

**RE 92 003/05.99**

replaces: 02.98

**Variable Displacement Pump A4VG**

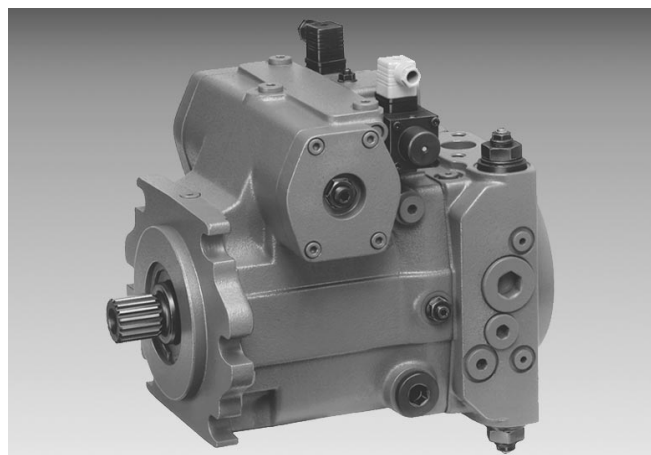
for closed circuits

Sizes 28...250

Series 3

Nominal pressure 400 bar

Peak pressure 450 bar



A4VG...EP

**Index**

Features	1
Ordering Code / Standard Program	2...3
Technical Data	4...5
Filtration	6...8
High Pressure Relief Valve	9
Pressure Cut-Off, D	9
HD - Hydraulic Control, Pilot Pressure Related	10
HW - Hydraulic Control, Mechanical Servo	11
DA - Hydraulic Control, Speed Related	12...13
DG - Hydraulic Control, Direct Operated	14
EZ - Electrical Two-Position Control with Switching Solenoid	14
EP - Electrical Control, with Proportional Solenoid	15
Unit Dimensions, Size 28	16...17
Unit Dimensions, Size 40	18...19
Unit Dimensions, Size 56	20...21
Unit Dimensions, Size 71	22...23
Unit Dimensions, Size 90	24...25
Unit Dimensions, Size 125	26...27
Unit Dimensions, Size 180	28...29
Unit Dimensions, Size 250	30...31
Unit Dimensions DA Control Valve	32...34
Dimensions for Through Drives	35...37
Permissible Input and Through Drive Rotation Torques	38
Combination Pumps	39
Mechanical Stroke Limiter, M	40
Ports X <sub>3</sub> and X <sub>4</sub> for Positioning Pressure, T	40
Rotary Inch Valve	41
Installation Situation for Coupling Assembly	42
Preferred Types	43

**Features**

- variable displacement axial piston pump of swashplate design for hydrostatic closed circuit transmissions
- flow is proportional to drive speed and displacement and is infinitely variable
- output flow increases with swivel angle from 0 to its maximum value
- swivelling the pump over centre smoothly changes the direction of flow
- a highly adaptable range of control and regulating devices is available
- the pump is equipped with two pressure relief valves on the high pressure ports to protect the hydrostatic transmission (pump and motor) from overloads
- these valves also function as boost inlet valves
- an integral auxiliary pump serves as boost and pilot oil pump
- the maximum boost pressure is limited by a built-in boost pressure relief valve
- the integral pressure cut-off is standard
- Further Informations:  
Variable Displacement Pump A4VTG RE 92 012  
for drum drives on mobile concrete Mixers



### Ordering Code / Standard Program

**Hydraulic fluid**

Mineral oil (no code)

**Axial piston unit**

Variable swashplate design, nominal pressure 400 bar, peak pressure 450 bar A4V

**Operation**

Pump in closed circuits G

**Size**

Displacement  $V_{g,max}$  in  $cm^3$

	28	40	56	71	90	125	180	250
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**Control device**

		28	40	56	71	90	125	180	250	
without control module	NV	●	●	●	●	●	●	●	●	NV
Hydraulic control, pilot pressure related	HD	●	●	●	●	●	●	●	●	HD
Hydraulic control, mechanical servo	HW	●	●	●	●	●	●	●	●	HW
Hydraulic control, speed related	DA	●	●	●	●	●	●	●	●	DA
Hydraulic control, direct operated	DG	●	●	●	●	●	●	●	●	DG
Electrical two-position control with switching solenoid	EZ	●	●	●	●	●	●	●	●	EZ
Electrical control with proportional solenoid	EP	●	●	●	●	●	●	●	●	EP

**Solenoid voltage (only for EP, EZ or DA)**

	28	40	56	71	90	125	180	250	
U = 12 V	●	●	●	●	●	●	●	●	1
U = 24 V	●	●	●	●	●	●	●	●	2

**Pressure cut-off**

with pressure cut-off (standard)	●	●	●	●	●	●	●	●	D
----------------------------------	---	---	---	---	---	---	---	---	---

**Zero position switch (only for HW)**

without zero position switch (no code)	●	●	●	●	●	●	●	●	
with zero position switch	●	●	●	●	●	●	●	●	L

**Mechanical stroke limiter**

without mechanical stroke limiter (no code)	●	●	●	●	●	●	●	●	
with mechanical stroke limiter, external adjustable	●	●	●	●	●	●	●	●	M

**Ports X<sub>3</sub>, X<sub>4</sub> for positioning pressure**

without ports X <sub>3</sub> , X <sub>4</sub> (no code)	●	●	●	●	●	●	●	●	
with ports X <sub>3</sub> , X <sub>4</sub>	●	●	●	●	●	●	●	●	T

**DA control valve**

		NV	EZ	DG	EP	HW	HD	DA	28...250	
without DA control valve		●	●	●	●	●	●	—	●	1
with DA control valve, fixed setting		—	—	●	●	●	●	●	●	2
with DA control valve, mech. adjust. with control lever	L	—	—	●	●	●	●	●	●	3L
	R	—	—	●	●	●	●	●	●	3R
with DA control valve, fixed setting and hydraulic inch valve built-on, control with breaking fluid		—	—	—	—	—	—	●	●	4
with DA control valve, mech. adjust. with control lever and hydraulic inch valve built-on, control with breaking fluid	L	—	—	—	—	—	—	●	●	5L
	R	—	—	—	—	—	—	●	●	5R
with DA control valve, fixed setting and connections for master controller		—	—	●	●	●	●	●	●	7
with DA control valve, fixed setting and hydraulic inch valve built-on, control with mineral oil		—	—	●	●	●	●	●	●	8
with DA control valve, mech. adjust. with control lever and hydraulic inch valve built-on, control with mineral oil	L	—	—	—	—	—	—	●	●	9L
	R	—	—	—	—	—	—	●	●	9R

**DA control valve with control lever**

without control lever (no code)	
with control lever - anti-clockwise operation direction	L
with control lever - clockwise operation direction	R

**Series**

3

**Index**

2

**Direction of rotation**

		28...250	
viewed on shaft end	clockwise	●	R
	anti-clockwise	●	L



## 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 resistant hydraulic 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). The operation with HFA-, HFB and HFC- hydraulic fluids requires additional special measures.

### 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 circuit temperature (closed circuit).

### Viscosity limits

The limiting values for viscosity are as follows:

$$v_{min} = 5 \text{ mm}^2/\text{s}$$

short term at a max. permissible temp. of  $t_{max} = 115^\circ\text{C}$ .

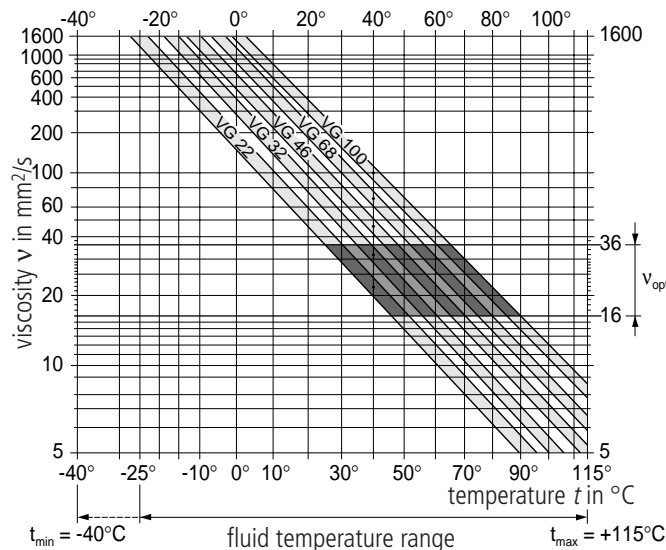
Please note that the max. fluid temperature is also not exceeded in certain areas (for instance bearing area).

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

short term on cold start ( $n \leq 1000 \text{ min}^{-1}$ ,  $t_{min} = -40^\circ\text{C}$ ).

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

### Selection diagram



### 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 circuit (closed 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  $X^\circ\text{C}$  circuit 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 pump speed and is always higher than the circuit temperature. However, at no point in the circuit may the temperature exceed  $115^\circ\text{C}$ .

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperatures please consult us.

### Temperature range of the radial shaft seal

The FPM shaft seal is admissible for a housing temperature range from  $-25^\circ\text{C}$  to  $+115^\circ\text{C}$ .

Note:

For applications below  $-25^\circ\text{C}$  a NBR shaft seal is necessary (admissible temperature range  $-40^\circ\text{C}$  to  $+90^\circ\text{C}$ ).

When ordering, please state in clear text: with NBR shaft seal

### Operating pressure range - inlet

Variable pump (with external supply, E):

for control devices EP, EZ, HW and HD

boost pressure (when  $n = 2000 \text{ rpm}$ )  $p_{sp}$  \_\_\_\_\_ 20 bar

for control devices DA, DG

boost pressure (when  $n = 2000 \text{ rpm}$ )  $p_{sp}$  \_\_\_\_\_ 25 bar

Auxiliary pump:

suction pressure  $p_{s \text{ min}}$  ( $v \leq 30 \text{ mm}^2/\text{s}$ ) \_\_\_\_\_  $\geq 0,8$  bar absolute

for cold start \_\_\_\_\_  $\geq 0,5$  bar absolute

### Operating pressure range - outlet

Variable pump:

Pressure at port A or B

nominal pressure  $p_N$  \_\_\_\_\_ 400 bar

peak pressure  $p_{max}$  \_\_\_\_\_ 450 bar

Auxiliary pump:

peak pressure  $p_{H \text{ max}}$  \_\_\_\_\_ 40 bar

(pressure data to DIN 24312)

### Case drain pressure

Permissible case drain pressure at ports  $T_1$  and  $T_2$

$p_L$  \_\_\_\_\_ 4 bar abs.

short term (at start) \_\_\_\_\_ 6 bar abs.

### Installation position

Optional. The 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.

**Note** for installation position "drive shaft up" (only sizes 71-250): When ordering please state in clear text "installation position: drive shaft up". The pump will be delivered with an additional air bleed port R1 located at the flange area.

## Technical Data

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

Size			28	40	56	71	90	125	180	250	
Displacement	variable pump	$V_{g\ max}$	cm <sup>3</sup>	28	40	56	71	90	125	180	250
	auxiliary pump (at p = 20 bar)	$V_{g\ H}$	cm <sup>3</sup>	6,1	8,6	11,6	19,6	19,6	28,3	39,8	52,5
Speed	max. speed with $V_{g\ max}$	$n_{max\ contin.}$	rpm	4250	4000	3600	3300	3050	2850	2500	2400
	limited max. speed <sup>1)</sup>	$n_{max\ limited}$	rpm	4500	4200	3900	3600	3300	3250	2900	2600
	intermittent max. speed <sup>2)</sup>	$n_{max\ interm.}$	rpm	5000	5000	4500	4100	3800	3450	3000	2700
	minimum speed	$n_{min}$	rpm	500	500	500	500	500	500	500	500
Flow	at $n_{max\ contin.}$ and $V_{g\ max}$	$q_{v\ max}$	L/min	119	160	202	234	275	356	450	600
Power	at $n_{max\ contin.}$ $\Delta p = 400$ bar	$P_{max}$	kW	79	107	134	156	183	237	300	400
Torque	at $V_{g\ max}$ $\Delta p = 400$ bar	$T_{max}$	Nm	178	255	356	451	572	795	1144	1590
	(variable pump without aux. pump) $\Delta p = 100$ bar	$T$	Nm	44,5	63,5	89	112,8	143	198,8	286	398
Moment of inertia (about drive axis)		$J$	kgm <sup>2</sup>	0,0017	0,003	0,0051	0,0072	0,0106	0,0164	0,0323	0,0879
Weight (standard model without through drive) approx.		$m$	kg	29	31	38	50	60	80	101	156

1) Limited maximum speed: – at half corner power (e.g. at  $V_{g\ max}$  and  $p_N / 2$ )

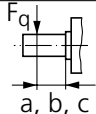

2) Intermittent maximum speed: – at high idling speed  
 – at engine overspeed:  $\Delta p = 70 \dots 150$  bar and  $V_{g\ max}$   
 – with reversing heads:  $\Delta p < 300$  bar and  $t < 5$  sec.

### Calculation of size

Output flow	$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$	in L/min	$V_g$ = displacement per revolution in cm <sup>3</sup>
Torque	$T = \frac{1,59 \cdot V_g \cdot \Delta p}{100 \cdot \eta_{mh}} = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$	in Nm	$\Delta p$ = differential pressure in bar $n$ = speed in rpm $\eta_v$ = volumetric efficiency
Power	$P = \frac{T \cdot n}{9549} = \frac{2 \pi \cdot T \cdot n}{60 \cdot 000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t}$	in kW	$\eta_{mh}$ = mechanical-hydraulic efficiency $\eta_t$ = overall efficiency

### Input drive

Permissible axial and radial loading on drive shaft

Size			28	40	56	71	90	125	180	250	
Distance of $F_q$ (from shaft collar)		a	mm	17,5	17,5	17,5	20	20	22,5	25	29
		b	mm	30	30	30	35	35	40	45	50
		c	mm	42,5	42,5	42,5	50	50	57,5	60	71
max. permissible radial load at distance	a	$F_{q\ max}$	N	2500	3600	5000	6300	8000	11000	16000	22000
	b	$F_{q\ max}$	N	2000	2891	4046	4950	6334	8594	12375	16809
	c	$F_{q\ max}$	N	1700	2416	3398	4077	5242	7051	10150	13600
max. permissible axial load		- $F_{ax\ max}$	N	1557	2120	2910	4242	4330	5743	7053	4150
		+ $F_{ax\ max}$	N	417	880	1490	2758	2670	3857	4947	4150

## 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) at least cleanliness class

8 to NAS 1638

17/14 to ISO/DIS 4406 necessary.

If above mentioned grades cannot be maintained please consult supplier.

