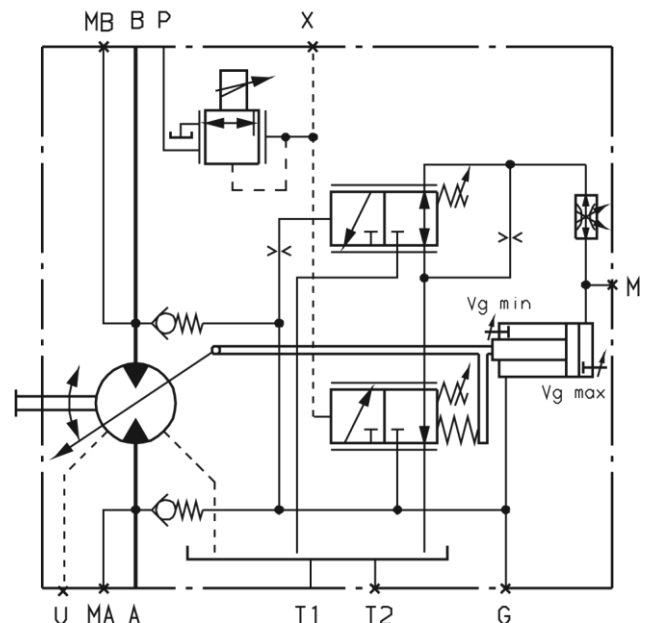


Sizes 28...200 \_\_\_\_\_ 80 - 400  
 bar Sizes 250...1000 \_\_\_\_\_ 80 - 350 bar

Sizes 28...200 (EP.D)



Sizes 250...1000 (EP.D)



0 0,2 0,4 0,6 0,8 1,0 **EP1** **EP2**  
 V<sub>g</sub> V<sub>g</sub> V<sub>g max</sub> (12 V) (24 V)  
 0 \_\_\_\_\_ displacement  
 V<sub>g max</sub>

Standard version:

- start of control at V<sub>g max</sub> (max. torque, min. speed)
- end of control at V<sub>g min</sub> (min. torque, max. perm. speed)

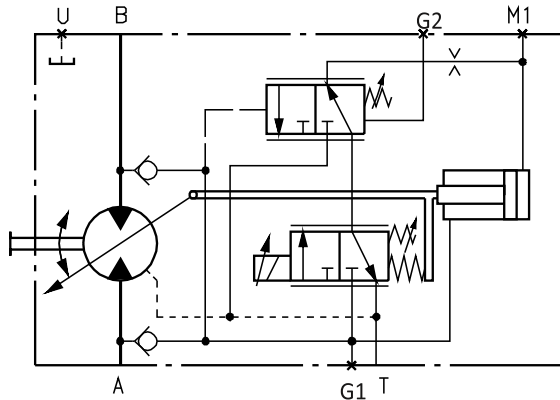
The required control oil is taken from the high pressure side; for this, a minimum operating pressure of 15 bar is necessary. If it is necessary to operate the control at an operating pressure of <15 bar, a boost pressure of min. 15 bar must be applied at port G via an external check valve (max. perm. pilot pressure: 100 bar).

Adjustment of the control speed or limiting of the displacement (limiting of swivel) range by electrical means is possible using the following control devices:

Proportional amplifier PV \_\_\_\_\_ see RE 95023

**Variation: pressure control with 2nd pressure setting (EP.E)**

Through input of an external control pressure at port G2 the setting of the pressure regulator can be overridden and a 2nd pressure setting can be realised. The pressure signal at port G2 must be between 20 and 50 bar (when ordering please state the 2nd pressure setting in clear text).

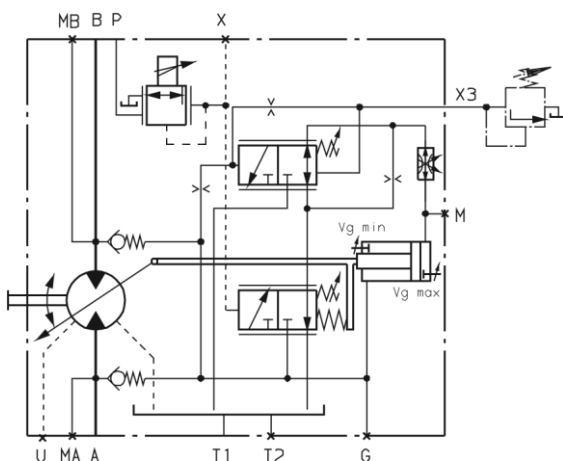
**Sizes 28...200 (EP.E)****Variation: Remote constant pressure control (EP.G)**

The remote pressure control controls the motor when reaching the set pressure command signal continuously until it reaches the max. displacement  $V_{g \max}$ . A pressure relief valve (not supplied), which is separate to the motor, is responsible for the control of the internal pressure cut-off valve.

As long as the pressure command signal has not been obtained, the valve is, in addition to the spring force, pressurised from both sides, and is held closed. The pressure command signal is between 80 bar and 350 bar. On reaching the pressure command signal at the separate pressure relief valve, this opens, whereby the pressure on the spring side is allowed to flow to tank. The internal pilot valve operates and the motor swivels to maximum displacement  $V_{g \max}$ . The pressure difference at the pilot valve is set as standard to 25 bar. We recommend the following as a separate pressure relief valve:

DBD 6 (hydraulic) to RE 25402 The

max. line length should not exceed 2 m.

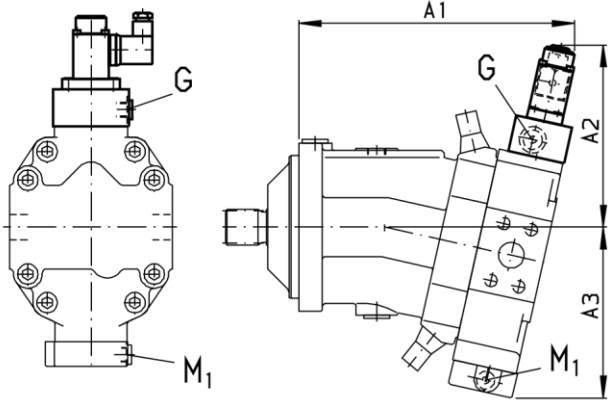
**Sizes 250...1000 (EP.G)**

Before finalising your design, please request a certified drawing.

### Unit Dimensions EP

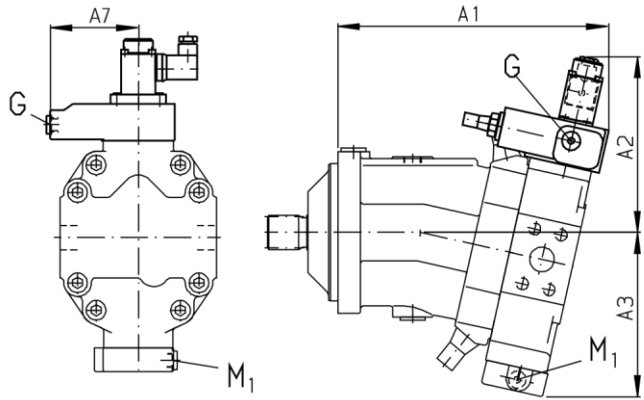
#### Unit dimensions EP1, EP2

Sizes 28...200



#### Unit dimensions EP.D

Sizes 28...200



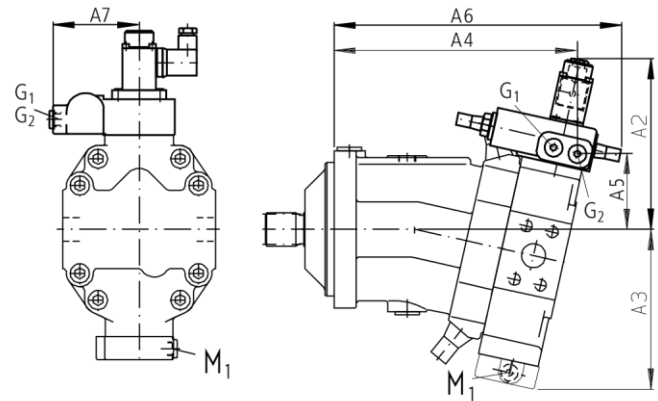
Size	A1	A2	A3	A4	A5	A6	A7
28	214	166	136				88,5
55	241	167	151	231	73	271	88,5
80	269	173	167	259	79	299	88,5
107	290	179	175				88,5
140	322	187	195				88,5
160	329	187	197	309	93	351	88,5
200	345	191	209	325	97	368	88,5

G1: port for synchronous control of a number of units and for remote control pressure  
M 14x1,5 (plugged)

G2: port for 2nd pressure setting  
M 14x1,5 (plugged)

#### Unit dimensions EP.E

Sizes 28...200

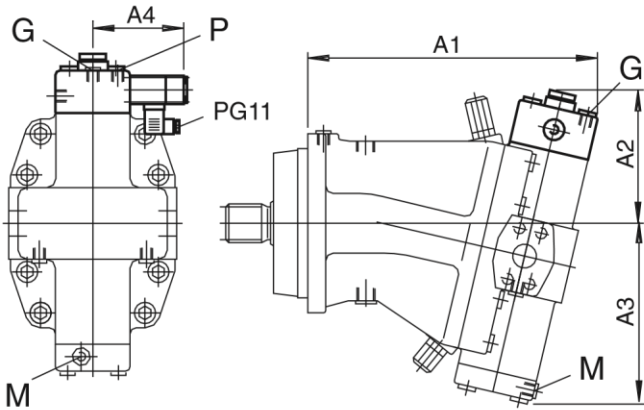


### Unit dimensions EP1, EP2

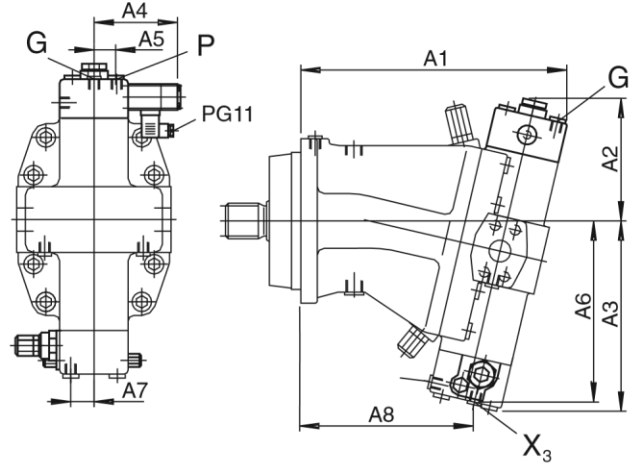
### Unit dimensions EP.D, EP.G

Before finalising your design, please request a certified drawing.