### Standard: Filtration in the suction line of the auxiliary pump, S

Standard model (preferred)

Filter type: \_\_\_\_\_ filter **without** bypass

Recommendation: \_\_\_\_\_ **with** contamination indicator

Through flow resistance at the filter element:

at  $v = 30 \text{ mm}^2/\text{s}$ ,  $n = n_{\text{max}}$  \_\_\_\_\_  $\Delta p \leq 0,1 \text{ bar}$

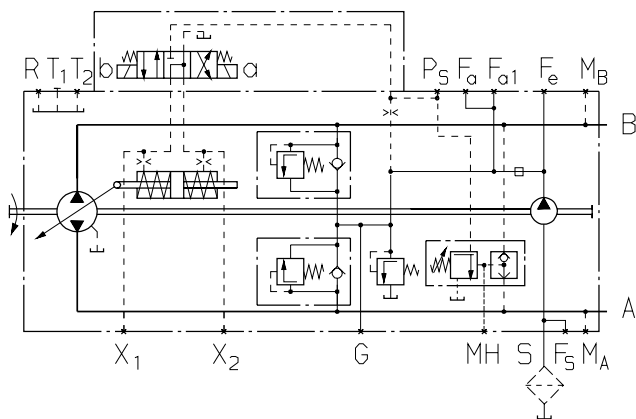
at  $v = 1000 \text{ mm}^2/\text{s}$ ,  $n = n_{\text{max}}$  \_\_\_\_\_  $\Delta p \leq 0,3 \text{ bar}$

Pressure at port S of the auxiliary pump:

at  $v = 30 \text{ mm}^2/\text{s}$  \_\_\_\_\_  $p \geq 0,8 \text{ bar}$

at cold start ( $v = 1600 \text{ mm}^2/\text{s}$ ,  $n \leq 1000 \text{ min}^{-1}$ ) \_\_\_\_\_  $p \geq 0,5 \text{ bar}$

### Circuit diagram standard S



### Variation: external supply, E

This variation is to be applied with models **without** integral auxiliary pump (N00 or K..).

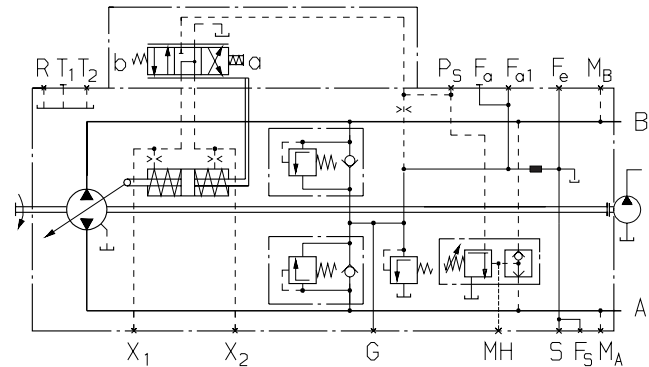
Connection S is closed.

Supply comes from connection  $F_a$ .

Filter arrangement: \_\_\_\_\_ separately

To ensure functioning the above mentioned purity grade for the boost pressure fluids at connection  $F_a$  has to be ensured.

### Circuit diagram variation E (external supply)



### Variation: Filtration in the pressure line of the auxiliary pump, ports for external boost circuit filter, D

Port  $F_e$ : Filter inlet

Port  $F_a$ : Filter outlet

Filter type: Filter with bypass are **not** recommended, when applying with bypass please consult supplier.

Recommendation: **with** contamination indicator

Please note:

for type with **DG**-displacement (with control pressure not from the supply circuit) the following filter type has to be used:

\_\_\_\_\_ filter **with** bypass and **with** contamination indicator

Filter arrangement: \_\_\_\_\_ separately in the pressure line (hose filter)

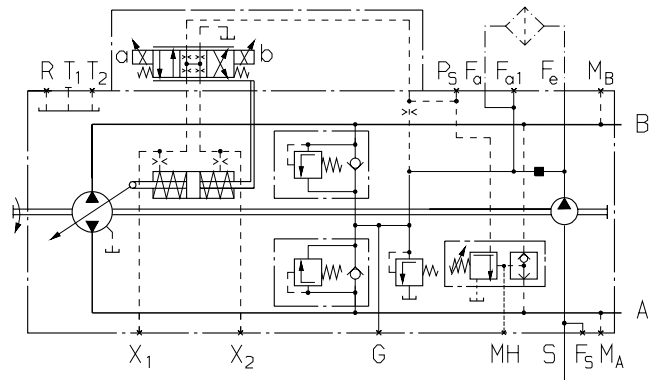
Through flow resistance at filter element:

at  $v = 30 \text{ mm}^2/\text{s}$  \_\_\_\_\_  $\Delta p \leq 1 \text{ bar}$

at cold start \_\_\_\_\_  $\Delta p_{\text{max}} = 3 \text{ bar}$

(valid for entire speed range  $n_{\text{min}} - n_{\text{max}}$ )

### Circuit diagram variation D



## Filtration

### Variation: Filtration in the pressure line of the auxiliary pump, with cold start valve and ports for external boost circuit filter, K

Design as variation D, however additionally with cold start valve:

- Filter is equipped with **cold start valve** and therefore protects the pump from damage. The valve opens at

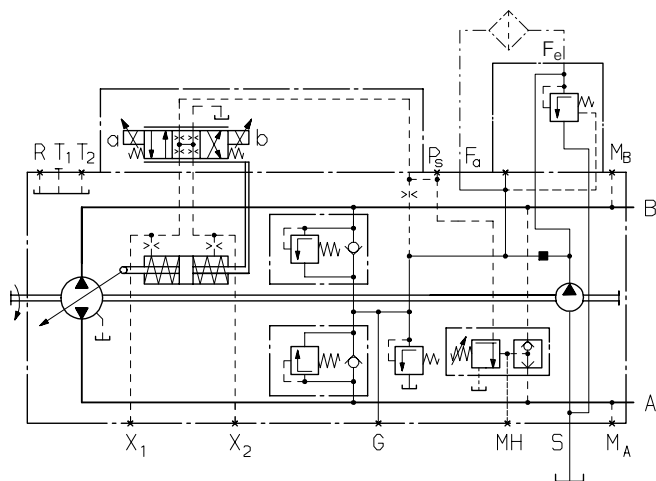
through flow resistance  $\Delta p \geq 6$  bar.

Port  $F_e$ : Filter inlet (at th cold start valve)

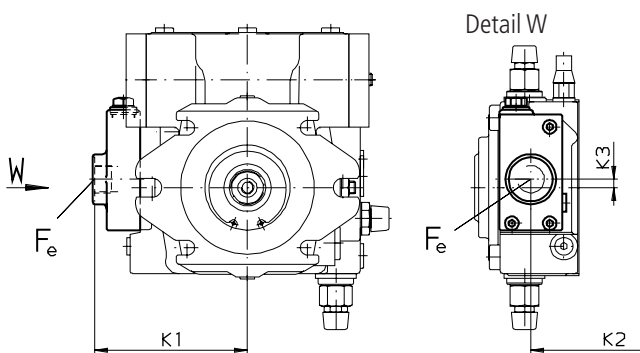
Port  $F_a$ : Filter outlet

Filter arrangement \_\_\_\_ separately in the pressure line (hose filter)

### Circuit diagram variation K (with cold start valve)



### Dimensions variation K (with cold start valve)



Size	K1	K2	K3	$F_e$
40	122,5	198,7	0	M18x1,5; 15 deep
56	125,5	215,4	0	M18x1,5; 15 deep
71	145,5	239,0	8	M26x1,5; 16 deep
90	139,5	248,5	24	M26x1,5; 16 deep
125	172,0	267,9	20	M33x2; 18 deep
180	173,0	311,9	3	M33x2; 18 deep

### Variation: Filtration in pressure line of the auxiliary pump, filter built-on, supplied complete, F

Filter type: \_\_\_\_\_ Filter **without** bypass

Please note:

- Filter is equipped with **cold start valve** and therefore protects the pump from damage.

The valve opens at

through flow resistance  $\Delta p \geq 6$  bar.

Recommendation: **with** contamination indicator (differential pressure  $\Delta p = 5$  bar)

Filter arrangement connected to pump through flow resistance at filter element:

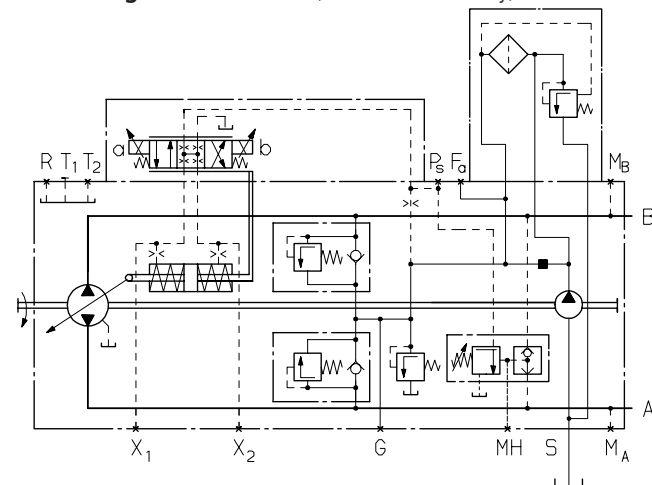
at  $v = 30$  mm<sup>2</sup>/s \_\_\_\_\_  $\Delta p \leq 1$  bar

at cold start \_\_\_\_\_  $\Delta p_{max} = 3$  bar

(valid for entire speed range  $n_{min} - n_{max}$ )

To be considered for sizes 40, 56: max perm. boost pressure  $p_{Sp max} = 35$  bar

### Circuit diagram variation F (with filter assembly)



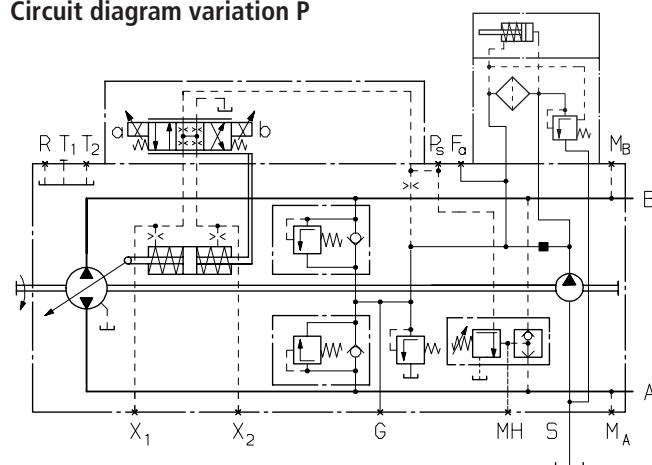
### Variation: Filtration in pressure line of the auxiliary pump, filter built-on, supplied complete, with visual contamination indicator, P

Design as variation F, however additionally with visual contamination indicator.

Indication: green/red window

differential pressure (switching pressure)  $\Delta p = 5$  bar

### Circuit diagram variation P





## Filtration

### Variation: Filtration in pressure line of the auxiliary pump, filter built-on, supplied complete, with electrical contamination indicator, L

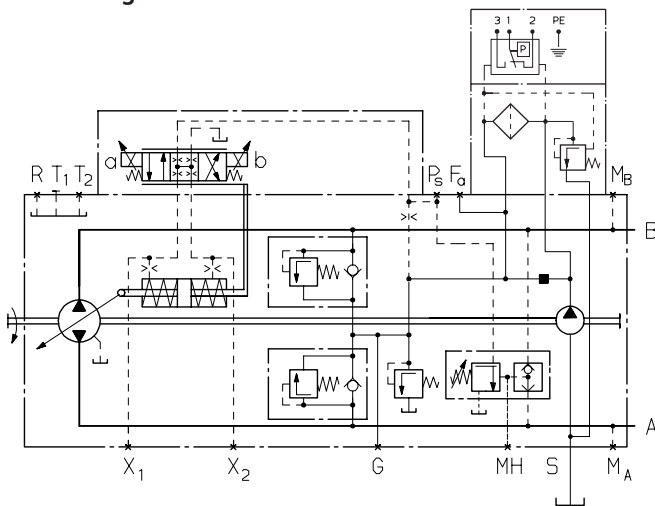
Design as variation F, however additionally with electrical contamination indicator.

Indication: electrical

differential pressure (switching pressure)  $\Delta p = 5 \text{ bar}$

Max. switching power at 24 V DC \_\_\_\_\_ 60 W

#### Circuit diagram variation L



### Variation: Filtration in pressure line of the auxiliary pump, filter built-on, supplied complete, with visual and electr. contamination indicator, M

Design as variation F, however additionally with visual and electrical contamination indicator.

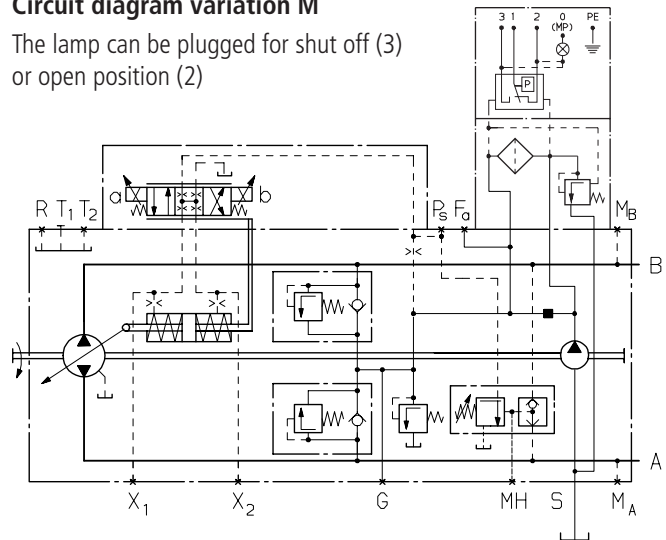
Indication: electrical and visual by lamp

differential pressure (switching pressure)  $\Delta p = 5 \text{ bar}$

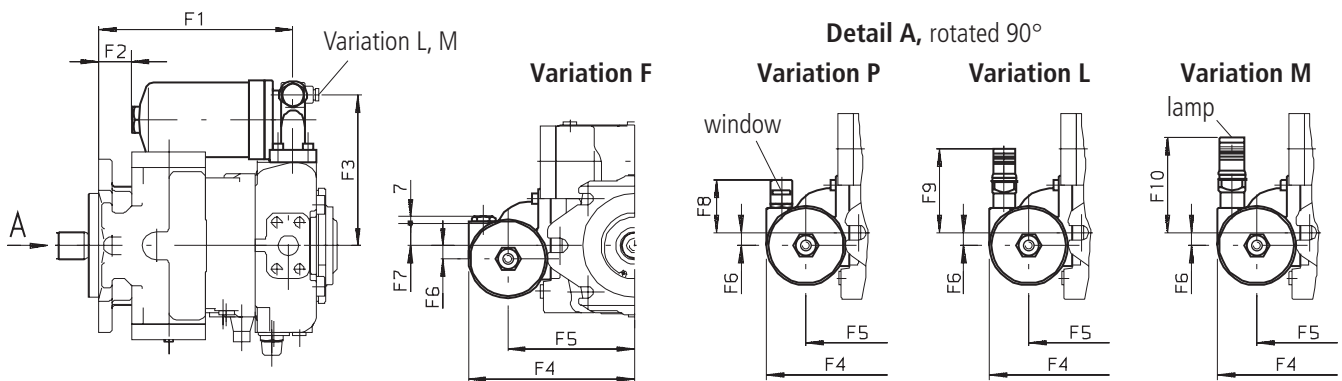
Max. switching power at 24 V DC \_\_\_\_\_ 60 W

#### Circuit diagram variation M

The lamp can be plugged for shut off (3) or open position (2)



### Dimensions variation F, P, L, M (with filter assembly)

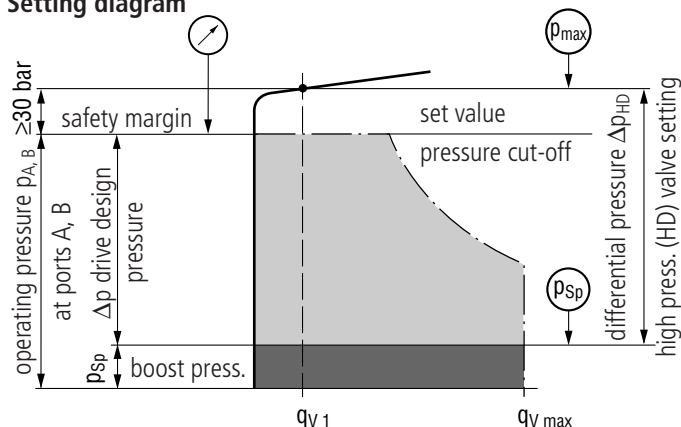


Size	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
40	201,7	47,7	160	175	135	0	42	78,5	122	125
56	218,4	64,4	163	178	138	0	42	78,5	122	125
71	239	46,5	185	203,5	155	16	29	65,5	109	112
90	248,5	56	179	197,5	149	0	45	81,5	125	128
125	235,9	59,4	201	219,5	171	0	53	89,5	133	136
180	279,9	40,3	202	220,4	171,9	17	36	72,5	116	119



# High Pressure Relief Valve

## Setting diagram



Note: valve setting is done at  
 $n = 1000 \text{ min}^{-1}$  and  $V_{g \text{ max}} (q_{V1})$

Example: boost pressure 20 bar; operating pressure 410 bar  
 operating pres.  $p_{A,B}$  - boost pres.  $p_{Sp}$  + safety margin = differential pres.  $\Delta p_{HD}$   
 410 bar - 20 bar + 30 bar = **420 bar**

## Setting range

High pressure relief valve, pilot controlled (sizes 71...250)	Differential pressure setting $\Delta p_{HD}$
Setting range valve <b>1</b> $\Delta p$ 100 - 420 bar (see ordering code)	420 bar
	400 bar <sup>1)</sup>
	360 bar
	340 bar
	320 bar
	300 bar
	270 bar
	250 bar
	230 bar
	200 bar
	100 bar

High pressure relief valve, direct controlled (sizes 28...56)	Differential pressure setting $\Delta p_{HD}$
Setting range valve <b>3, 5</b> $\Delta p$ 250 - 420 bar (see ordering code)	420 bar
	400 bar <sup>1)</sup>
	360 bar
	340 bar
	320 bar
	270 bar
Setting range valve <b>4, 6</b> $\Delta p$ 100 - 250 bar (see ordering code)	250 bar
	230 bar <sup>1)</sup>
	200 bar
	150 bar
	100 bar

<sup>1)</sup> Standard setting of differential pressure, valves set to this value if no details given on order.

## Bypass function

- Sizes 28...56: HD valves direct controlled (**3**), (**4**): without bypass
- Sizes 28...56: HD valves direct controlled (**5**), (**6**): with bypass
- Sizes 71...250: HD valves pilot controlled (**1**): with bypass

Simplification: The bypass function is not shown in the circuit diagrams  
 The pilot controlled HD-valves (sizes 71...250) are not shown in the circuit diagrams.

## Please state in clear text when ordering:

(possible are only the values  $\Delta p_{HD}$  shown in the table)  
**High pressure relief valve A**  
 Differential pressure setting:  $\Delta p_{HD} = \dots \text{ bar}$   
 Opening pressure of the HD-valve (at  $q_{V1}$ ):  $p_{max} = \dots \text{ bar}$   
 ( $p_{max} = \Delta p_{HD} + p_{Sp}$ )

**High pressure relief valve B**  
 Differential pressure setting:  $\Delta p_{HD} = \dots \text{ bar}$   
 Opening pressure of the HD-valve (at  $q_{V1}$ ):  $p_{max} = \dots \text{ bar}$   
 ( $p_{max} = \Delta p_{HD} + p_{Sp}$ )

## Pressure Cut-Off, D

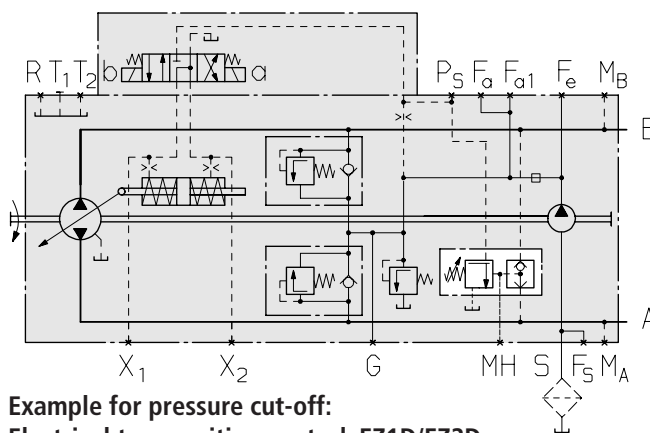
The pressure cut-off corresponds to a pressure regulation which, after reaching the set pressure, adjusts the pump volume of the pump to  $V_{g0} = 0$ .

This valve prevents the operation of the high pressure relief valves when accelerating or decelerating.

The pressure peaks occurring when the swashplate is swivelled rapidly and also the maximum pressure in the system are safeguarded by the high pressure limit valves.

The setting range of the pressure cut-off may be anywhere within the entire working pressure range. However, it must be set 30 bar lower than the setting of the high pressure safety relief valves (see setting diagram).

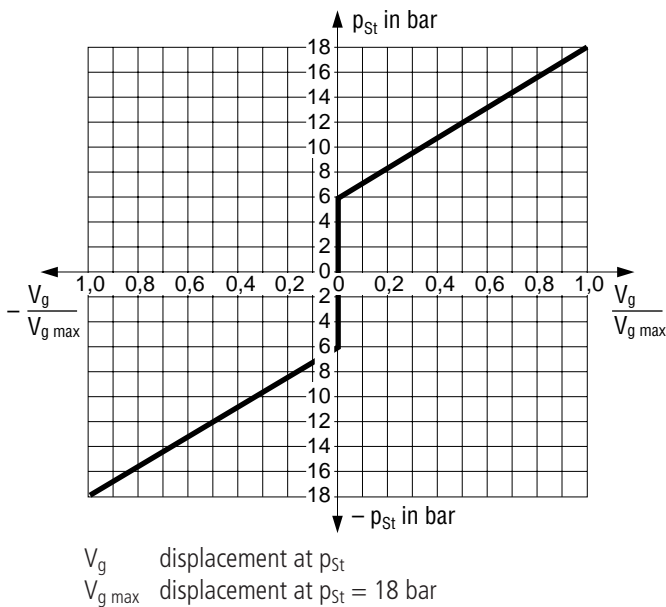
Please state the setting value of the pressure cut-off in clear text when ordering.



Example for pressure cut-off:  
**Electrical two-position control, EZ1D/EZ2D**

# HD Hydraulic Control, Pilot Pressure Related

The positioning cylinder of the pump and therefore the swivel angle is varied in proportion to the difference in pilot pressure applied to the two control ports (Y<sub>1</sub> and Y<sub>2</sub>). The pump displacement is therefore steplessly variable. One pilot line is assigned to each direction of flow.



Pilot pressure  $p_{St} = 6 - 18$  bar (at ports Y<sub>1</sub>, Y<sub>2</sub>)  
 Start of control 6 bar  
 End of control 18 bar (max. displacement  $V_{g\ max}$ )

If the pump is also fitted with a DA control valve, e.g. for automotive control of the vehicle transmission is also possible. DA control valve see page 13.

For pressure cut-off, see page 9.

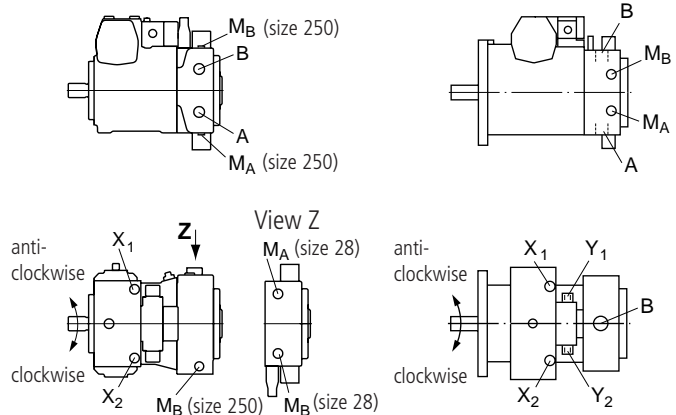
## Graph

### Direction of rotation - Control - Direction of through flow

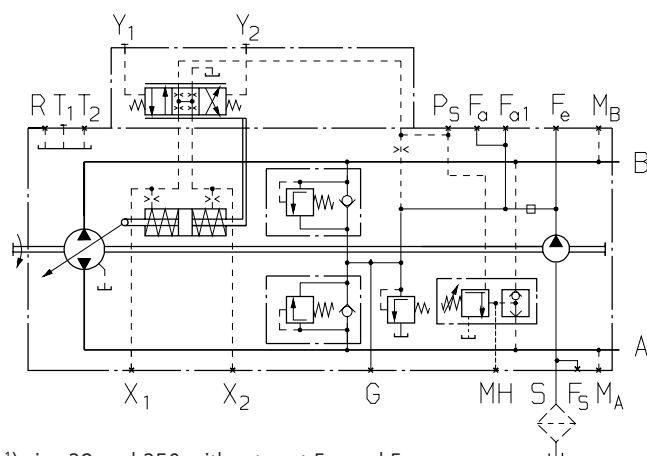
	Size	Pilot pressure	Control pressure	Direction flow	Operating pressure
Direction of rotation clockwise	28...56	Y <sub>1</sub>	X <sub>1</sub>	A to B	M <sub>B</sub>
		Y <sub>2</sub>	X <sub>2</sub>	B to A	M <sub>A</sub>
Direction of rotation anti-clockwise	28...56	Y <sub>1</sub>	X <sub>1</sub>	B to A	M <sub>A</sub>
		Y <sub>2</sub>	X <sub>2</sub>	A to B	M <sub>B</sub>
Direction of rotation clockwise	71...250	Y <sub>1</sub>	X <sub>1</sub>	B to A	M <sub>A</sub>
		Y <sub>2</sub>	X <sub>2</sub>	A to B	M <sub>B</sub>
Direction of rotation anti-clockwise	71...250	Y <sub>1</sub>	X <sub>1</sub>	A to B	M <sub>B</sub>
		Y <sub>2</sub>	X <sub>2</sub>	B to A	M <sub>A</sub>

### Sizes 28, 250

### Sizes 40...180

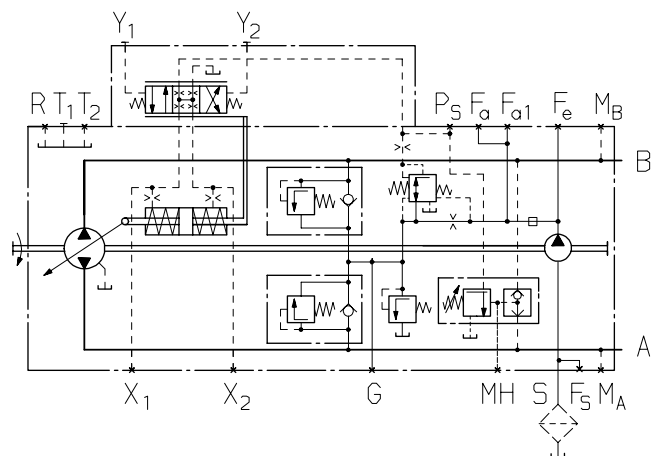


### Standard model 1)



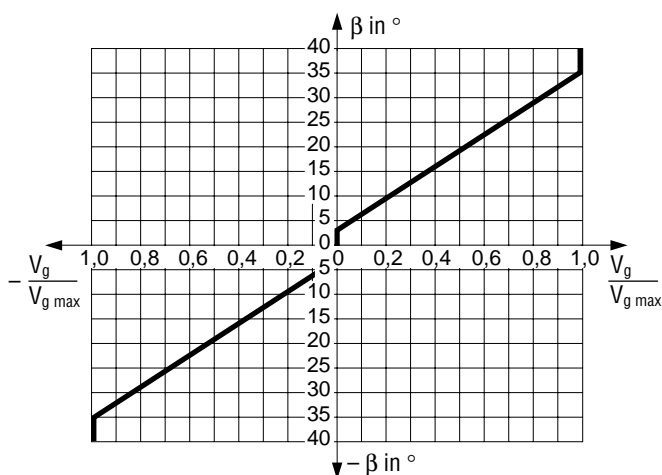
1) size 28 and 250 without port F<sub>a1</sub> and F<sub>5</sub>

### Model with DA control valve 1)



# HW Hydraulic Control, Mechanical Servo

The positioning cylinder of the pump and therefore the swivel angle is varied in proportion to the movement of the control lever. The pump control is steplessly variable. Each direction of flow is assigned to one direction of lever movement.



Swivel angle of control lever:

from 0 bis  $\pm V_{g \max} \cong \beta = 0^\circ$  to  $\pm 35^\circ$

mech. stop: sizes 28...71  $\pm 40^\circ$

sizes 90...250  $\pm 35^\circ$

Torque necessary at control lever is between 85 and 210 Ncm. The limitation of the operating range of the HW control lever must be fixed in the external control mechanism (required value setting).

If the pump is also fitted with a DA control valve, automotive control of the vehicle transmission is also possible. DA control valve see page 13.

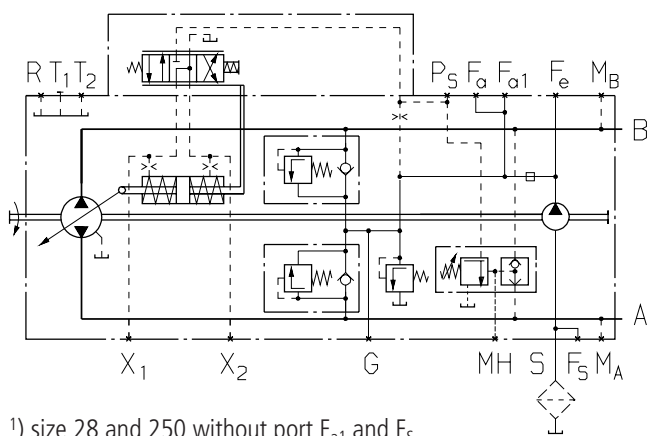
For pressure cut-off, see page 9.