Sizes 250...1000



Sizes 250...1000



Size	A1	A2	A3	A4
250	385	188	272	124
355	432	203	288	125
500	490	215	306	132
1000				

Size	A1	A2	A3	A4	A5	A6	A7	A8
250	385	188	272	124	36	256	35	267
355	432	203	288	125	36	271	33	287
500	490	215	306	132	43	287	32	314
1000								

pilot pressure port P: M 14x1,5

pilot pressure port P: M 14x1,5

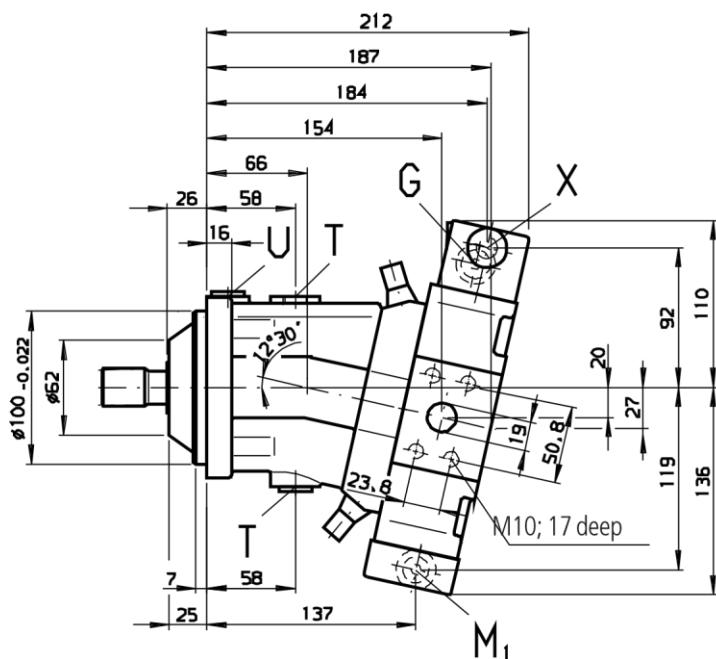
pilot pressure port X<sub>3</sub>: M 14x1,5 (open at EP.G, plugged at EP.D)

**Unit Dimensions Size 28**

Hydraulic control, pilot pressure related HD1, HD2

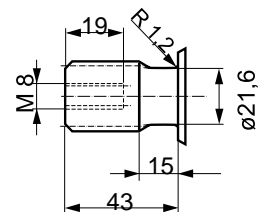
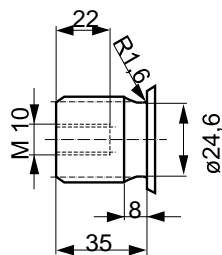
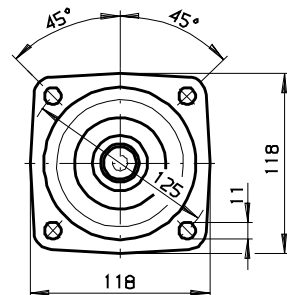
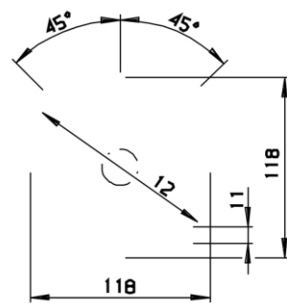
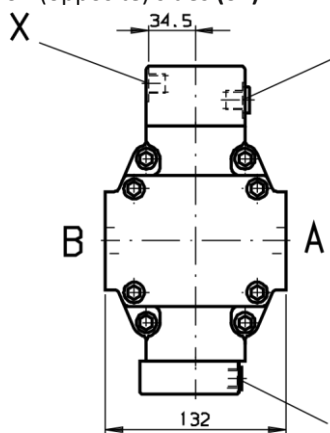
Before finalising your design, please request a certified drawing.

**Hydraulic two-position control HZ1**  
 Service line ports A/B on (opposite) sides (02)



View Z

Service line ports A/B on (opposite) sides (02)



Service line ports A/B

**Shaft ends**

**A**  
 Splined shaft  
 W 30x2x30x14x9g  
 DIN 5480

**Z**  
 Splined shaft,  
 W 25x1,25x30x18x9g  
 DIN 5480



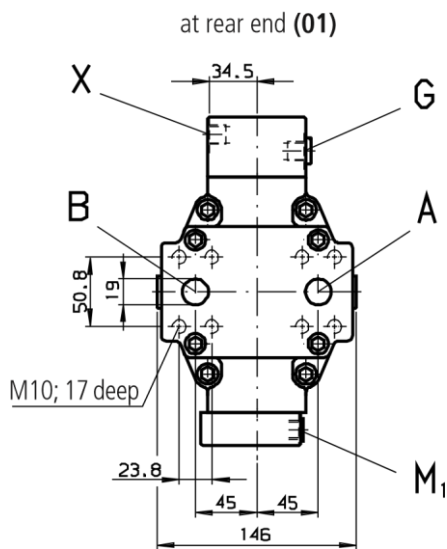
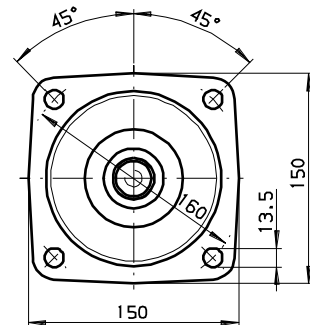
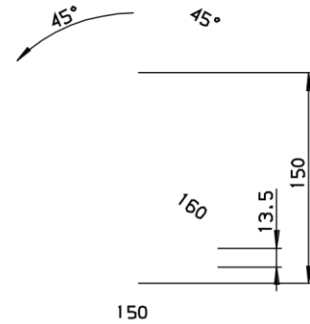
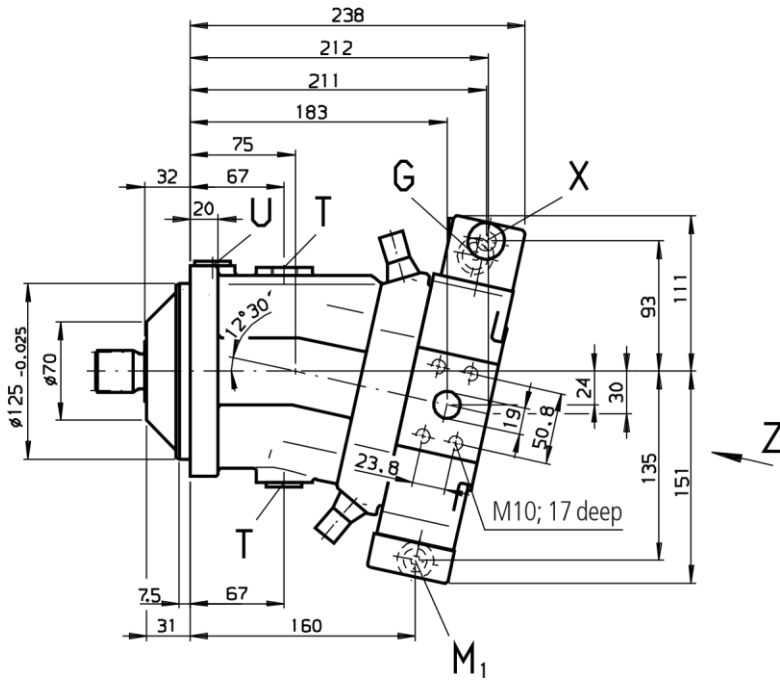


Before finalising your design, please request a certified dr

**Unit Dimensions Size 55**

**Hydraulic control, pilot pressure related HD1, HD2**  
 Service line ports A/B on (opposite) sides **(02)**

A; B  
 Service  
 line  
 ports  
 SAE  
 3/4"  
 420 bar  
 (6000  
 psi) high



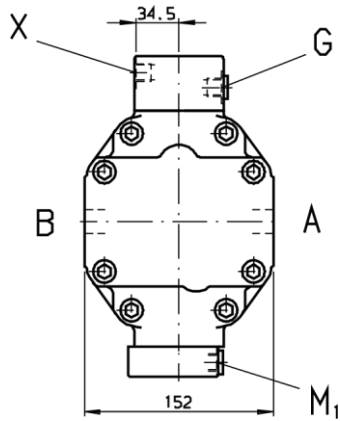
pressure series

- G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)
- X Pilot pressure port M 14x1,5 T Case drain port M 18x1,5
- U Flushing port (plugged) M 16x1,5
- M<sub>1</sub> Test port for control pressure (plugged) M 14x1,5
- View Z Service line ports A/B

on (opposite) sides **(02)**

**Connections**

Before finalising your design, please request a certified drawing.

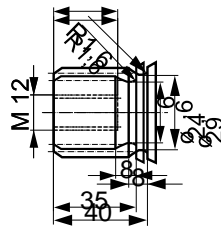
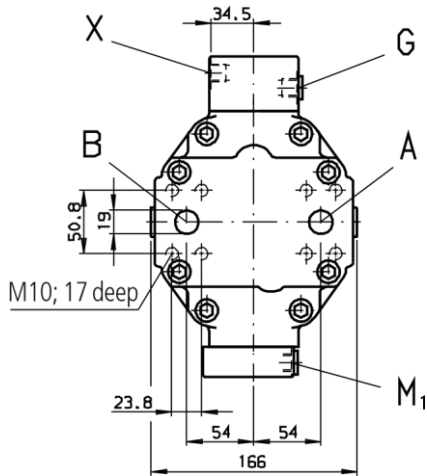


**Shaft ends**

**A**  
Splined shaft  
W 35x2x30x16x9g  
DIN 5480  
28

**Z**  
Splined shaft  
W 30x2x30x14x9g  
DIN 5480  
28

Service line ports A/B  
at rear end (01)



**Connections**

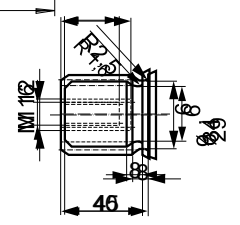
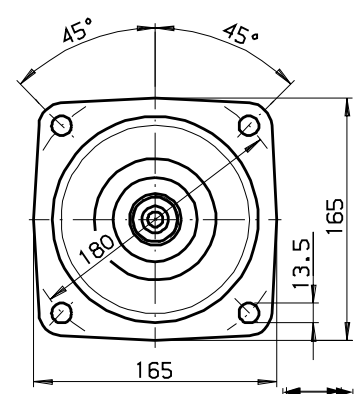
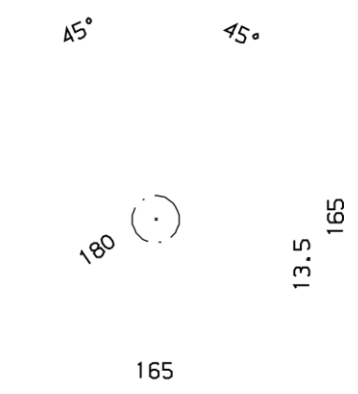
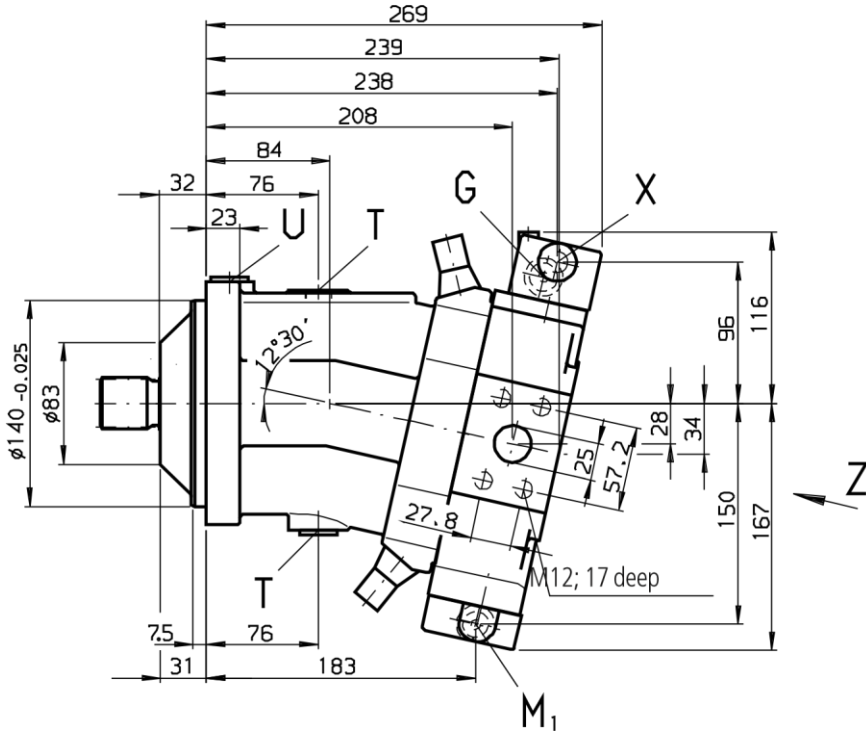
- A; B Service line ports SAE 3/4"  
420 bar (6000 psi) high pressure series
- G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)
- X Pilot pressure port M 14x1,5
- T Case drain port M 18x1,5
- ▲ UFlushing port (plugged) M 18x1,5

Before finalising your design, please request a certified drawing

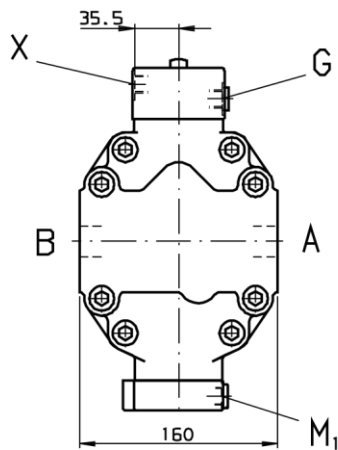
### Unit Dimensions Size 80

**Shaft ends**

**Hydraulic control, pilot pressure related HD1, HD2**  
Service line ports A/B on (opposite) sides (02)



M<sub>1</sub> Test port for control pressure (plugged)  
M 14x1,5 View Z Service line ports A/B  
on (opposite) sides (02)

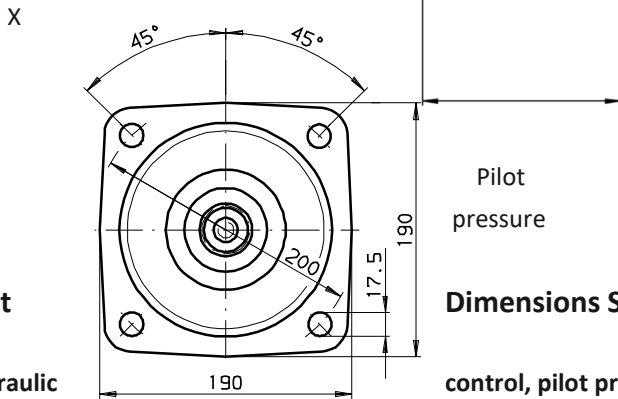


Before finalising your design, please request a certified drawing.