### Variation: zero position switch, L

At zero position of the control lever of the HW control device the switch contact of the zero position switch is closed. In case of start-on of the control lever from the center position the contact is interrupted.

The zero position switch assures a safety function for drives which necessitate the zero position under certain operation conditions (for example start of the diesel engine).

### Standard model 1)



1) size 28 and 250 without port  $F_{a1}$  and  $F_5$

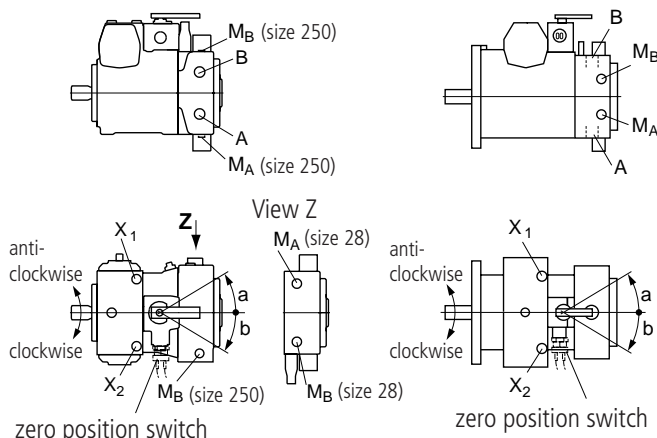
### Graph

#### Direction of rotation - Control - Direction of through flow

	Size	Lever direction	Control pressure	Direction flow	Operating pressure
Direction of rotation clockwise	28...56	a	$X_2$	B to A	$M_A$
		b	$X_1$	A to B	$M_B$
Direction of rotation clockwise	71...250	a	$X_2$	A to B	$M_B$
		b	$X_1$	B to A	$M_A$
Direction of rotation anti-clockwise	28...56	a	$X_2$	A to B	$M_B$
		b	$X_1$	B to A	$M_A$
Direction of rotation anti-clockwise	71...250	a	$X_2$	B to A	$M_A$
		b	$X_1$	A to B	$M_B$

### Sizes 28, 250

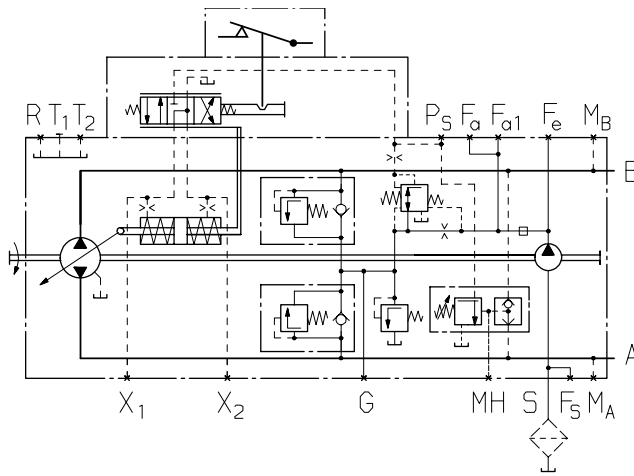
### Sizes 40...180



### Technical data for zero position switch

load performance	20 A (continuous)
switch performance	15A / 32V (DC)
	4A / 32V (AC - inductive)

### Model with DA control valve and zero position switch 1)



## DA Hydraulic Control, Speed Related

In relation to the drive speed, control pressure is applied to the positioning cylinder of the pump by means of the DA control valve via a 4/3 way directional valve. Pump displacement is steplessly variable in each direction of flow. Each direction of flow is assigned to one of the two solenoids on the directional valve.

Increasing drive speed generates a higher control pressure through the DA valve.

Increasing control pressure increases the pump displacement.

Dependent upon the pump operating curve, pressure in the high pressure lines causes the pump to swivel back towards a smaller displacement.

Increasing operating pressure gives reduced displacement.

A constant torque input to the pump is achieved by this combination of de-stroking of the pump as the operating pressure increases and in response to the "pull-down" of the prime mover (leading to a reduced control pressure).

The least possible pull down leads to optimum usage of the drive power. This is achieved by "partial inching". In this form of the control, the DA valve is mechanically coupled to the accelerator pedal. This means that on reaching a certain speed (movement of the accelerator pedal), the control curve is offset parallel to the engine speed curve.

Any additional power requirements, e.g. the service hydraulics, may lead to engine pull down occurring. This leads to a reduction in control pressure and therefore pump displacement. The power thus released is then available to supply that demanded. Automatic power division and full utilisation of power available is thus achieved for both the vehicle transmission and the service hydraulics.

In an automotive transmission, the DA control valve is used in conjunction with the directly controlled hydraulic "DA control".

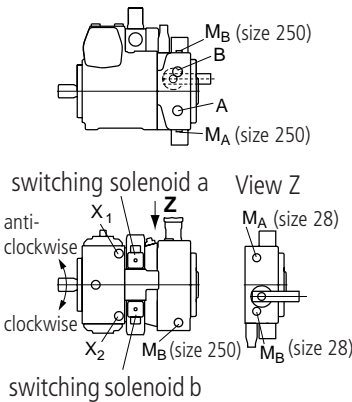
However, pumps with EP, HW or HD control devices can also be equipped with a DA control valve. In this way, the automatic transmission function (speed related high pressure/flow increase with load limiting control) may be overridden.

The maximum flow will then be determined by the setting of the relevant control module fitted.

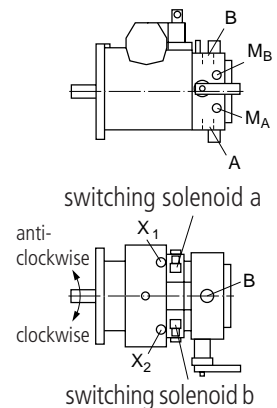
**Graph**  
Direction of rotation - Control - Direction of through flow

	Size	Solenoid	Control pressure	Direction flow	Operating pressure
Direction of rotation clockwise	28...56	a	X <sub>2</sub>	B to A	M <sub>A</sub>
		b	X <sub>1</sub>	A to B	M <sub>B</sub>
Direction of rotation anti-clockwise	71...250	a	X <sub>2</sub>	A to B	M <sub>B</sub>
		b	X <sub>1</sub>	B to A	M <sub>A</sub>
Direction of rotation clockwise	28...56	a	X <sub>2</sub>	A to B	M <sub>B</sub>
		b	X <sub>1</sub>	B to A	M <sub>A</sub>
Direction of rotation anti-clockwise	71...250	a	X <sub>2</sub>	B to A	M <sub>A</sub>
		b	X <sub>1</sub>	A to B	M <sub>B</sub>

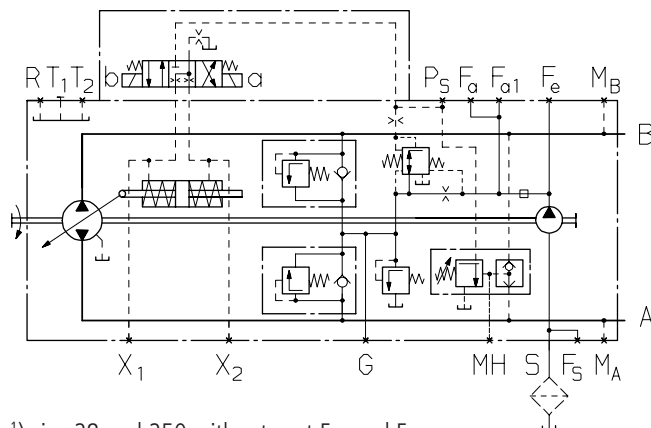
Sizes 28, 250



Sizes 40...180



### Hydraulic control, speed related, DA-control valve, fixed setting, DA1D2/DA2D2 1)



1) size 28 and 250 without port F<sub>a1</sub> and F<sub>5</sub>

## Function and Control of DA Valves

(Unit dimensions see page 32...34)

### DA control valve, fixed setting, (2)

Control pressure is generated in relation to drive speed. When ordering, please state in clear text: Start of control (set at factory).

### DA control valve, mechanically adjustable with control lever (3)

Control pressure is generated in relation to drive speed. When ordering, please state in clear text: Start of control (set at factory).

Control pressure may be reduced (independently of drive speed) as required by operation of the control lever (inch function).

Max. adm. operating torque at the control lever  $T_{max} = 4 \text{ Nm}$

Max. angle of lever operation  $70^\circ$ . The position of the lever is optional.

**Variation 3L** \_ operation direction of the control lever anti-clockwise

**Variation 3R** \_\_\_\_ operation direction of the control lever clockwise

### Hydraulic inch valve, (4, 5, 8, 9)

(only for pumps with DA control device)

- for inch function; for use in conjunction with DA control valve, fixed setting (4, 8) or mechanically adjustable (5, 9)
- Model with throttle valve sizes 28, 40, 56, 71**
- Model with pressure reducing valve sizes 90, 125, 180, 250**

Permits the control pressure to be reduced independently of the drive speed via hydraulic control (port Z).

#### Variation 4, 5:

The control at port Z by means of braking fluid from the vehicle braking system (hydraulically linked with the operation brake).

#### Variation 8, 9:

The control at port Z by means of mineral oil.

### Master controller as inch valve, (7)

- for inch function; for use in conjunction with DA control valve, fixed setting

Any reduction of control pressure, independent from the input speed through the mechanical operation of the master controller.

The master controller is installed separately from the pump (for instance in the driver's cabin) connected with the pump by 2 hydraulic control lines at ports  $P_5$  and Y.

A suitable master controller is to be ordered separately and is not included in delivery volume.

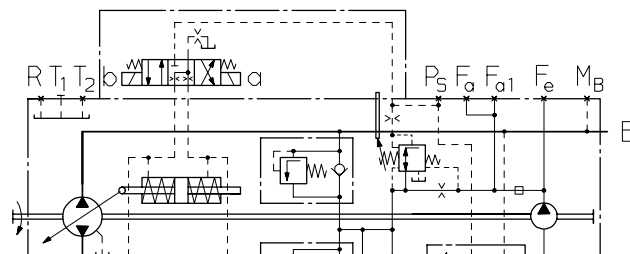
Extensive information is available from our mobile sales department. Please make use of an opportunity to confirm your transmission design through our computer programme in BRUENINGHAUS HYDROMATIK. A DA control can only be approved by BRUENINGHAUS HYDROMATIK.

Note: rotary inch valve see page 41.

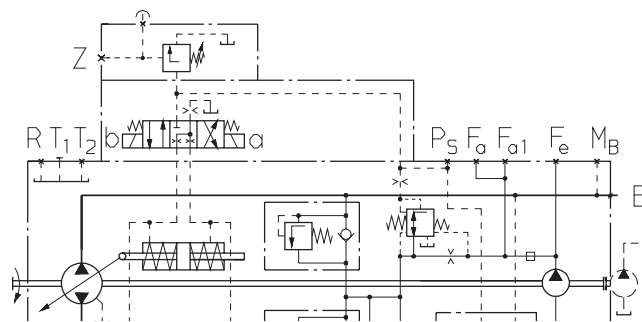
<sup>1)</sup> size 28 and 250 without port  $F_{a1}$  and  $F_5$

### Circuit diagrams 1):

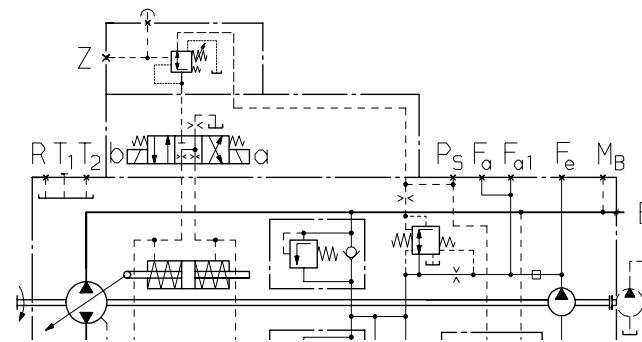
Hydraulic control, speed related,  
DA control valve, mech. adjustable with control lever DA1D3/DA2D3



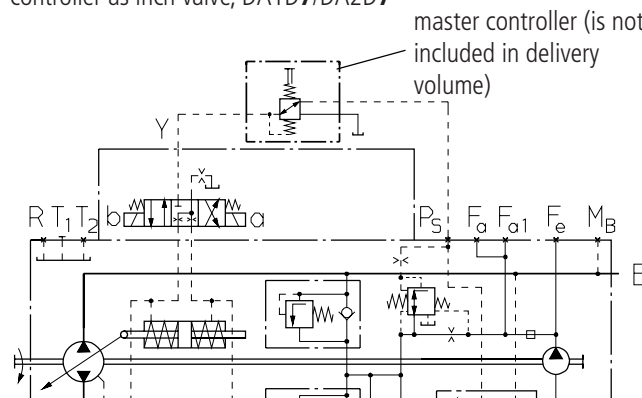
Hydraulic control, speed related,  
DA control valve, fixed setting,  
with hydraulic inch valve, DA1D4/DA2D4  
with throttle valve,  
sizes 28...71



with pressure reducing valve,  
sizes 90...250



Hydraulic control, speed related, DA  
DA control valve, fixed setting, with separately installed master controller as inch valve, DA1D7/DA2D7



## DG Hydraulic Control, Direct Operated

By switching the pilot pressure at the connections  $X_1$  or  $X_2$  the positioning cylinder of the pump is directly supplied with internal control pressure. Thus the swashplate and so the displacement is adjustable between  $V_{g0} = 0$  and  $V_{gmax}$ . Each direction of flow is assigned to a connection.

pilot pressure 0 bar  $\hat{=}$  setting  $V_{g0} = 0$

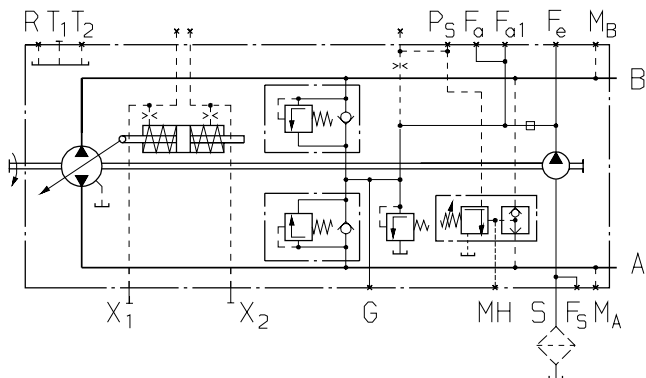
The necessary pilot pressure for the setting  $V_{gmax}$  depends upon the operation pressure and rotational speed.

Please contact us for further information.

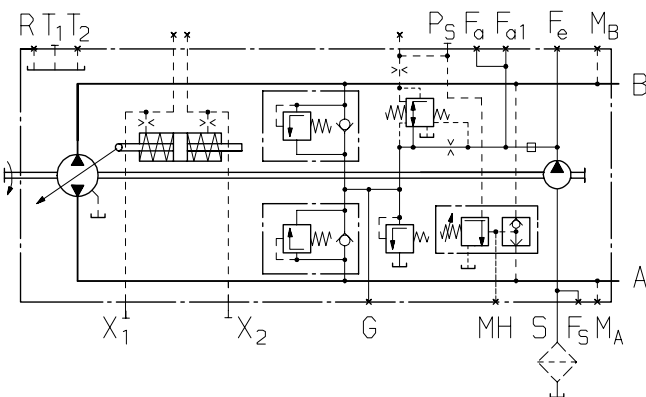
For pressure cut-off, see page 9.

Assignment direction of rotation – control – direction of flow  
 HD control see page 10 (control pressure  $X_1; X_2$ ).

### Standard model 1)



### Model with DA control valve 1)



1) size 28 and 250 without port  $F_{a1}$  and  $F_5$

## EZ Electrical Two-Position Control with Switching Solenoid

By energizing either solenoid a or b, the positioning cylinder of the pump is directly supplied with internal control pressure, and the pump swivels to maximum displacement. In this way, the swashplate and thus the displacement is switchable from  $V_{g0} = 0$  to  $V_{gmax}$ . Each direction of flow is assigned to a solenoid.

solenoid de-energized  $\hat{=}$  setting  $V_{g0} = 0$   
 solenoid energized  $\hat{=}$  setting  $V_{gmax}$

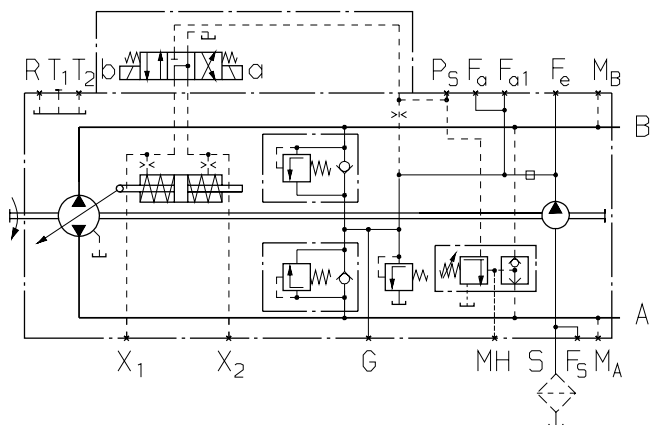
EZ1 \_\_\_\_\_ solenoid 12 V

EZ2 \_\_\_\_\_ solenoid 24 V

For pressure cut-off, see page 9.

Assignment direction of rotation – control – direction of flow  
 DA control see page 12.

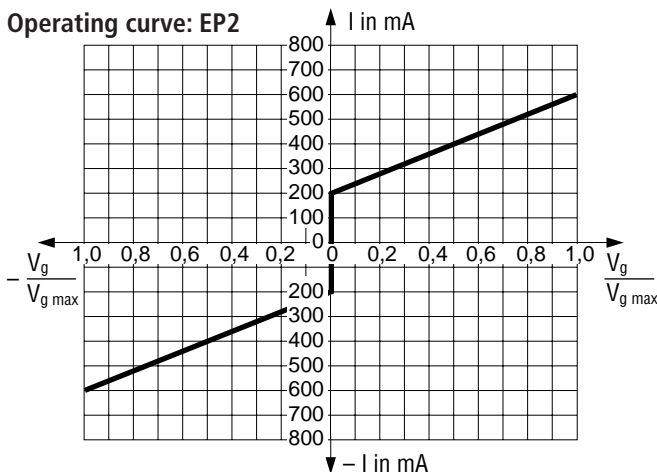
### Standard model 1)



## EP Electrical Control, with Proportional Solenoids

In relation to the preselected current, control pressure is applied to the positioning cylinder of the pump via two proportional solenoids on control device EP. The displacement of the pump is thus steplessly variable. One solenoid is assigned to each direction of flow.

Operating curve: EP2



model	control voltage (DC)	control current / start of control at $V_{g0}$ – end of control at $V_{gmax}$
EP1	12 V	400 mA – 1200 mA
EP2	24 V	200 mA – 600 mA

To control the proportional solenoids the following electronic amplifiers and microcontroller are available:

proportional amplifiers PVR and PVRs (see RE 95022), chopper amplifier CV (see RE 95029), open loop control electronics RVR (see RE 95031), open loop control electronics CSD (see RE 95075), closed loop control electronics RVE (see RE 95033), universal closed loop control electronics RVU (see RE 95048) and microcontroller MC with software solutions related to the field of application (see RE 95050).

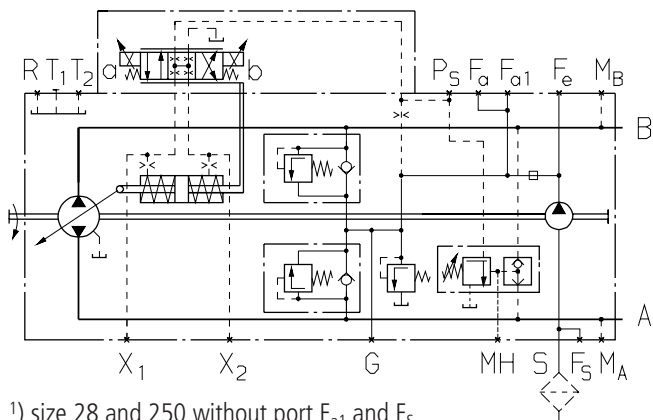
If the pump is also fitted with a DA control valve, automotive control of the vehicle transmission is also possible.

DA control valve, see page 13.

For pressure cut-off, see page 9.

Standard: proportional solenoid with manual emergency (without spring return)

### Standard model 1)



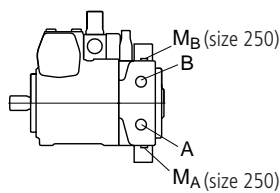
1) size 28 and 250 without port  $F_{a1}$  and  $F_5$

### Graph

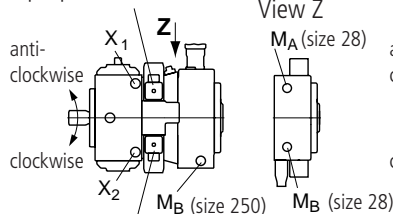
#### Direction of rotation - Control - Direction of through flow

	Size	Solenoid	Control pressure	Direction flow	Operating pressure
Direction of rotation clockwise	28...56	a	$X_1$	A to B	$M_B$
		b	$X_2$	B to A	$M_A$
	71...250	a	$X_1$	B to A	$M_A$
		b	$X_2$	A to B	$M_B$
Direction of rotation anti-clockwise	28...56	a	$X_1$	B to A	$M_A$
		b	$X_2$	A to B	$M_B$
	71...250	a	$X_1$	A to B	$M_B$
		b	$X_2$	B to A	$M_A$

### Sizes 28, 250

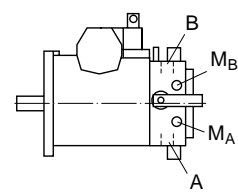


proportional solenoid a

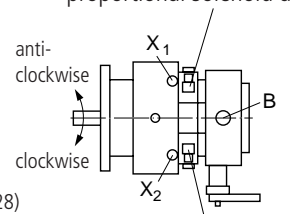


proportional solenoid b

### Sizes 40...180

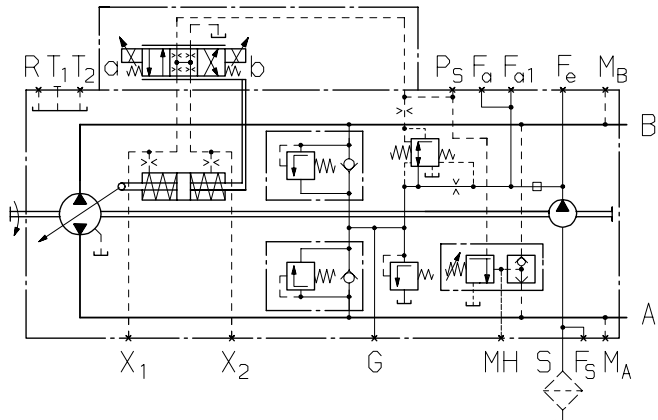


proportional solenoid a



proportional solenoid b

### Model with DA control valve 1)

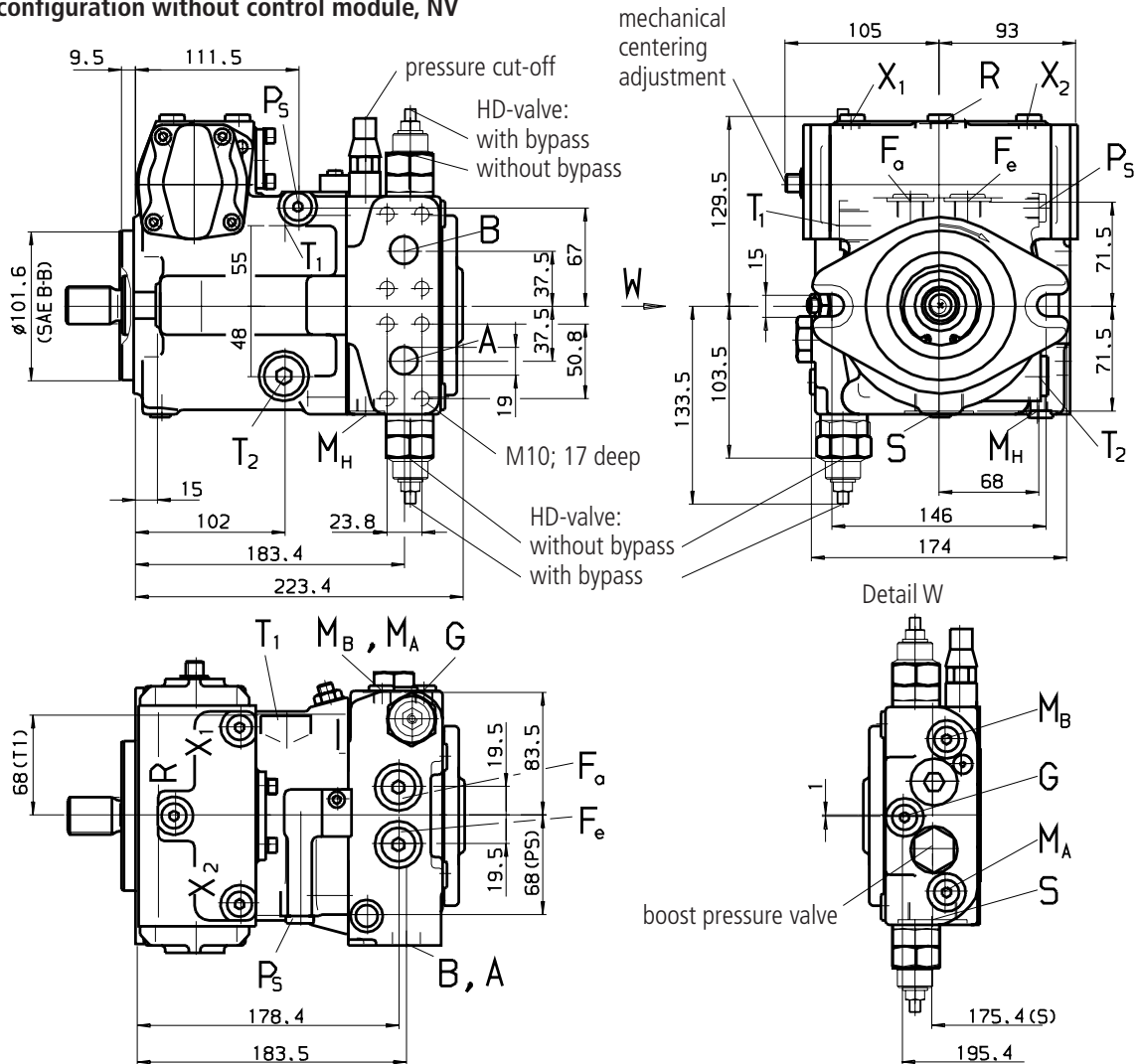




## Unit Dimensions, Size 28

Before finalising your design, please request a certified drawing.

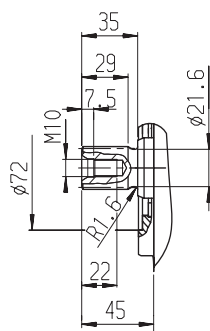
### Pump configuration without control module, NV



### Shaft ends

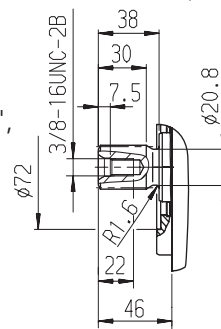
#### Z

Splined shaft  
W 25x1,25x30x18x9g  
DIN 5480



#### S

Splined shaft SAE 1",  
pressure angle 30°,  
15 teeth, 16/32 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976



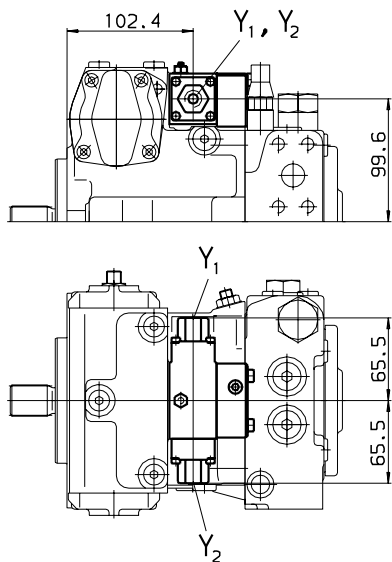
### Connections

A, B	Service line ports SAE 3/4", high pressure series 420 bar (6000 psi)
T <sub>1</sub>	Case drain or filling port M22x1,5; 14 deep
T <sub>2</sub>	Case drain M22x1,5; 14 deep
M <sub>A</sub> , M <sub>B</sub>	Pressure gauge - operating pressure A, B M12x1,5; 12 deep
R	Air bleed M12x1,5; 12 deep
S	Boost suction port M33x2; 18 deep
X <sub>1</sub> , X <sub>2</sub>	Control pressure ports (before the orifice) M12x1,5; 12 deep
G	Pressure port for auxiliary circuit M12x1,5; 12 deep
P <sub>S</sub>	Control pressure supply M14x1,5; 12 deep
F <sub>a</sub>	Filter outlet M18x1,5; 12 deep
F <sub>e</sub>	Filter inlet M18x1,5; 12 deep
M <sub>H</sub>	Port for balanced high pressure M12x1,5; 12 deep
Y <sub>1</sub> , Y <sub>2</sub>	Remote control ports (only for HD control) M14x1,5; 12 deep

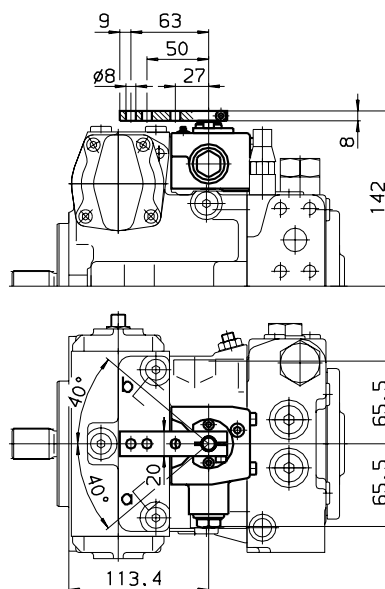
Unit Dimensions, Size 28

Before finalising your design, please request a certified drawing.