Service line ports A/B

Connections

- A; B Service line ports SAE 1" 420 bar (6000 psi) high pressure series
- G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)



Unit

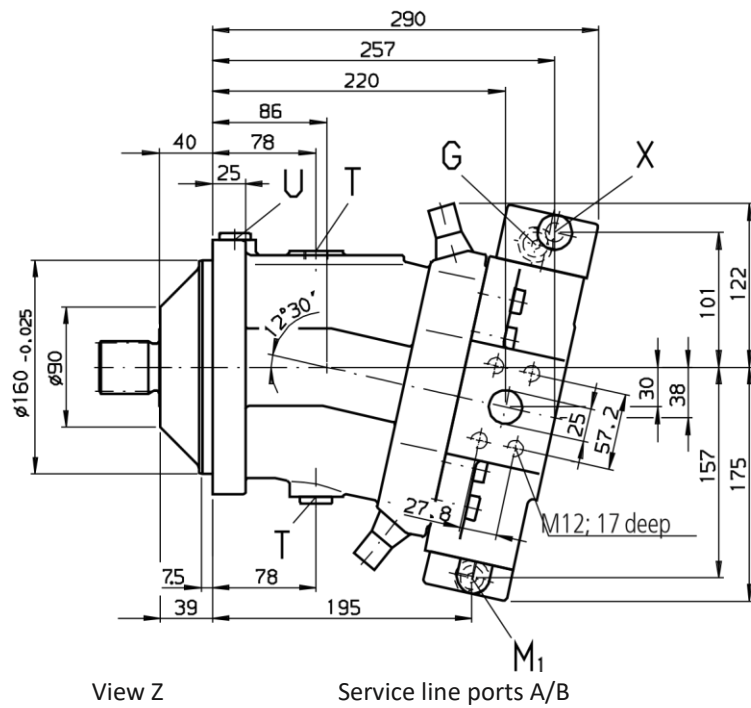
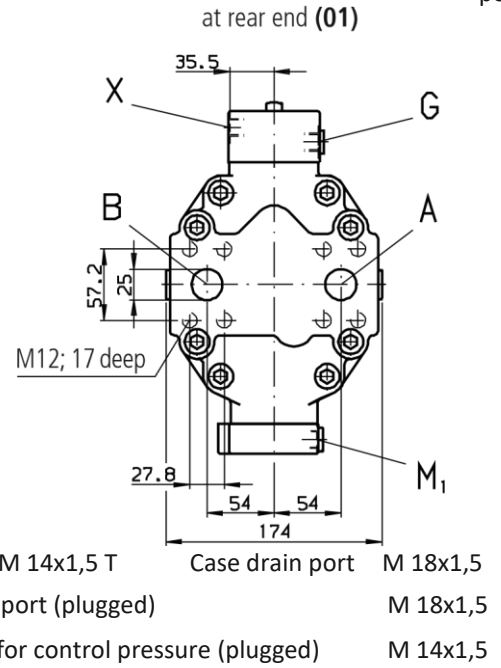
Hydraulic

Service line ports A/B on (opposite) sides (02)

Dimensions Size 107

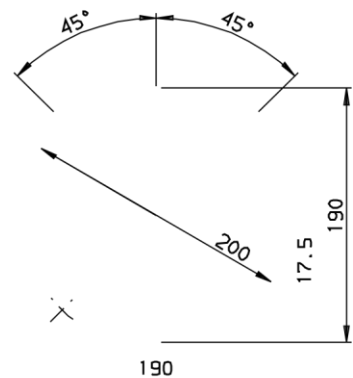
control, pilot pressure related HD1, HD2

port



View Z

Service line ports A/B



Service line ports A/B



Before finalising your design, please request a certified drawing.

on (opposite) sides (02)

40.5

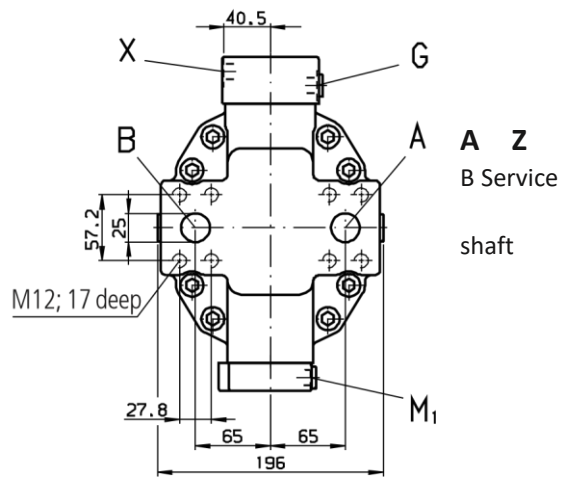
Shaft ends

Connections

line ports  
Splined

A;  
SAE 1"

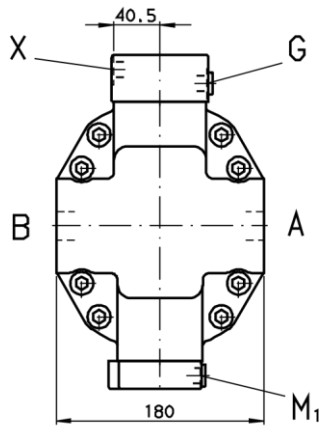
at rear end (01)



Splined shaft, 420 series

W 40x2x30x18x9g  
synchronous control of a  
DIN 5480 DIN  
remote control pressure

bar (6000 psi) high pressure  
W 45x2x30x21x9g  
G Port for  
number of M 14x1,5  
5480 units and for  
(plugged)



Pilot pressure port M 14x1,5  
T Case drain

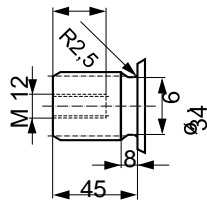
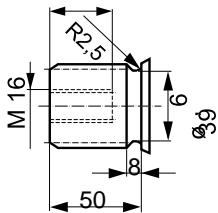
27.

65 port M 18x1,5

196 U Flushing port

(plugged) M 18x1,5

M<sub>1</sub> Test port for control pressure (plugged) M 14x1,5



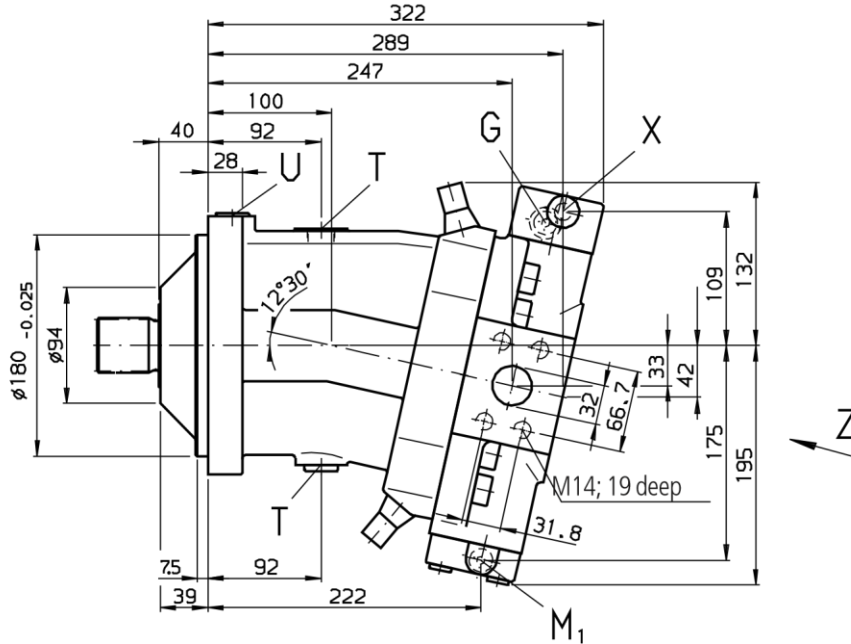
**Unit Dimensions Size 140**

Hydraulic control, pilot pressure related HD1, HD2

Before finalising your design, please request a certified drawing.

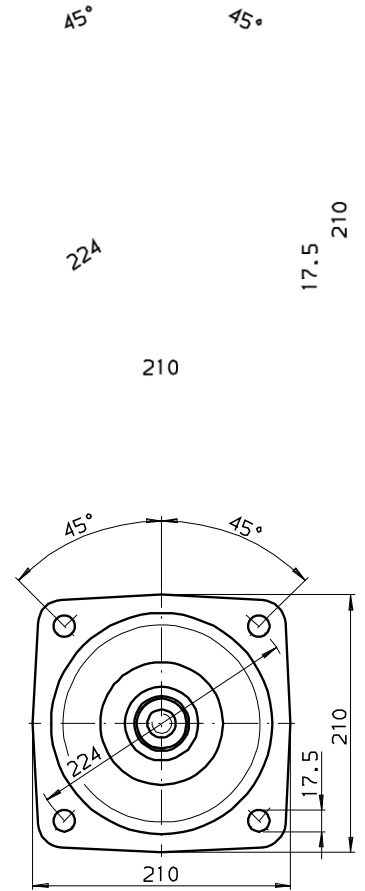
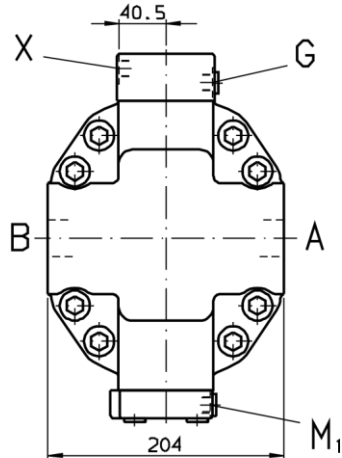
**Hydraulic two-position control HZ1**

Service line ports A/B on (opposite) sides (02)



View Z

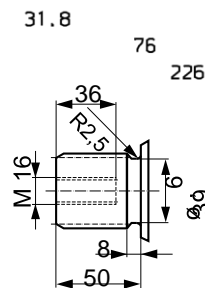
Service line ports A/B  
on (opposite) sides (02)



**Shaft ends**

Z

Splined shaft,  
W  
45x2x30x21x9g  
DIN 5480



Before finalising your design, please request a certified dra

Service line ports A/B

Connections

40.5

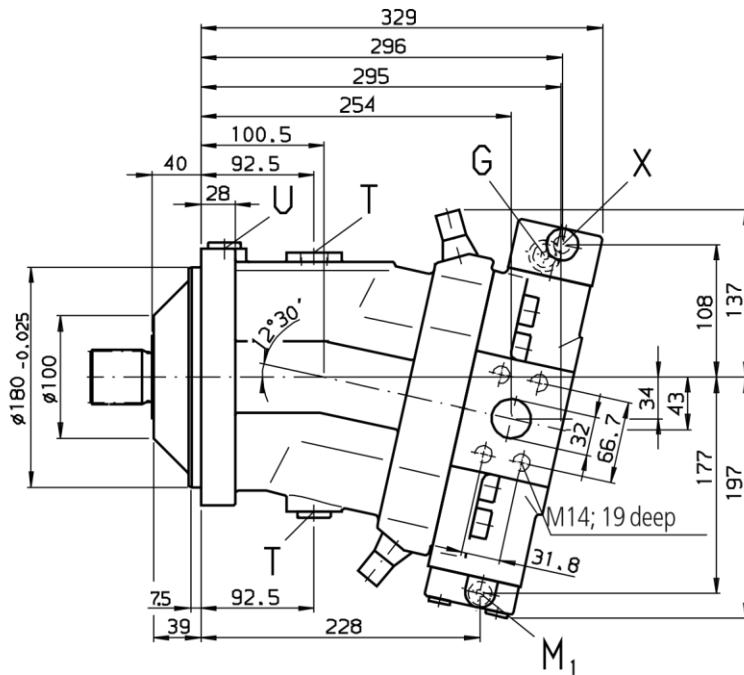
- A; B Service line ports SAE 1<sup>1</sup>/<sub>4</sub>"  
420 bar (6000 psi) high pressure series
- G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)
- X Pilot pressure port M 14x1,5 T  
Case drain port M 26x1,5
- U Flushing port (plugged) M 22x1,5