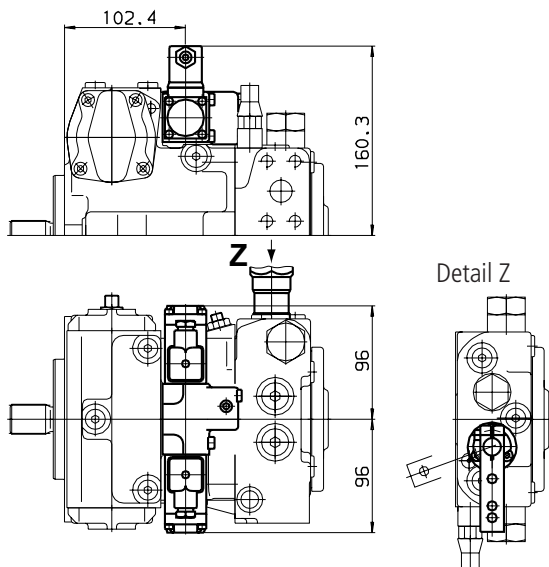
Hydraulic control, pilot pressure related, HD



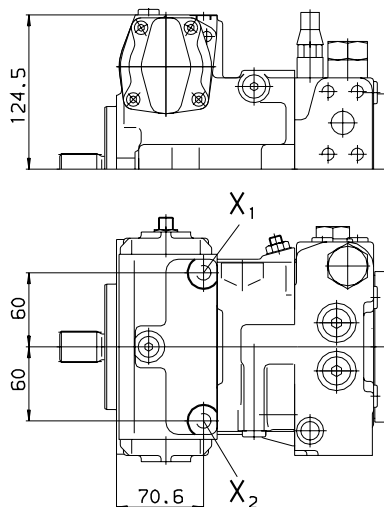
Hydraulic control, mechanical servo, HW



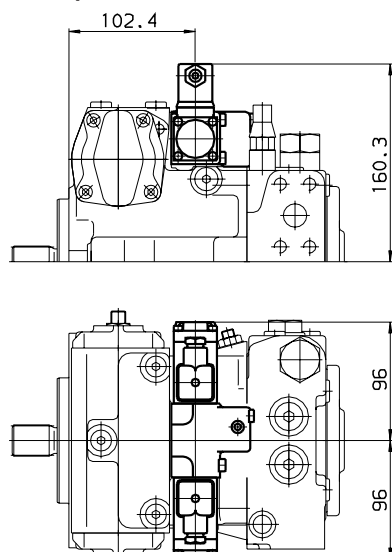
Hydraulic control, speed related, DA  
(dimensions of the DA control valve see pages 32, 33)



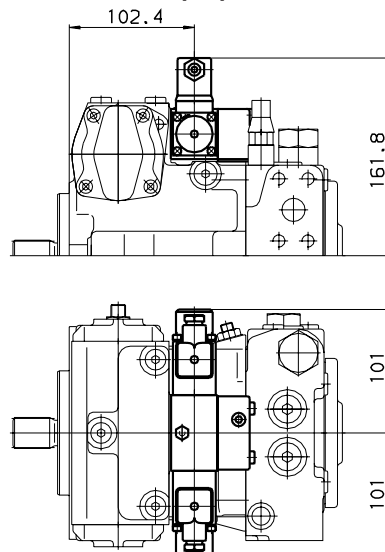
Hydraulic control, direct operated, DG



Electrical two-position control, with switching solenoid, EZ



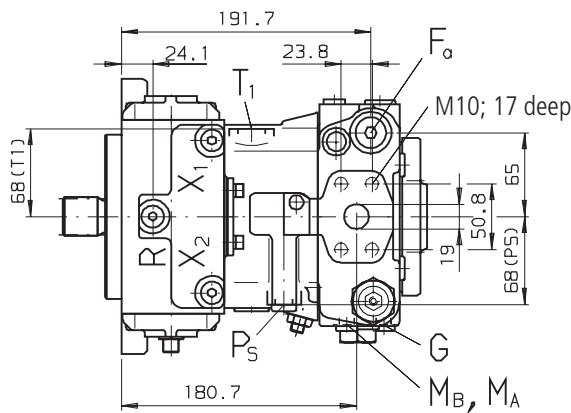
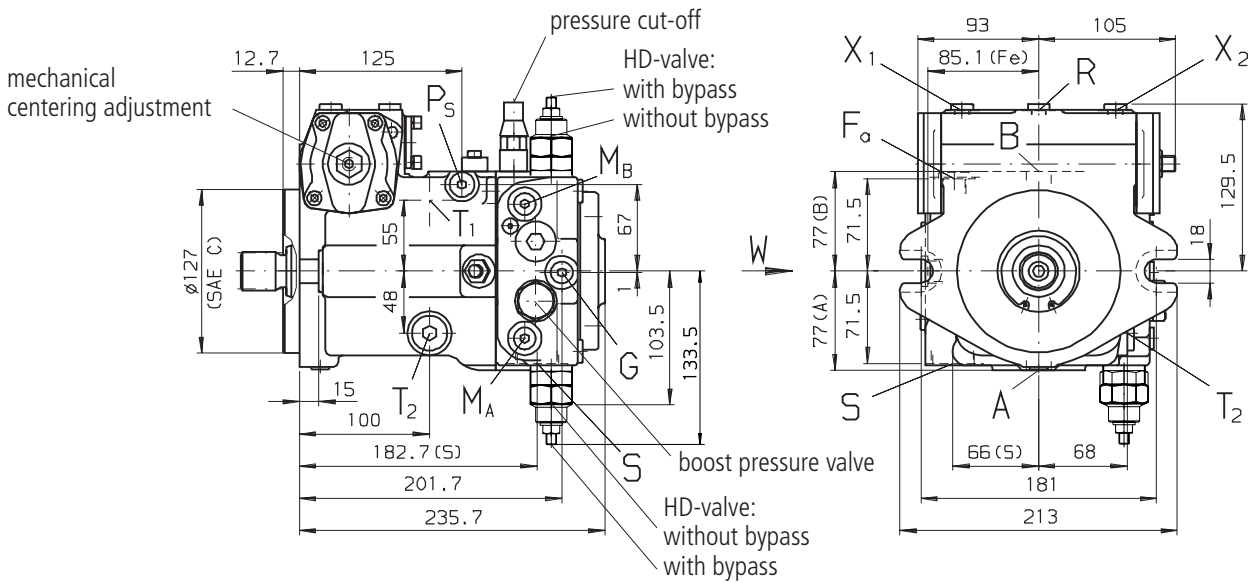
Electrical control, with proportional solenoid, EP



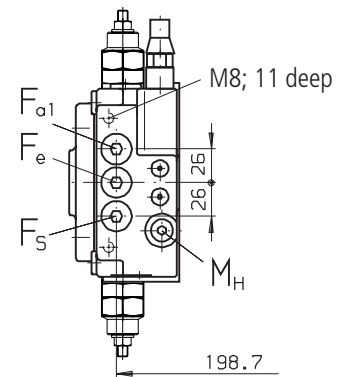
## Unit Dimensions, Size 40

Before finalising your design, please request a certified drawing.

### Pump configuration without control module, NV



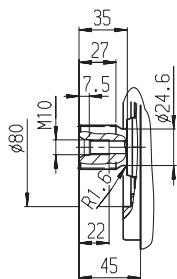
Detail W



### Shaft ends

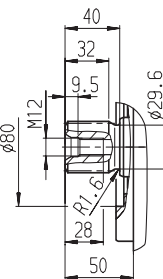
#### Z

Splined shaft  
W 30x2x30x14x9g  
DIN 5480



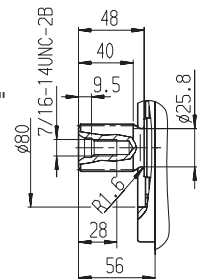
#### A

Splined shaft  
W 35x2x30x16x9g  
DIN 5480



#### S

Splined shaft SAE 1 1/4"  
pressure angle 30°,  
14 teeth, 12/24 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976

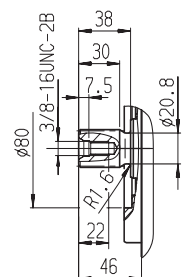


### Connections

A, B	Service line ports SAE 3/4", high pressure series 420 bar (6000 psi)
T <sub>1</sub>	Case drain or filling port M22x1,5; 14 deep
T <sub>2</sub>	Case drain M22x1,5; 14 deep
M <sub>A</sub> , M <sub>B</sub>	Pressure gauge - operating pressure A, B M12x1,5; 12 deep
R	Air bleed M12x1,5; 12 deep
S	Boost suction port M33x2; 18 deep
X <sub>1</sub> , X <sub>2</sub>	Control pressure ports (before the orifice) M12x1,5; 12 deep
G	Pressure port for auxiliary circuit M12x1,5; 12 deep
P <sub>S</sub>	Control pressure supply M14x1,5; 12 deep
F <sub>a</sub>	Filter outlet M18x1,5; 12 deep
F <sub>a1</sub>	Filter outlet (filter assembly) M18x1,5; 12 deep
F <sub>e</sub>	Filter inlet M18x1,5; 12 deep
F <sub>S</sub>	Port from filter to suction line (cold start) M18x1,5; 12 deep
M <sub>H</sub>	Port for balanced high pressure M12x1,5; 12 deep
Y <sub>1</sub> , Y <sub>2</sub>	Remote control ports (only for HD control) M14x1,5; 12 deep

#### U

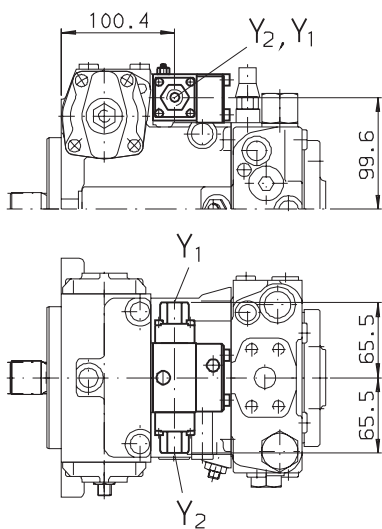
Splined shaft SAE 1"  
pressure angle 30°,  
15 teeth, 16/32 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976



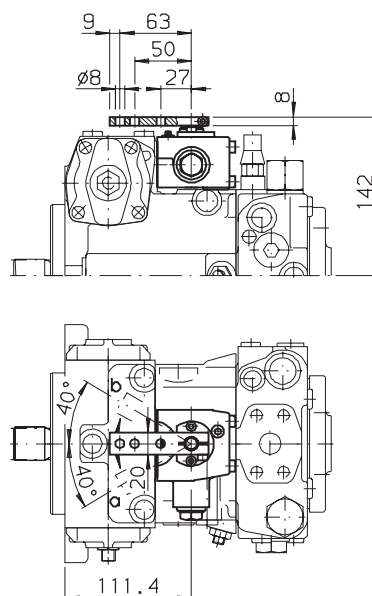
**Unit Dimensions, Size 40**

Before finalising your design, please request a certified drawing.

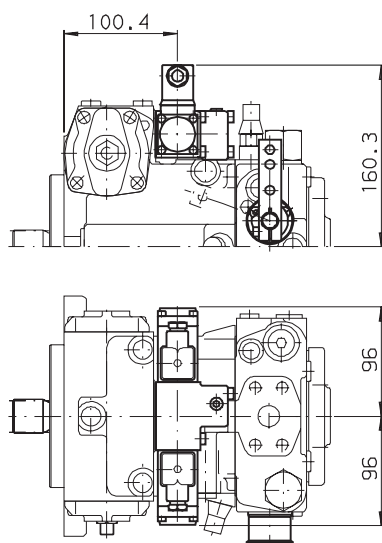
**Hydraulic control, pilot pressure related, HD**



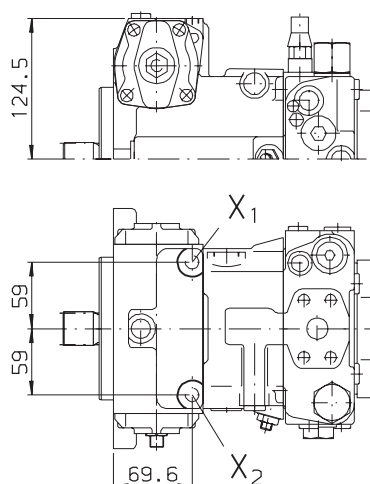
**Hydraulic control, mechanical servo, HW**



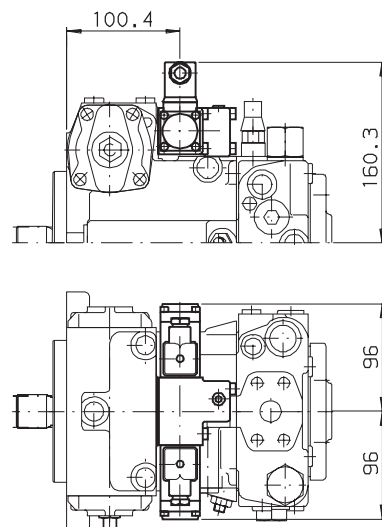
**Hydraulic control, speed related, DA**  
(dimensions of the DA control valve see pages 32, 33)



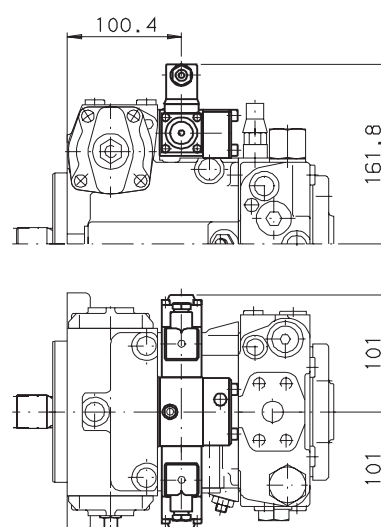
**Hydraulic control, direct operated, DG**



**Electrical two-position control, with switching solenoid, EZ**



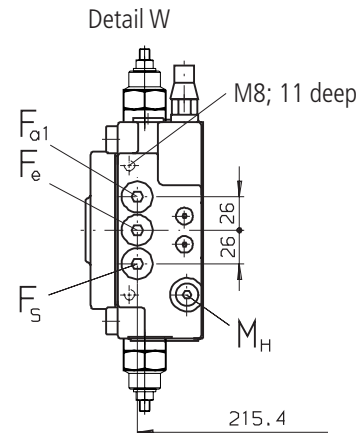
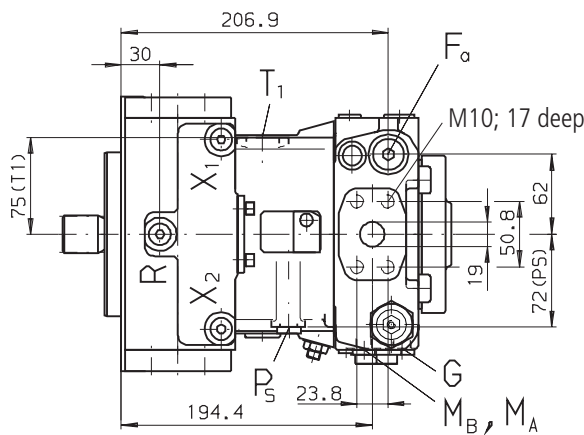
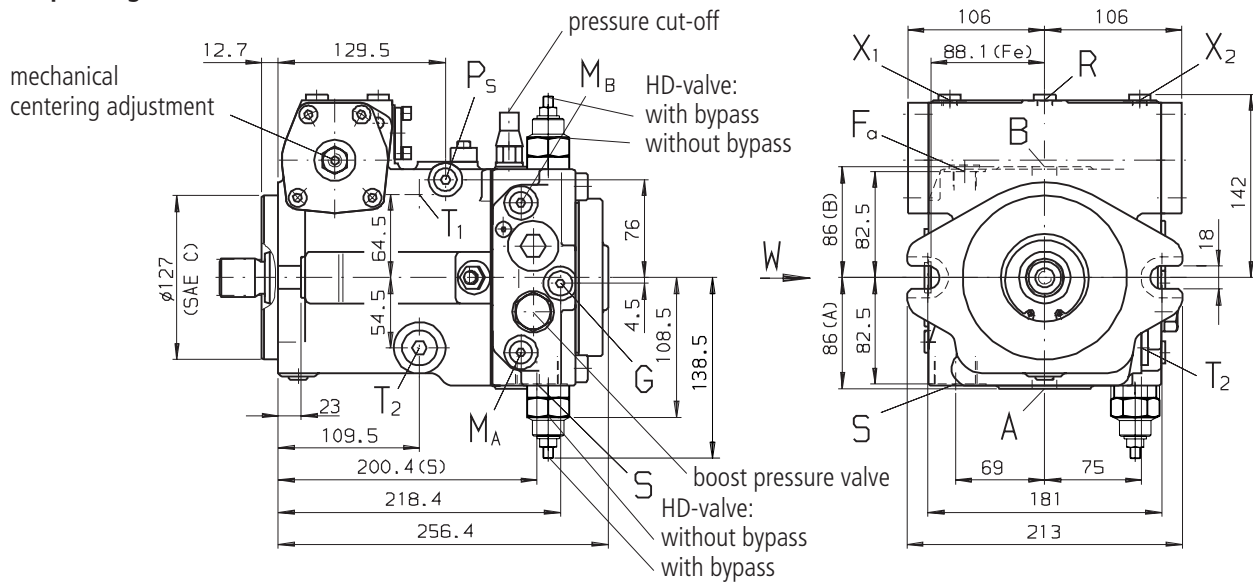
**Electrical control, with proportional solenoid, EP**



## Unit Dimensions, Size 56

Before finalising your design, please request a certified drawing.

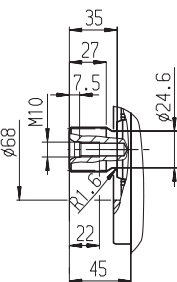
### Pump configuration without control module, NV



### Shaft ends

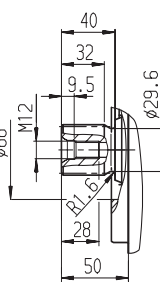
#### Z

Splined shaft  
W 30x2x30x14x9g  
DIN 5480



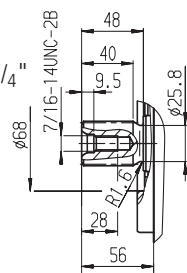
#### A

Splined shaft  
W 35x2x30x16x9g  
DIN 5480



#### S

Splined shaft SAE 1 1/4"  
pressure angle 30°,  
14 teeth, 12/24 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976

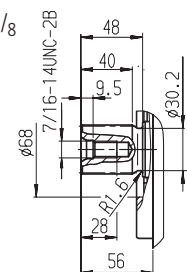


### Connections

A, B	Service line ports SAE 3/4", high pressure series 420 bar (6000 psi)	
T <sub>1</sub>	Case drain or filling port	M22x1,5; 14 deep
T <sub>2</sub>	Case drain	M22x1,5; 14 deep
M <sub>A</sub> , M <sub>B</sub>	Pressure gauge - operating pressure A, B	M12x1,5; 12 deep
R	Air bleed	M12x1,5; 12 deep
S	Boost suction port	M33x2; 18 deep
X <sub>1</sub> , X <sub>2</sub>	Control pressure ports (before the orifice)	M12x1,5; 12 deep
G	Pressure port for auxiliary circuit	M14x1,5; 12 deep
P <sub>S</sub>	Control pressure supply	M14x1,5; 12 deep
F <sub>a</sub>	Filter outlet	M18x1,5; 12 deep
F <sub>a1</sub>	Filter outlet (filter assembly)	M18x1,5; 12 deep
F <sub>e</sub>	Filter inlet	M18x1,5; 12 deep
F <sub>S</sub>	Port from filter to suction line (cold start)	M18x1,5; 12 deep
M <sub>H</sub>	Port for balanced high pressure	M12x1,5; 12 deep
Y <sub>1</sub> , Y <sub>2</sub>	Remote control ports (only for HD control)	M14x1,5; 12 deep

#### T

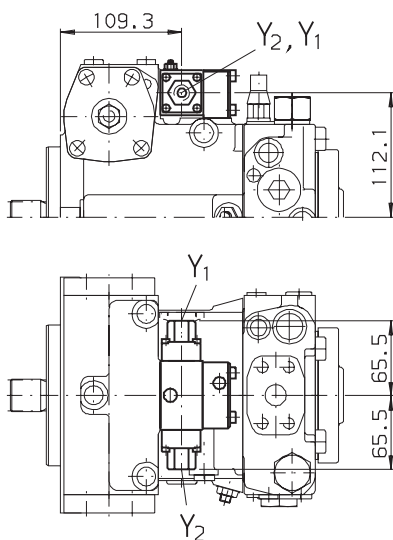
Splined shaft SAE 1 3/8"  
pressure angle 30°,  
21 teeth, 16/32 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976



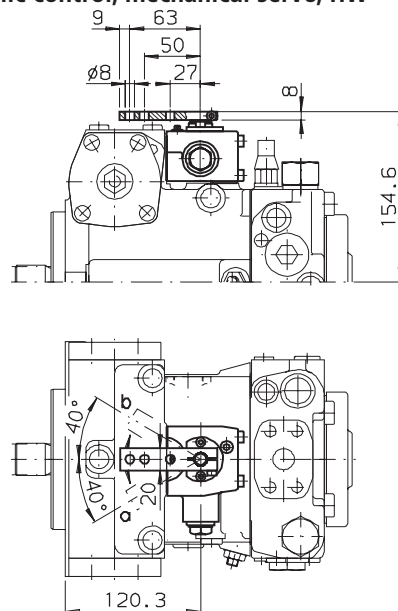
Unit Dimensions, Size 56

Before finalising your design, please request a certified drawing.

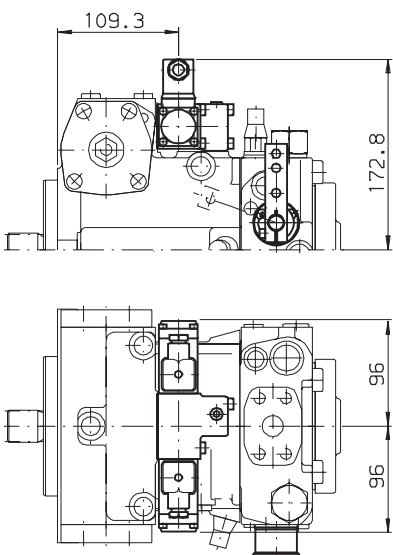
Hydraulic control, pilot pressure related, HD



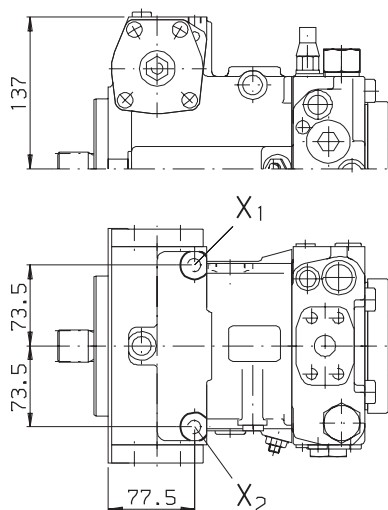
Hydraulic control, mechanical servo, HW



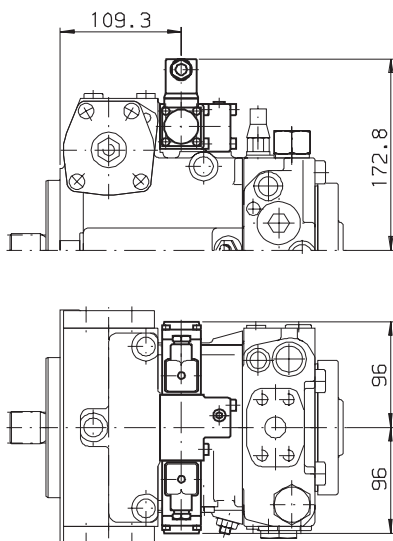
Hydraulic control, speed related, DA  
(dimensions of the DA control valve see pages 32, 33)



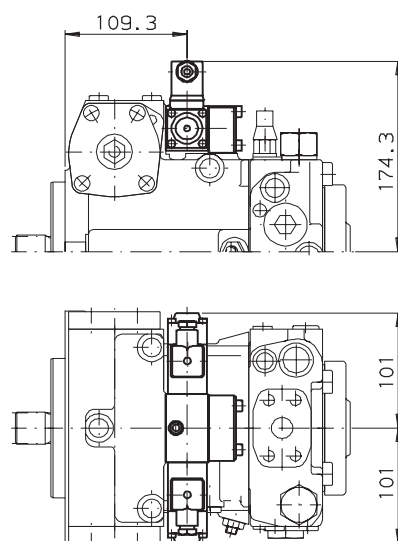
Hydraulic control, direct operated, DG



Electrical two-position control, with switching solenoid, EZ



Electrical control, with proportional solenoid, EP



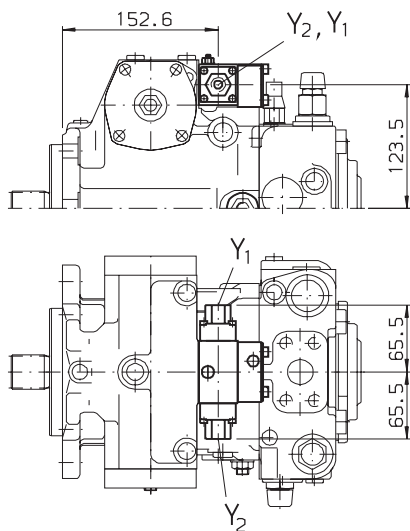




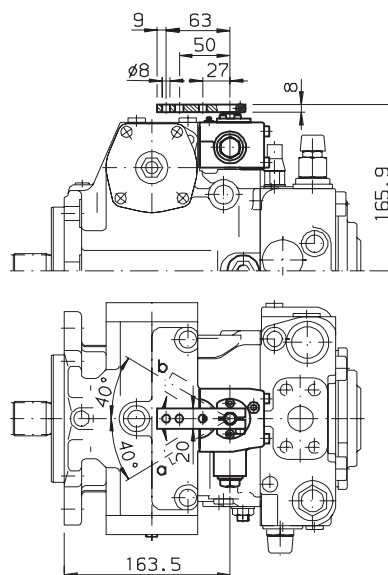
**Unit Dimensions, Size 71**

Before finalising your design, please request a certified drawing.

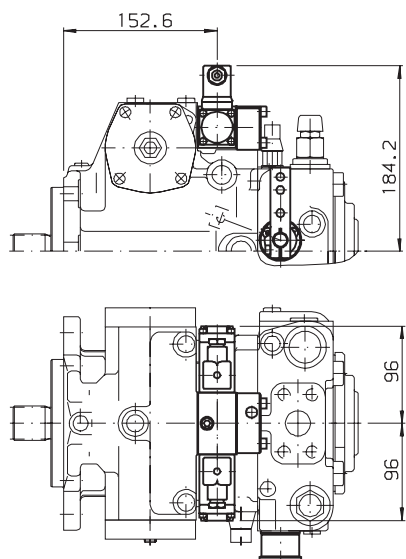
**Hydraulic control, pilot pressure related, HD**



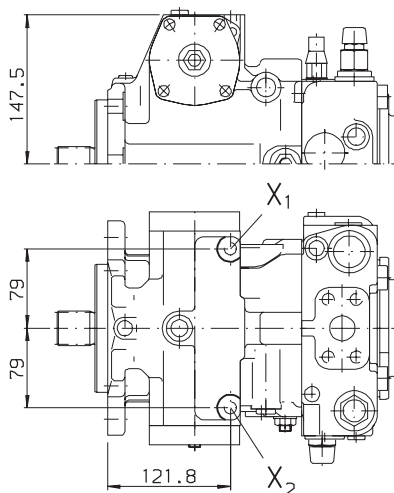
**Hydraulic control, mechanical servo, HW**



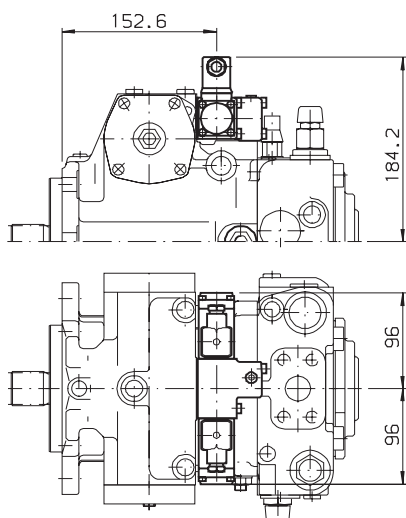
**Hydraulic control, speed related, DA**  
(dimensions of the DA control valve see pages 32, 33)



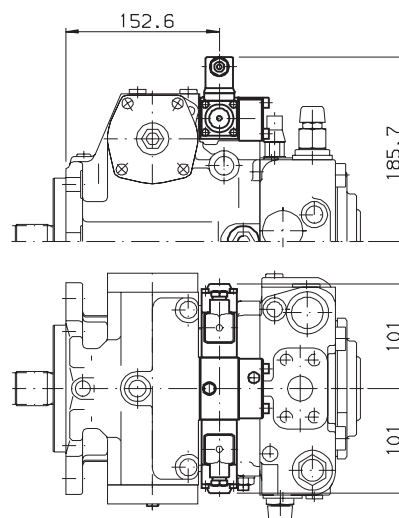
**Hydraulic control, direct operated, DG**



**Electrical two-position control, with switching solenoid, EZ**



**Electrical control, with proportional solenoid, EP**

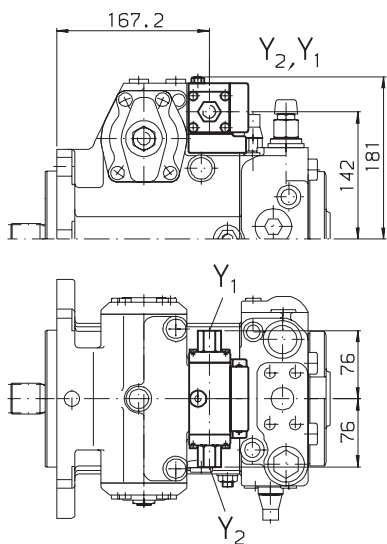




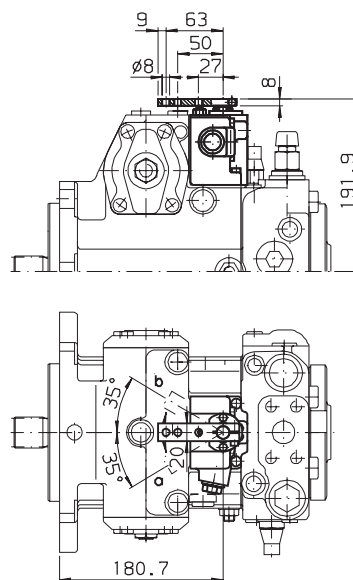
Unit Dimensions, Size 90

Before finalising your design, please request a certified drawing.