Unit Dimensions Size 160

204

Hydraulic two-position control HZ1

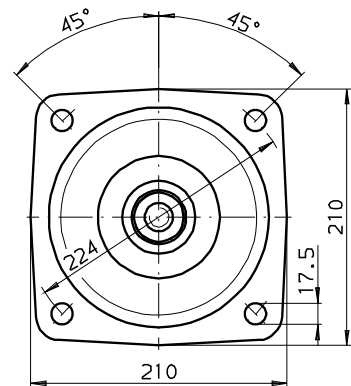
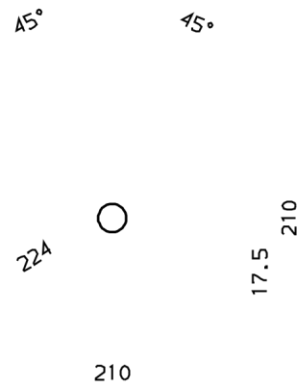
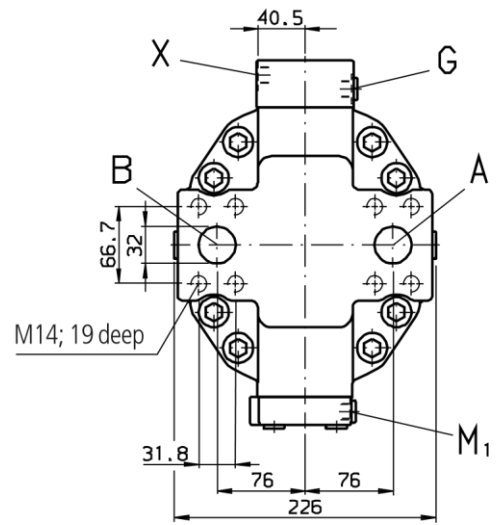
Service line ports A/B on (opposite) sides (02)



Hydraulic control, pilot pressure related HD1, HD2

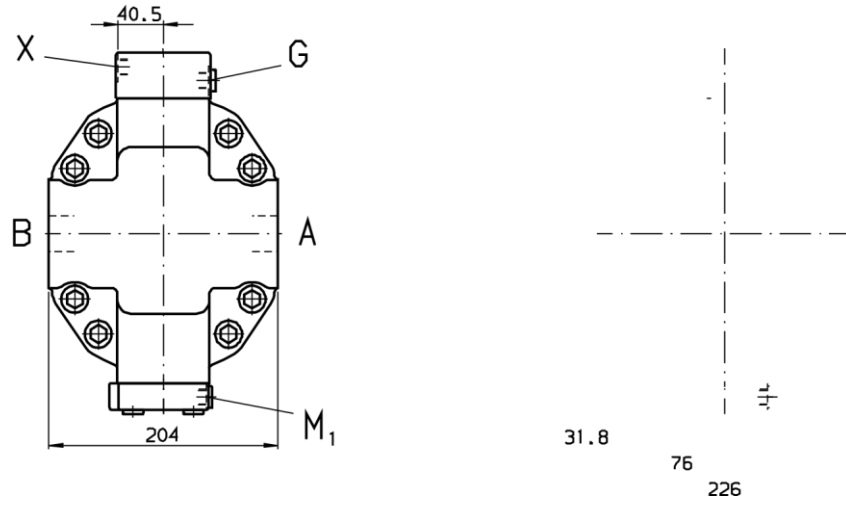
- M<sub>1</sub> Test port for control pressure (plugged) M 14x1,5
- View Z Service line ports A/B

at rear end (01)



Before finalising your design, please request a certified drawing.

on (opposite) sides (02)

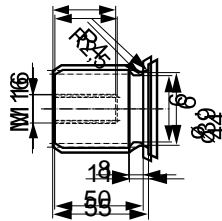


**Shaft ends**

**A**  
Splined shaft  
W 50x2x30x24x9g  
DIN 5480  
36

**Z**  
Splined shaft,  
W 45x2x30x21x9g  
DIN 5480  
36

Service line ports A/B



**Connections**

A; B Service line ports  
420 bar (6000 psi) high pressure series

G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)

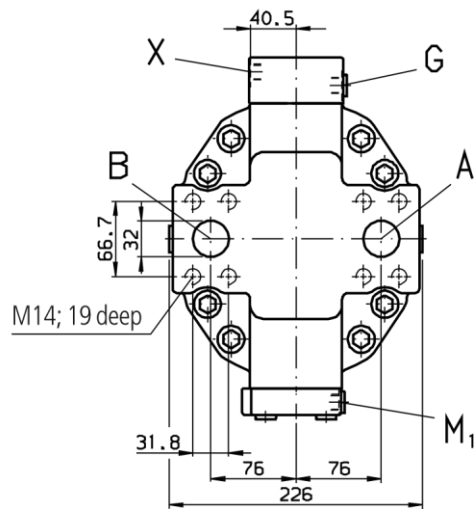
X Pilot pressure port  
M 14x1,5 T  
Case drain port M 26x1,5

U Flushing port (plugged) M 22x1,5

40.5



at rear end (01)





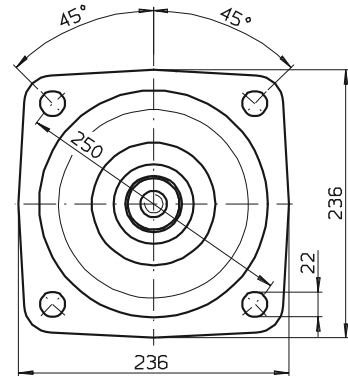
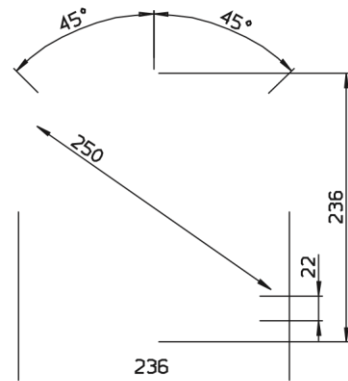
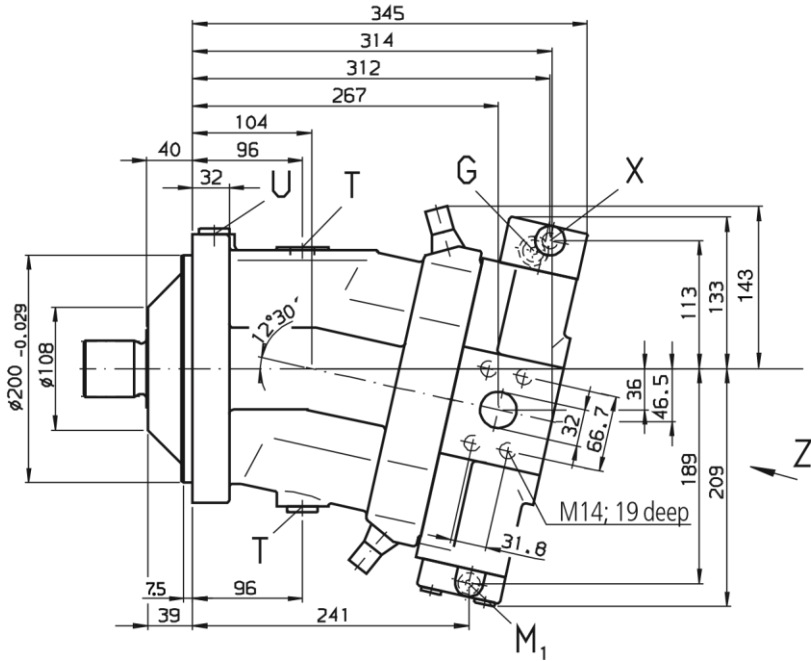
Before finalising your design, please request a certified drawing.

### Unit Dimensions Size 200

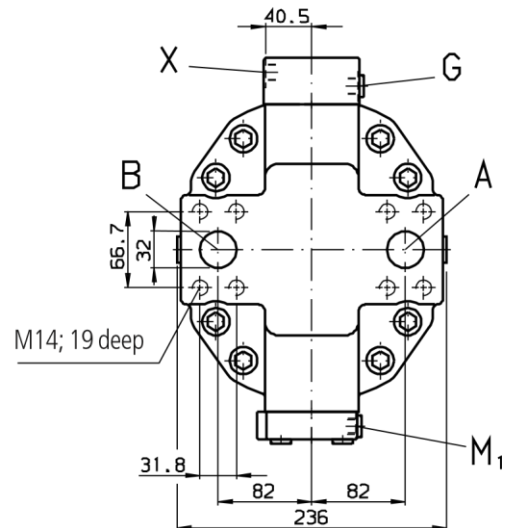
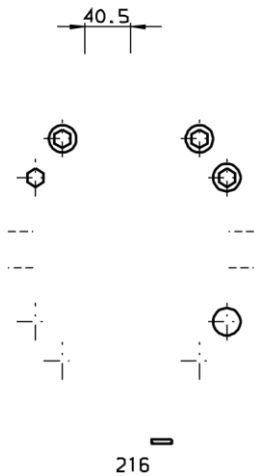
Hydraulic control, pilot pressure related HD1, HD2

Hydraulic two-position control HZ1

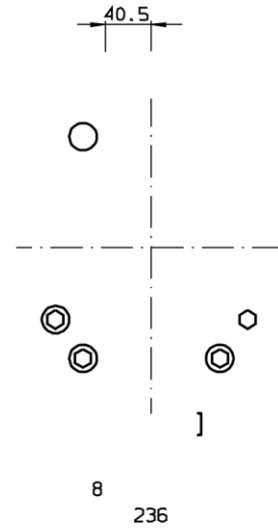
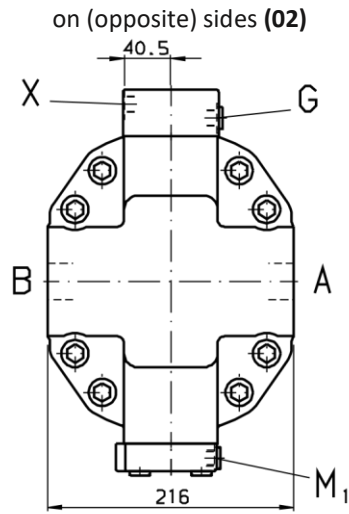
Service line ports A/B on (opposite) sides (02)



M<sub>1</sub> Test port for control pressure (plugged) M 14x1,5  
View Z Service line ports A/B



Before finalising your design, please request a certified drawing.



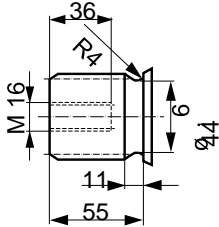
**Shaft ends**

**A**

Splined shaft

W 50x2x30x24x9g

DIN 5480



**Connections**

- A; B Service line ports SAE 1<sup>1</sup>/<sub>4</sub>"  
420 bar (6000 psi) high pressure series
- G Port for synchronous control of a number of M 14x1,5  
units and for remote control pressure (plugged)
- X Pilot pressure port M 14x1,5 T Case drain port M 26x1,5
- U Flushing port (plugged) M 22x1,5
- M<sub>1</sub> Test port for control pressure (plugged) M 14x1,5



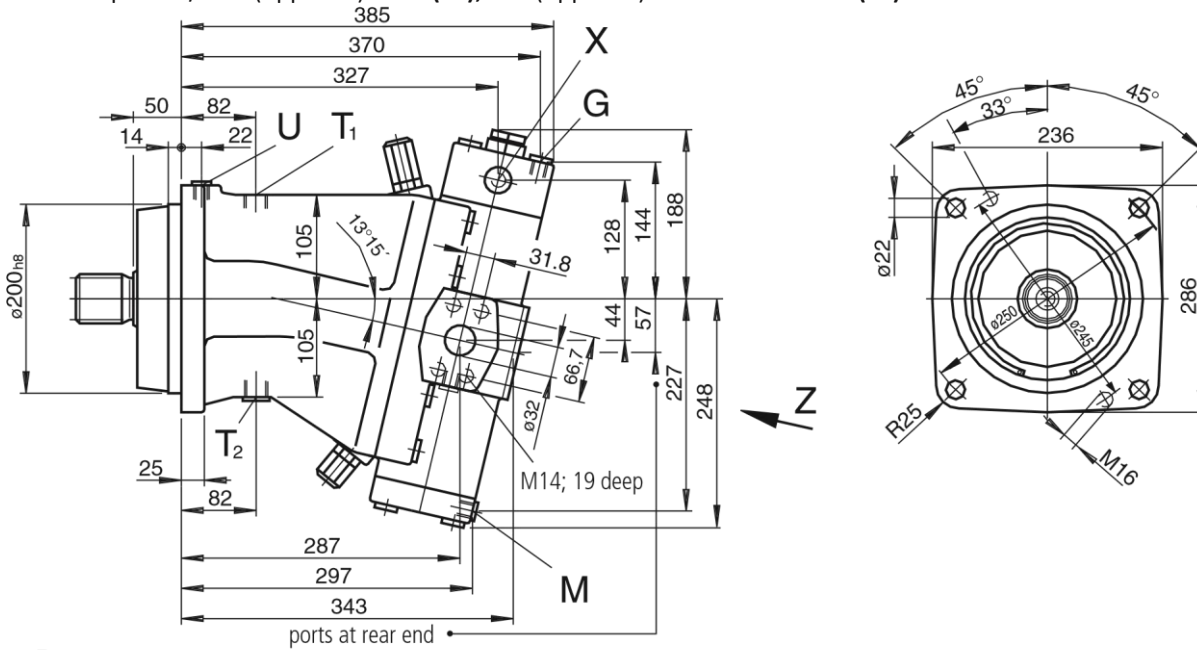
Before finalising your design, please request a certified drawing.

### Unit Dimensions Size 250

Hydraulic control, pilot pressure related HD1, HD2, HD3

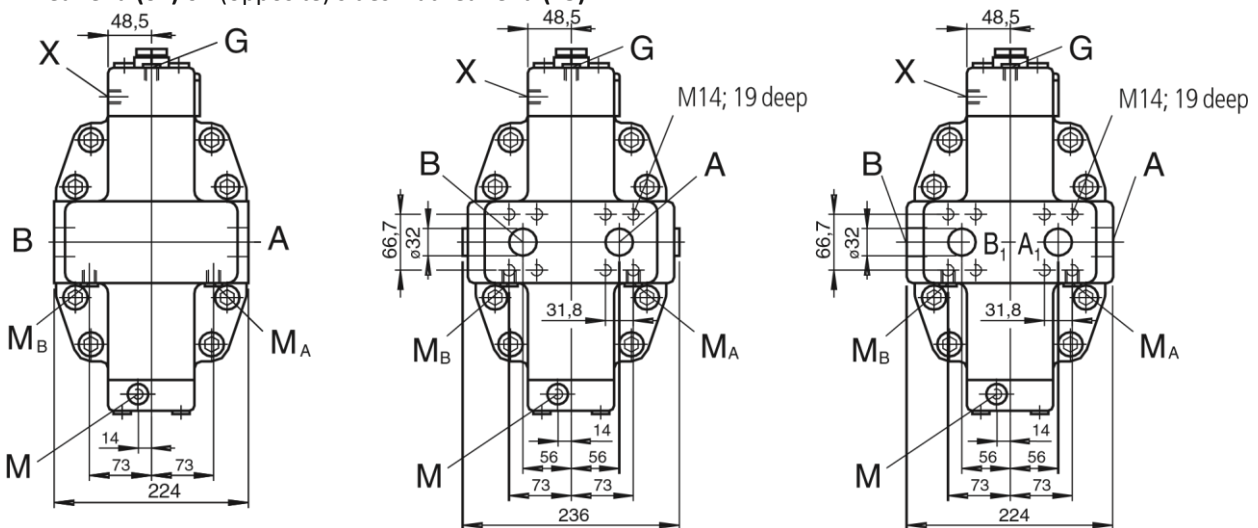
Hydraulic two-position control HZ

Service line ports A/B on (opposite) sides (02); on (opposite) sides + at rear end (15)



View Z

Service line ports A/B Service line ports A/B Service line ports A / B / A<sub>1</sub> / B<sub>1</sub> on (opposite) sides (02) at rear end (01) on (opposite) sides + at rear end (15)



#### Shaft ends

Z

Splined shaft

W 50x2x30x24x9g

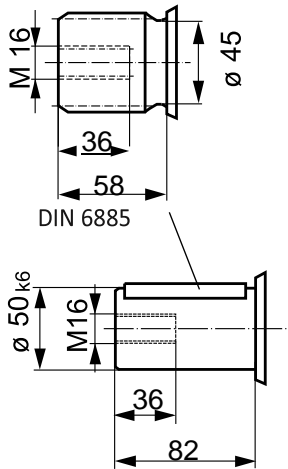
P

Parallel shaft

with key AS 14x9x80

Before finalising your design, please request a certified drawing.

DIN 5480



Connections

### Unit Dimensions Size 355

Hydraulic control, pilot pressure related HD1, HD2

Hydraulic two-position control HZ

A; B Service line ports SAE 1<sup>1</sup>/<sub>4</sub>" high pressure series

A<sub>1</sub>; B<sub>1</sub> Additional service line ports at port plate 15 SAE 1<sup>1</sup>/<sub>4</sub>"

G Port for synchronous control of a number of M 14x1,5 units and for remote control pressure (plugged)

X Pilot pressure port M 14x1,5

T<sub>1</sub>, T<sub>2</sub> Case drain ports M 22x1,5

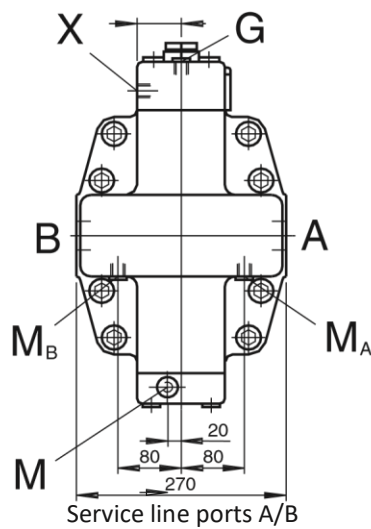
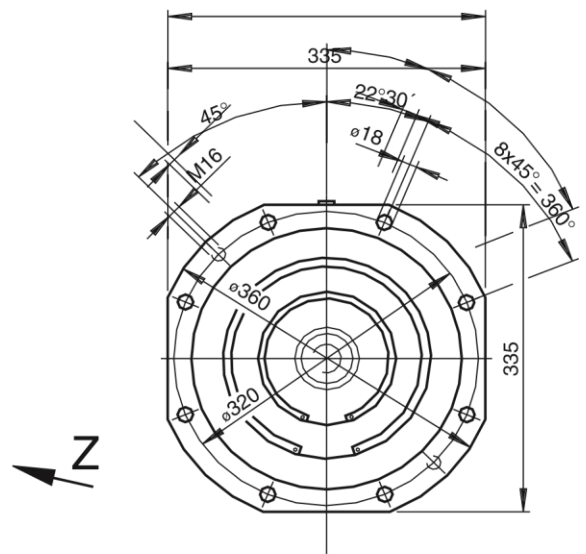
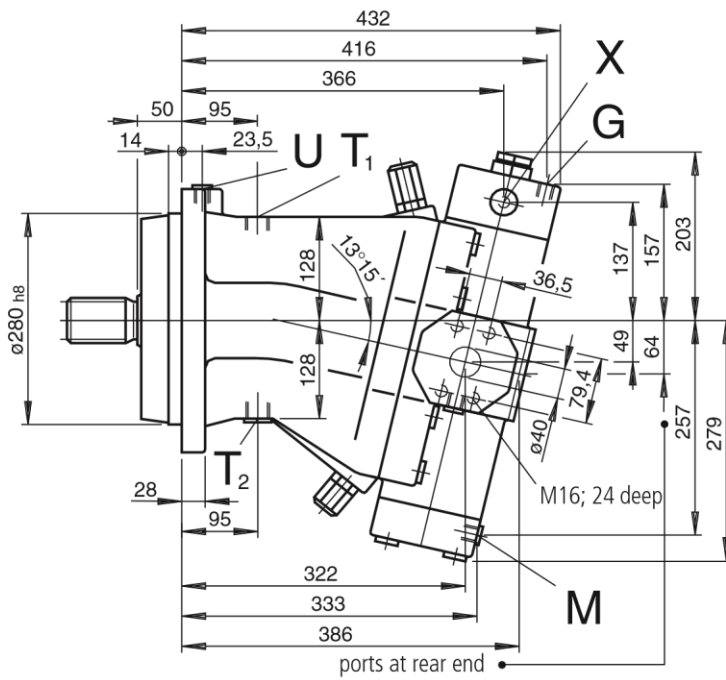
U Flushing port M 14x1,5

M<sub>A</sub>, M<sub>B</sub> Test ports M 14x1,5

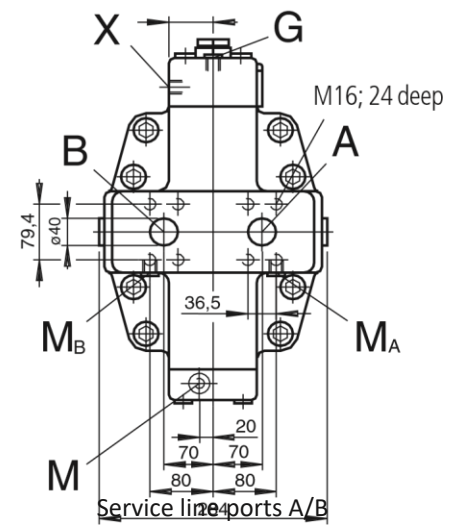
M Test port for control pressure (plugged) M 14x1,5

Before finalising your design, please request a

Service line ports A/B on (opposite) sides (02)



View Z



Service line ports A/B

Before finalising your design, please request a certified drawing

on (opposite) sides **(02)**

at rear end **(01)**

54

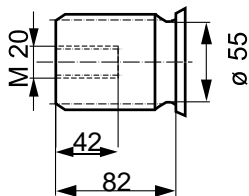
54

**Shaft ends**

**Z**

Splined shaft

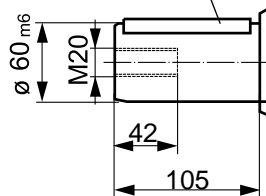
DIN 5480



**P**

Parallel shaft

DIN 6885



**Connections**

- A,B Service line ports SAE 1 1/2"  
high pressure series
- W 60x2x30x28x9g with key AS 18x11x100 G  
Port for synchronous control of a number of M 14x1,5 units  
and for remote control pressure (plugged)
- X Pilot pressure port M 14x1,5 T<sub>1</sub>' T<sub>2</sub> Case drain ports  
M 33x2
- U Flushing port M 14x1,5
- M<sub>A</sub>' M<sub>B</sub> Test ports M 14x1,5
- M Test port for control pressure (plugged) M 14x1,5

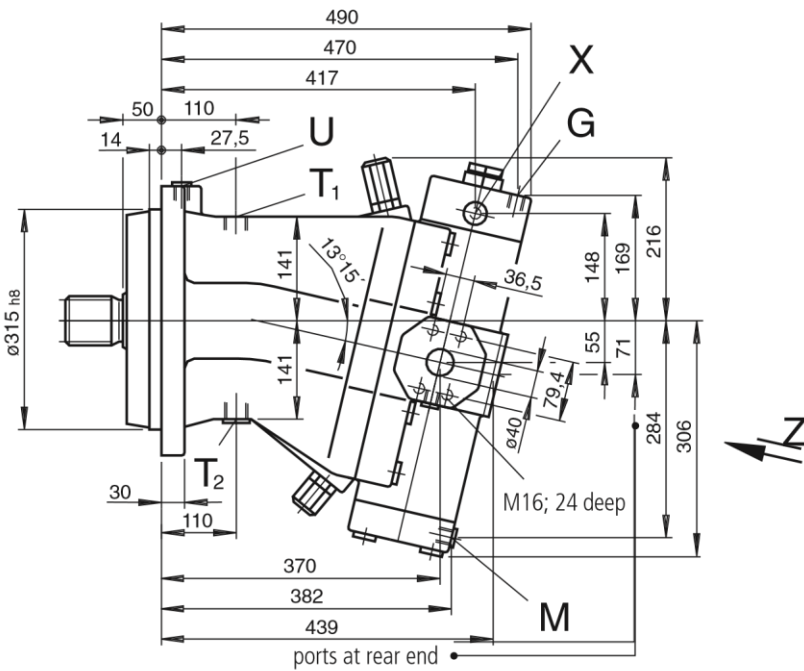
**Unit Dimensions Size 500**

Hydraulic control, pilot pressure related HD1, HD2, HD3

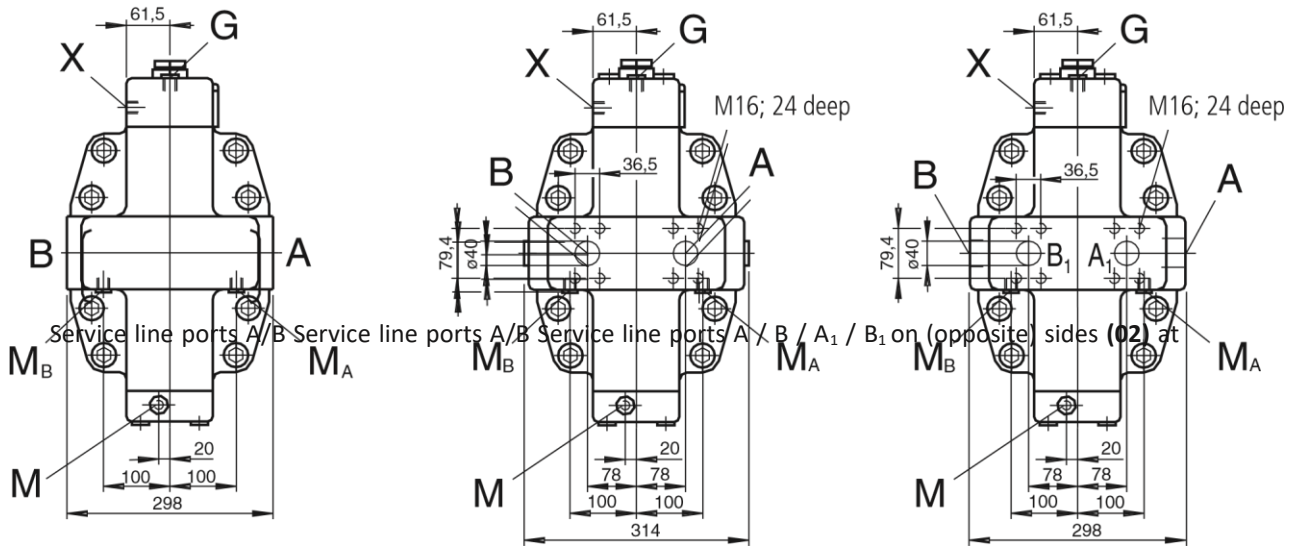
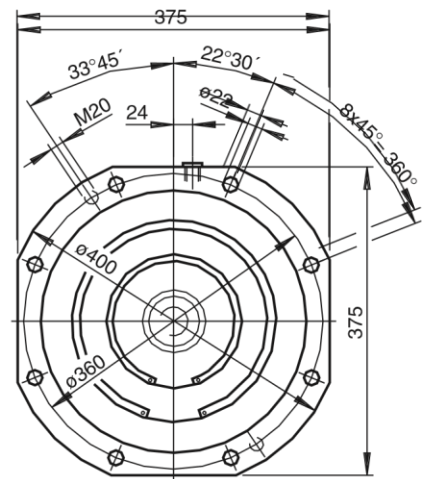
Hydraulic two-position control HZ

Service line ports A/B on (opposite) sides **(02)**; on (opposite) sides + at rear end **(15)**

Before finalising your design, please request a



View Z



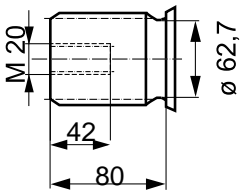
Before finalising your design, please request a certified drawing

rear end **(01)** on (opposite) sides + at rear end **(15)**

**Shaft ends**

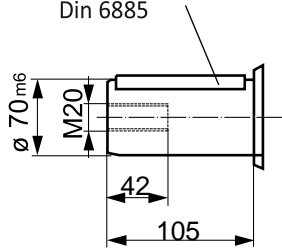
**Z**

Splined shaft  
W 70x3x30x22x9g  
DIN 5480



**P**

Parallel shaft  
with key AS 20x12x100  
Din 6885



**Connections**

A,B Service line ports SAE 1 1/2"  
high pressure series

A<sub>1</sub>; B<sub>1</sub> Additional service line ports at port plate 15 SAE 1 1/2"

G Port for synchronous control of a number of M 18x1  
units and for remote control pressure (plugged)

X Pilot pressure port M 14x1,5 T<sub>1</sub>' T<sub>2</sub> Case drain ports M  
33x2

U Flushing port M 18x1,5

M<sub>A</sub>' M<sub>B</sub> Test ports M 14x1,5

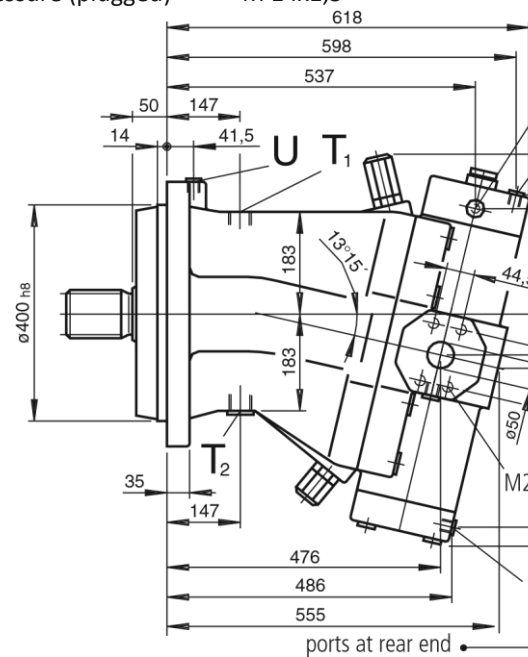
M Test port for control pressure (plugged) M 14x1,5

**Unit Dimensions Size 1000**

Hydraulic control, pilot pressure related HD1, HD2

Hydraulic two-position control HZ

Service line ports A/B on (opposite) sides **(02)**

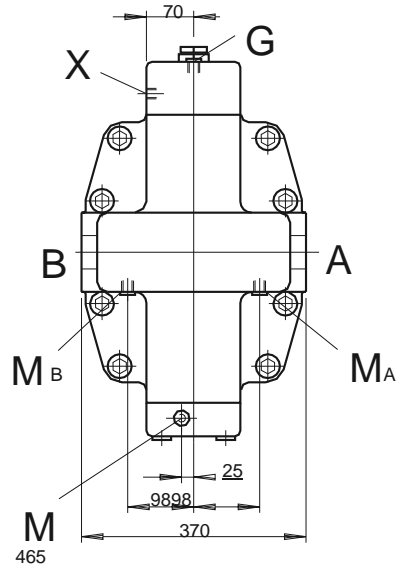




Before finalising your design, please request a certified drawing.

View Z

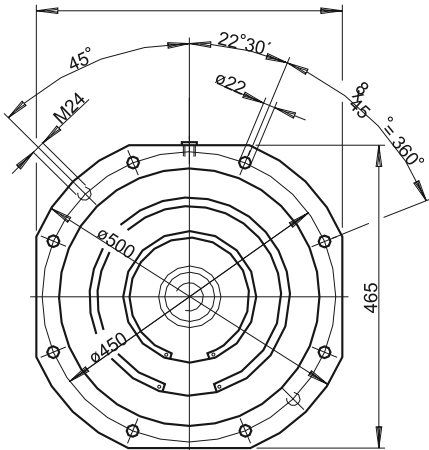
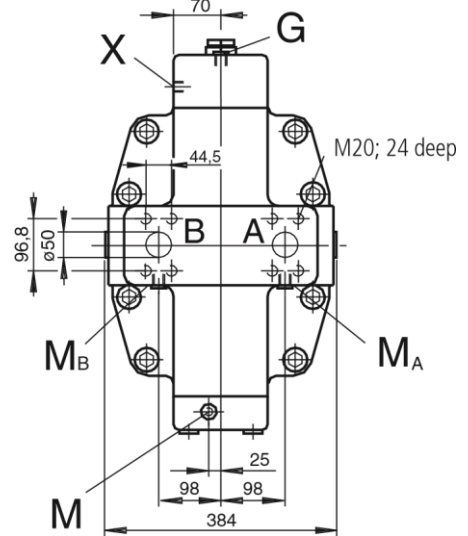
Service line ports A/B  
on (opposite) sides (02)



Z



Service line ports  
A/B at rear end  
(01)



**Shaft ends**

**Z**

Splined shaft  
W 90x3x30x28x9g

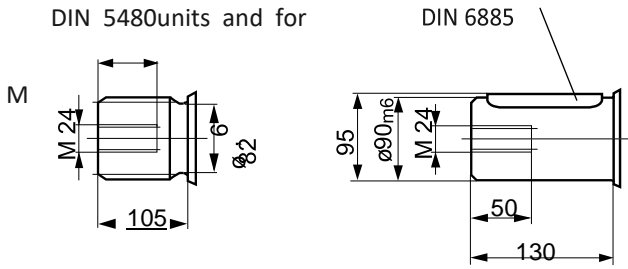
**P**

Parallel shaft with  
key AS 25x14x125

**Connections**

A,B	Service line ports high pressure	SAE 2 "
G	Port for synchronous control of a number of	M 18x1,5

Before finalising your design, please request a certified drawing



remote control pressure (plugged)	50X	Pilot pressure port
14x1,5		
T <sub>1</sub> , T <sub>2</sub> Case drain ports		M 42x2
U Flushing port		M 18x1,5
M <sub>A</sub> , M <sub>B</sub> Test ports		M 14x1,5
M Test port for control pressure (plugged)		M 14x1,5

**Winch Motion Control Valve MHB...E, Simple Function**

**Variable motor A6VM, with winch motion control valve MHB..E** Variable motor A6VM, with winch motion control valve MHB...E

Design with start of control at V<sub>g max</sub> (standard for HD, EP) Design with start of control at V<sub>g max</sub> (standard for HD, EP)

Hoist: direction of rotation of the motor "clockwise" Hoist: direction of rotation of the motor "anti-clockwise"

A G T

valve: B)

A B) valve:

**Note:**

- Because of safety reasons hoist winch drives are not allowed with control devices with start of control at V<sub>g min</sub> (standard design for HA)!
- For the assembly of a motion control valve on a variable motor with the start of control at V<sub>g max</sub> (standard design for HD, EP) the port A of the motion control valve is mounted on the port B of the variable motor. This has to be taken into consideration when a motion control valve is used (direction of hoisting, design BR or AL) see table below.

Hoist: direction of rotation of the motor "clockwise" "anti-clockwise"

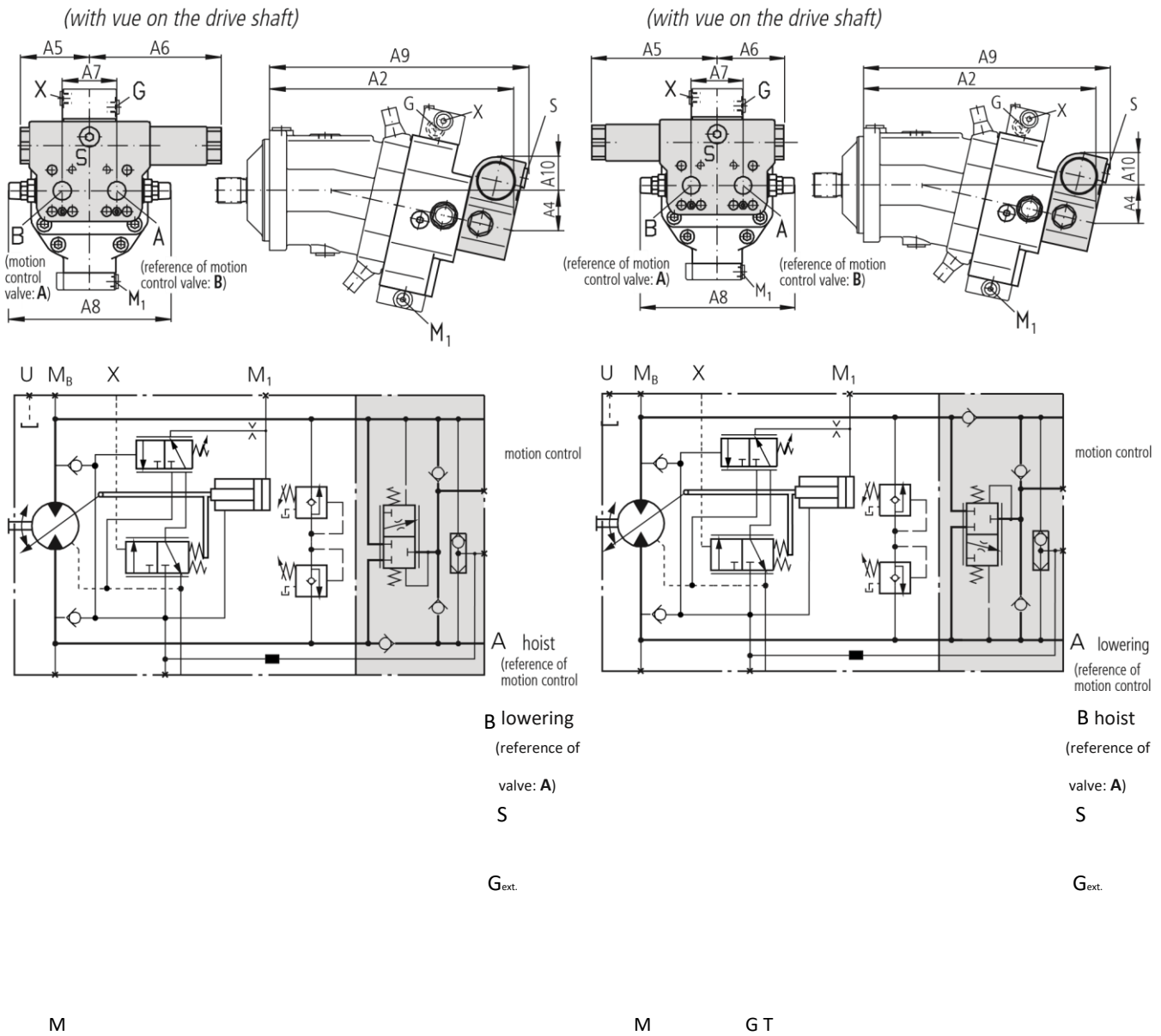
**Connections**

- A, B Service line ports SAE, 420 bar (6000 psi) high pressure series
- S Boosting (plugged)

**The motion control valve is not included in the type references, please order separately! We recommend total supply through Brueninghaus Hydromatik.**

Further informations for motion control valve MHB:

Before finalising your design, please request a



reference of motion control valve*)	control HD, EP	BR	AL	- MHB20, MHB25 (for A6VM 55...160)	RE 64318
	control HA	AL	BR		

\*) see RE 64318

Unit dimensions (Variable displacement motor A6VM with winch motion control valve MHB...E)

Before finalising your design, please request a certified drawing

motor A6VM		motion control valve MHB...E			dimensions									
size	plate	type	ports A, B	port S	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55	38	MHB20...11	SAE 3/4"	M22x1,5	311	302	143	50	98	187	75	222	325	
80	38	MHB20...18	SAE 1"	M22x1,5	340	331	148	55	98	187	75	222		
107	37	MHB20...18E	SAE 1"	M22x1,5	362	353	152	59	98	187	84	234		
107	38	MHB25...18	SAE 1 1/4"	M27x2	380	370	165	63	120,5	214	84	234		
140	38	MHB25...18	SAE 1 1/4"	M27x2					120,5	214	84			
160	38	MHB25...18	SAE 1 1/4"	M27x2	417	407	169	68	120,5	214	84			
250		on demand												

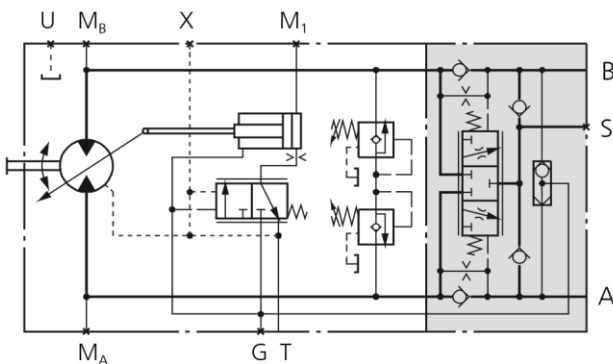
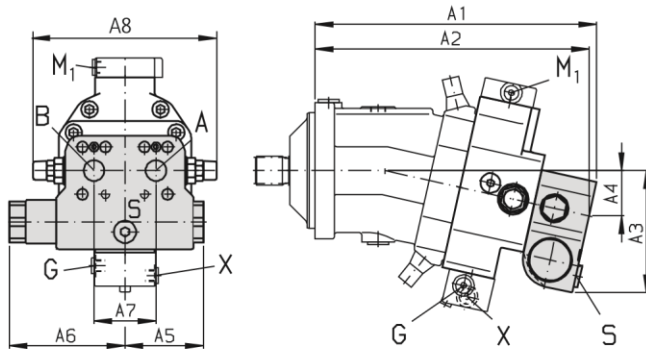
### Drive Motion Control Valve MHB...R, Double Function

Variable motor A6VM, with drive motion control valve MHB...R Variable motor A6VM, with drive motion control valve

MHB

Design with start of control at  $V_{g\ min}$  (standard for HA)

Sizes 55... 160



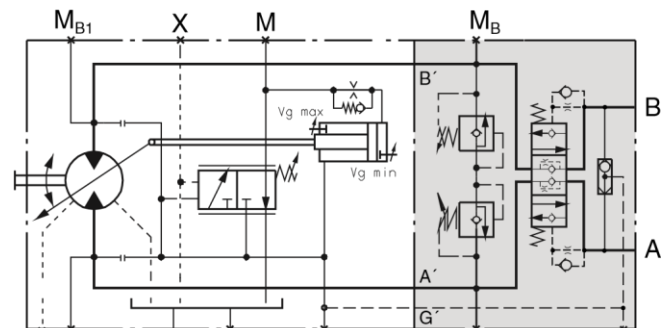
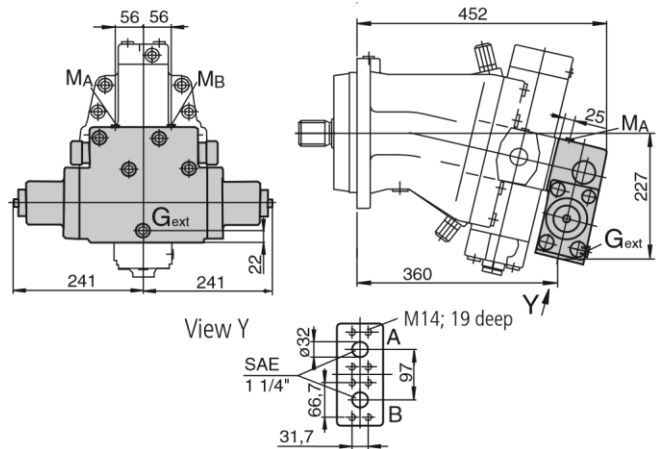
#### Connections

A, B Service line ports SAE, 420 bar (6000 psi) high pressure series

S Boosting (plugged)

Design with start of control at  $V_{g\ min}$  (standard for HA)

Size 250



The motion control valve is not included in the type references, please order separately! We recommend total supply through Brueninghaus Hydromatik.

U MA1 T1 T2 G MA Gext

Before finalising your design, please request a

Further informations for motion control valve MHB:

- MHB20, MHB25 (für A6VM 55...160) \_\_\_\_\_ RE 64318

- MHB30 (für A6VM 250) \_\_\_\_\_ RE 64316

**Flushing and Boost Pressure Valve**

The flushing and boost pressure valve is set at a fixed opening pressure of 16 bar and serves to maintain the minimum boost pressure (set primary valve accordingly).

A fixed flow of fluid is taken via an orifice from the low pressure side of the circuit and fed into the motor housing. This flow is then passed back to tank with the case drain fluid. Fluid thus removed from the closed circuit must be made up by means of the boost pump.

**Flows** (at low pressure  $\Delta p_{ND} = 25 \text{ bar}$ )\*

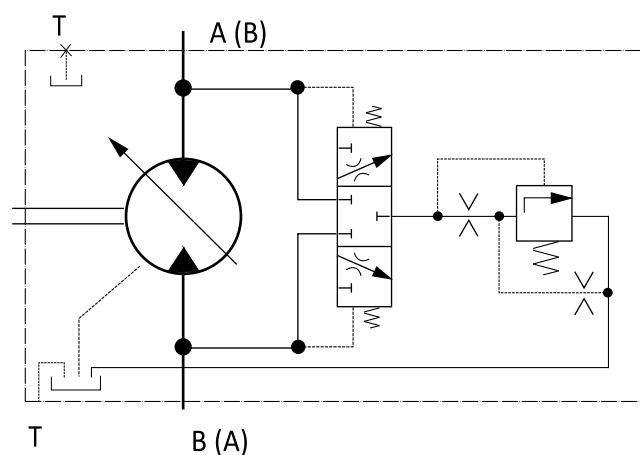
Size                      Flow                      Orifice No.

**Unit dimensions** (Variable displacement motor A6VM with drive motion control valve MHB...R)

motor A6VM		motion control valve MHB...E			dimensions							
size	plate	type	ports A, B	port S	A1	A2	A3	A4	A5	A6	A7	A8
55	38	MHB20...11	SAE 3/4"	M22x1,5	311	302	143	50	96	139	75	222
80	38	MHB20...18	SAE 1"	M22x1,5	340	331	148	55	96	139	75	222
107	37	MHB20...18E	SAE 1"	M22x1,5	362	353	152	59	96	139	84	234
107	38	MHB25...18	SAE 1 1/4"	M27x2	380	370	165	63	120,5	165,5	84	234
140	38	MHB25...18	SAE 1 1/4"	M27x2					120,5	214	84	
160	38	MHB25...18	SAE 1 1/4"	M27x2	417	407	169	68	120,5	165,5	84	
250	08	MHB30	SAE 1 1/4"	-	see above							

The valve is mounted onto the variable motor or integrated in the control device.

Different orifice sizes may be used to select varying flows of flushing fluid.



28, 55                      3,5 L/min                      651766/503.12.01.01

80                              5 L/min                      419695/503.12.01.01

107                            8 L/min                      419696/503.12.01.01

160, 200                    10 L/min                    419697/503.12.01.01

250                            10 L/min

355                            16 L/min

500                            20 L/min

1000                        25 L/min

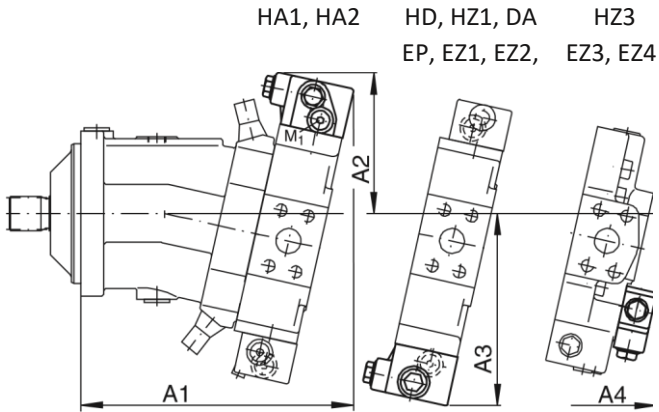
\* standard flushing volumes

(For sizes 28...200 flushing volumes of 3,5 - 10 L/min can be supplied. If a flushing volume different from the standard flushing volume is required, please indicate the requested orifice in clear text when ordering.)

<sup>1)</sup> Exception: A6VM 250../63..088 (design with mounted motion control valve MHB 30, please state the design of the motion control valve in clear text)!

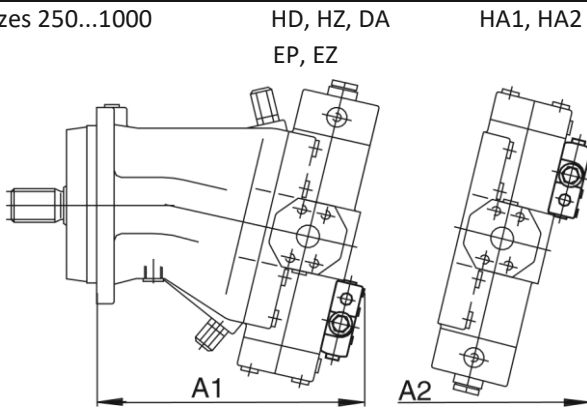
Before finalising your design, please request a certified drawing.

Sizes 28...200



Size	A1	A2	A3	A4
28	214	125	161	—
55	243	133	176	236
80	273	142	193	254
107	288	144	200	269
140	321	154	218	—
160	328	154	220	—
200	345	160	231	—

Sizes 250...1000



Size	A1	A2
250	357	402
355	397	446
500	440	504
1000	552	—

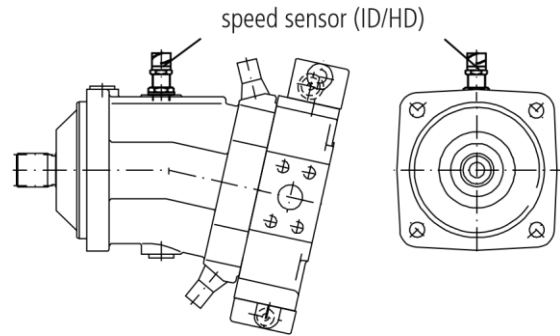
Version A6VM...D ("suitable for fitting speed sensor") includes gearing on the rotary group.

Sizes 28...200

A speed-proportional signal is produced by means of the rotating, splined rotary group which can be picked up by a suitable sensor and fed back for evaluation..

The sensor is screwed into the upper leakage port T (sizes 28...200) respectively in the additional port for the rotational speed sensor (sizes 250...1000). For the sizes 140...200 the port T is equipped with an adapter piece (M18x1,5) for the installation of the sensors.

### Speed Sensor

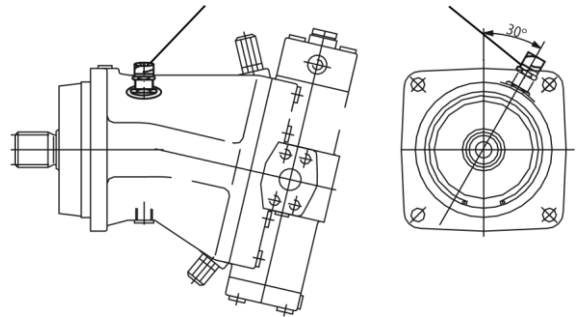


No. of teeth	40	54	58	67	72	75	80	Size	28
length of thread (mm)	19,9	19,9	19,9	19,9	31,9	31,9	31,9	55	80
								200	107
									140
									160

Size	250	355	500	1000
No. of teeth	78	90	99	

length of thread (mm) sensor with variable length of thread

Sizes 250...1000 speed sensor (ID/HD)

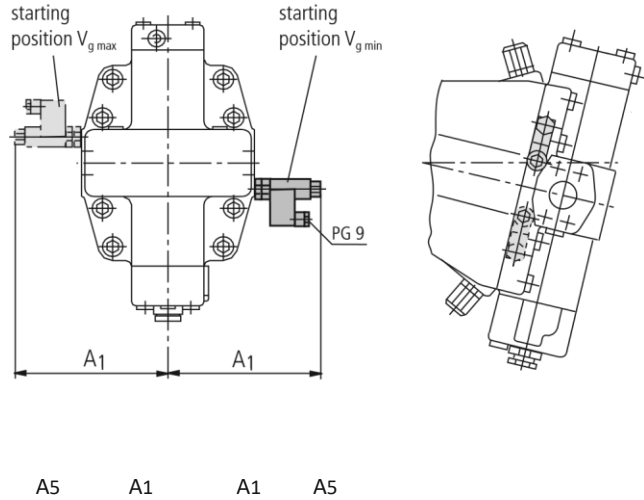
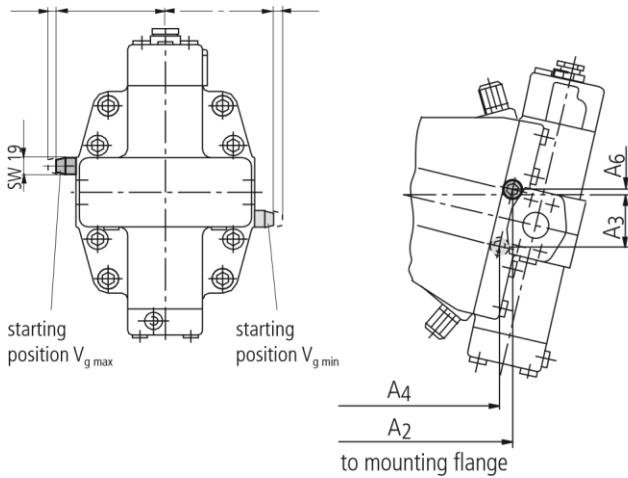


The speed sensor is not included in standard supply.

Suitable sensors (order separately!):

- inductive impulse detector ID (see RE 95130)
- hall effect speed sensor HD (see RE 95134)

Before finalising your design, please request a certified drawing.



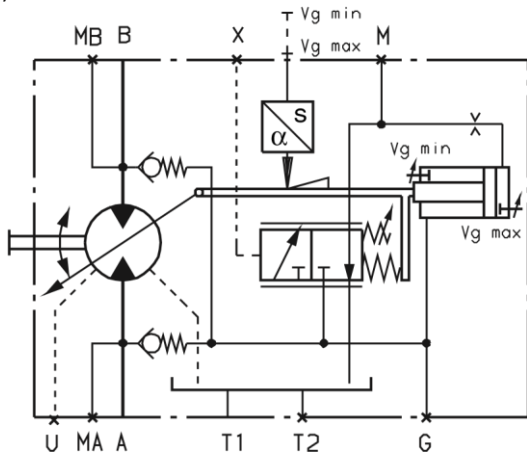
**Swivel Angle Indicator**

**Optical swivel angle indicator (V)**

The swivel position is indicated by a pin on the side of the housing. (Disassemble of the head nut necessary.) The length of the outstanding pin depends upon the position of the control lens.

If it is flush with the housing the motor is at zero. At max. swivel  $V_{g \max}$  the length of the pin is 8 mm (Display is still possible if the protective cap is removed).

Sizes 250...1000 (Example: A6VM...HD, starting position  $V_{g \max}$ )

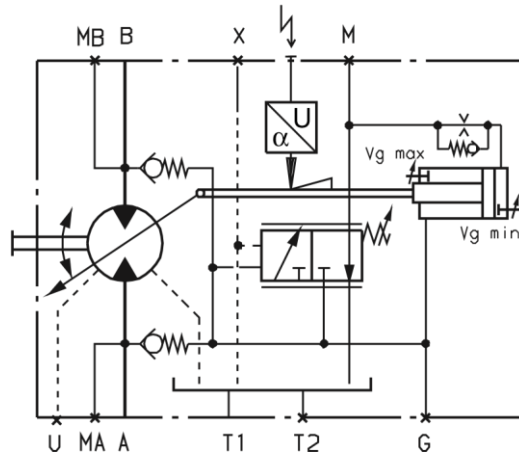


**Electronical swivel angle indicator (E)**

The motor position is fed back here by means of an inductive positional transducer. It converts the displacement of the variable unit into an electrical signal.

The swivel position may be further processed by means of this signal, eg. it may be fed to an amplifier card. Inductive positional transducer type IW9-03-01

Sizes 250...1000 (Example: A6VM...HA, starting position  $V_{g \min}$ )



Size	A1	A2	A3	A4	A5 <sup>*)</sup>	A6
250	136,5	256	73	238	11	5
355	159,5	288	84	266	11	8
500	172,5	331	89	309	11	3
1000	208,5	430	114	402	11	3

Size	A1
250	182
355	205
500	218
1000	254

<sup>\*)</sup>space required to remove protective cap



## Preferred Types

Type	Ident-No.	Type	Ident-No.
A6VM28DA1/63W-VZB020B	9604014	A6VM140DA1/63W-VZB020B	9603559
A6VM28DA2/63W-VZB020B	9604015	A6VM140DA3/63W-VZB020B	9610778
A6VM28EP1/63W-VZB020B	9604063	A6VM140EP2/63W-VZB020B	9605666
A6VM28EZ1/63W-VZB020B	9604250	A6VM140EZ2/63W-VZB020B	9610772
A6VM28HA1/63W-VZB020A	9604219	A6VM140HA1/63W-VZB020A	9610774
A6VM28HA1R2/63W-VZB020A	2036653	A6VM140HA1R2/63W-VZB020A	9610776
A6VM28HA1U2/63W-VZB020A	9604665	A6VM140HA1U2/63W-VZB020A	9605670
A6VM28HD1/63W-VZB020B	9603912	A6VM140HD1/63W-VZB020B	9605664
A6VM28HZ1/63W-VZB020B	9604249	A6VM140HZ1/63W-VZB020B	9605648
A6VM55DA1/63W-VZB020B	9604017	A6VM160DA1/63W-VZB020B	9604026
A6VM55DA2/63W-VZB020B	9604018	A6VM160DA3/63W-VZB020B	9604794
A6VM55EP1/63W-VZB020B	9604065	A6VM160EP2/63W-VZB020B	9604072
A6VM55EZ3/63W-VZB020B	9604523	A6VM160EZ2/63W-VZB020B	9604254
A6VM55HA1/63W-VZB020A	9604223	A6VM160HA1/63W-VZB020A	9604235
A6VM55HA1R2/63W-VZB020A	2036655	A6VM160HA1R2/63W-VZB020A	2036656
A6VM55HA1U2/63W-VZB020A	9605637	A6VM160HA1U2/63W-VZB020A	9604666
A6VM55HD1/63W-VZB020B	9603911	A6VM160HD1/63W-VZB020B	9603805
A6VM55HZ3/63W-VZB020B	9604517	A6VM160HZ1/63W-VZB020B	9604252
A6VM80DA1/63W-VZB020B	9604020	A6VM200DA1/63W-VAB020B	9604029
A6VM80DA2/63W-VZB020B	9604021	A6VM200DA3/63W-VAB020B	9610785
A6VM80EP1/63W-VZB020B	9604067	A6VM200EP2/63W-VAB020B	9604074
A6VM80EZ3/63W-VZB020B	9604522	A6VM200EZ2/63W-VAB020B	9604257
A6VM80HA1/63W-VZB020A	9604227	A6VM200HA1/63W-VAB020A	9604239
A6VM80HA1R2/63W-VZB020A	9610911	A6VM200HA1R2/63W-VAB020A	9610792
A6VM80HA1U2/63W-VZB020A	9605641	A6VM200HA1U2/63W-VAB020A	9604667
A6VM80HD1/63W-VZB020B	9603720	A6VM200HD1/63W-VAB020B	9603913
A6VM80HZ3/63W-VZB020B	9604516	A6VM200HZ1/63W-VAB020B	9604255
A6VM107DA1/63W-VZB020B	9604023	A6VM250EP2D/63W2-VZB020B	978 736
A6VM107DA2/63W-VZB020B	9604024	A6VM250HD2D/63W1-VZB020B	983 132
A6VM107EP1/63W-VZB020B	9604069	A6VM250HZ/63W2-VZB027B	999 277
A6VM107EZ3/63W-VZB020B	9604521		
A6VM107EZ4/63W-VZB020B	9611133		
A6VM107HA1/63W-VZB020A	9604231		
A6VM107HA1R2/63W-VZB020A	2011699		
A6VM107HA1U2/63W-VZB020A	9605644		

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Before finalising your design, please request a certified drawing.

A6VM107HD1/63W-VZB020B      9603804

A6VM107HZ3/63W-VZB020B      9604515

Sizes 28...200: production plant Elchingen

Sizes 250...1000: production plant Horb

Please state type and ident-no. when ordering

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