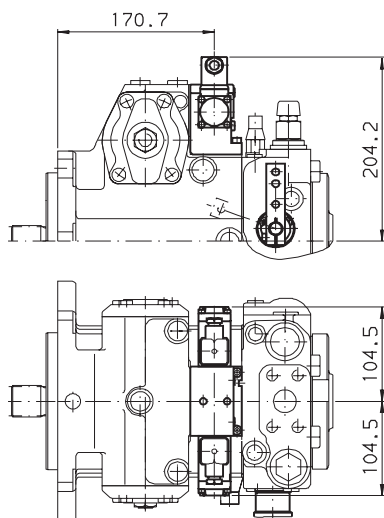
Hydraulic control, pilot pressure related, HD



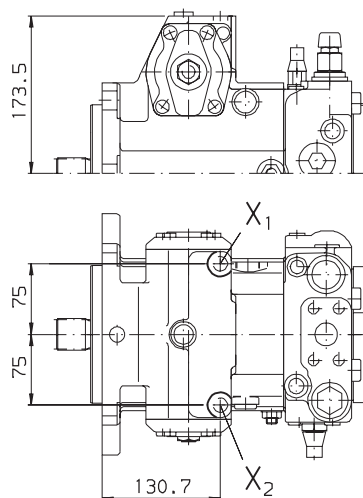
Hydraulic control, mechanical servo, HW



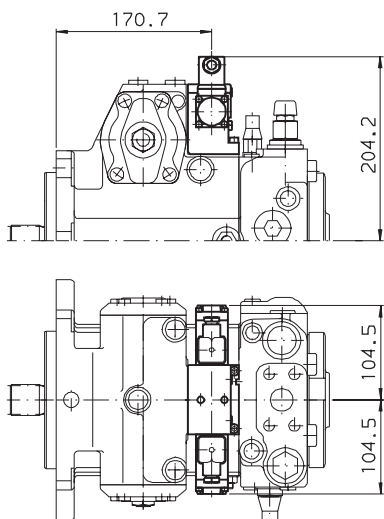
Hydraulic control, speed related, DA  
(dimensions of the DA control valve see pages 32, 33)



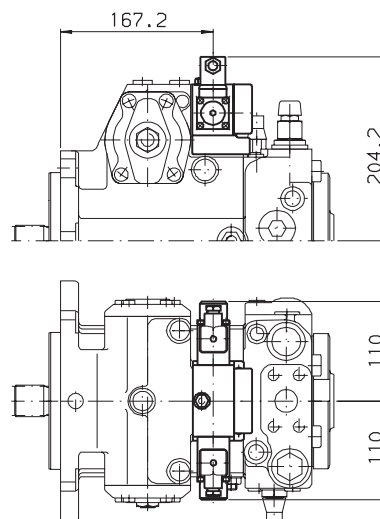
Hydraulic control, direct operated, DG



Electrical two-position control, with switching solenoid, EZ



Electrical control, with proportional solenoid, EP

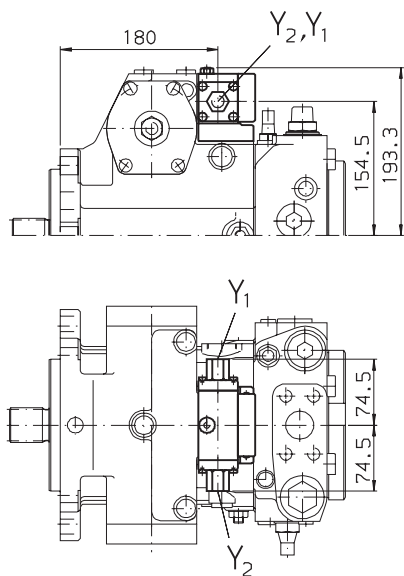




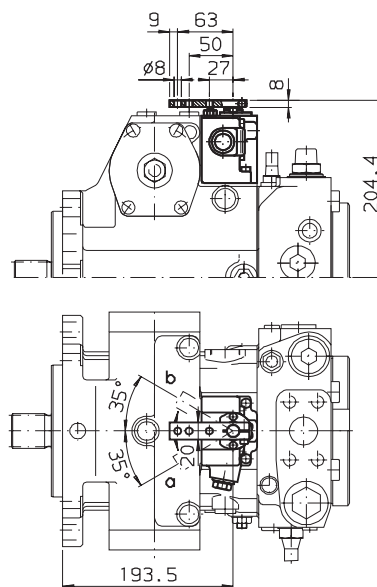
**Unit Dimensions, Size 125**

Before finalising your design, please request a certified drawing.

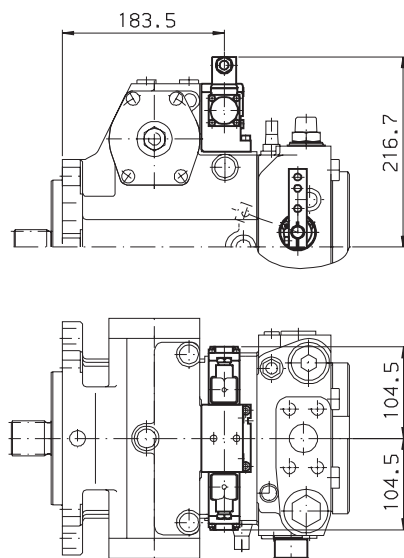
**Hydraulic control, pilot pressure related, HD**



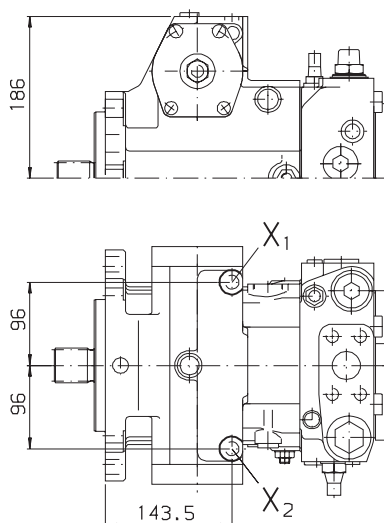
**Hydraulic control, mechanical servo, HW**



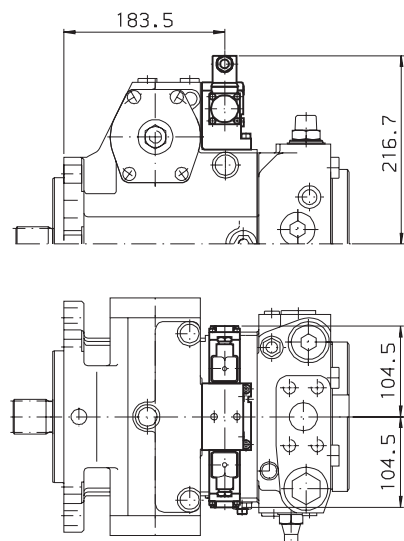
**Hydraulic control, speed related, DA**  
(dimensions of the DA control valve see pages 32, 33)



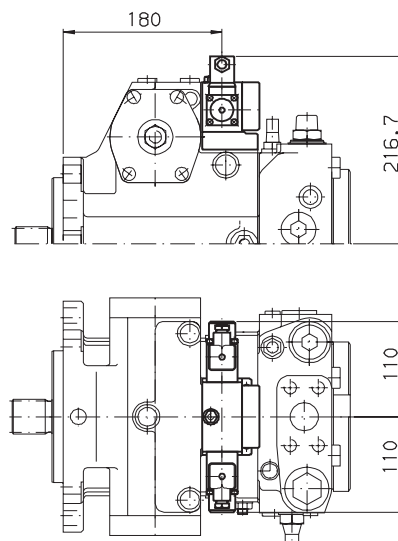
**Hydraulic control, direct operated, DG**



**Electrical two-position control, with switching solenoid, EZ**



**Electrical control, with proportional solenoid, EP**

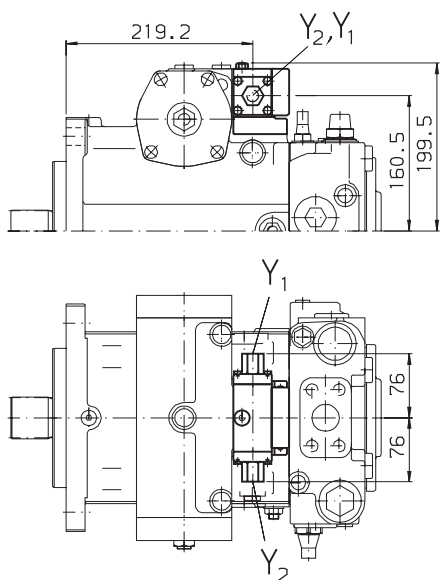




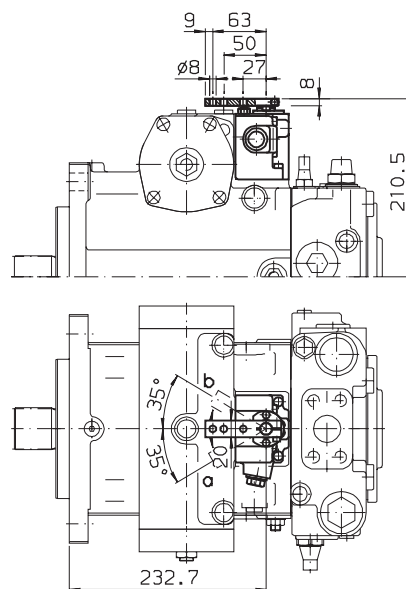
Unit Dimensions, Size 180

Before finalising your design, please request a certified drawing.

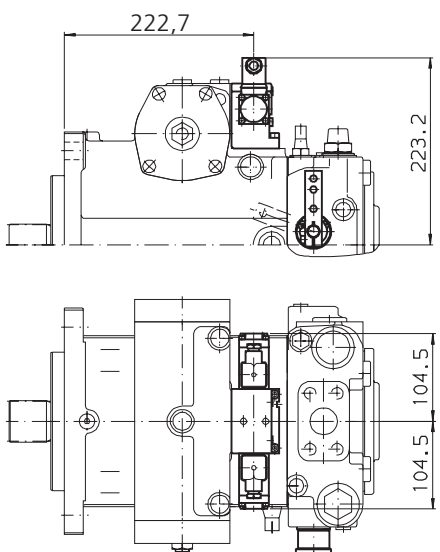
Hydraulic control, pilot pressure related, HD



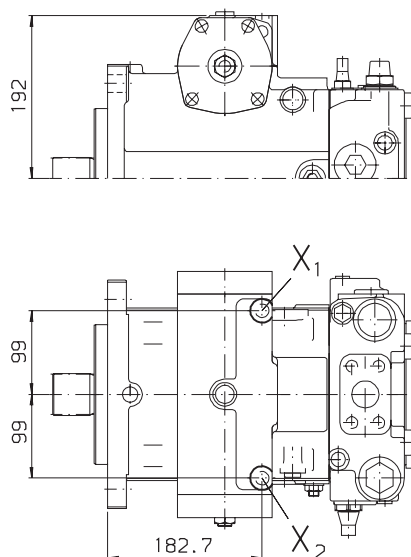
Hydraulic control, mechanical servo, HW



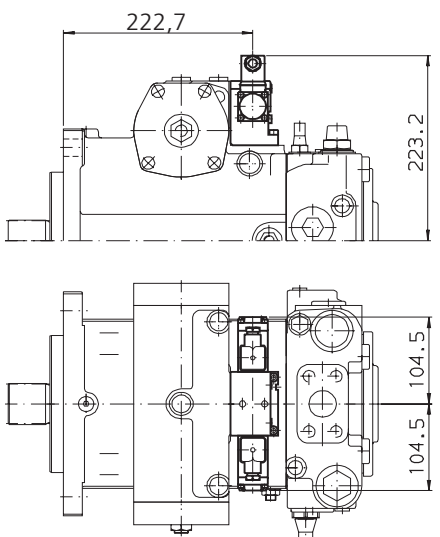
Hydraulic control, speed related, DA  
(dimensions of the DA control valve see pages 32, 33)



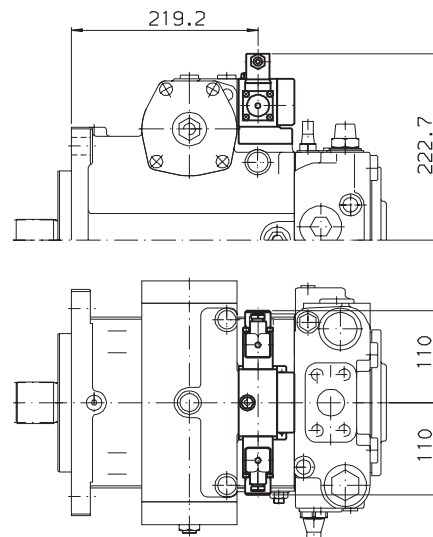
Hydraulic control, direct operated, DG



Electrical two-position control, with switching solenoid, EZ



Electrical control, with proportional solenoid, EP

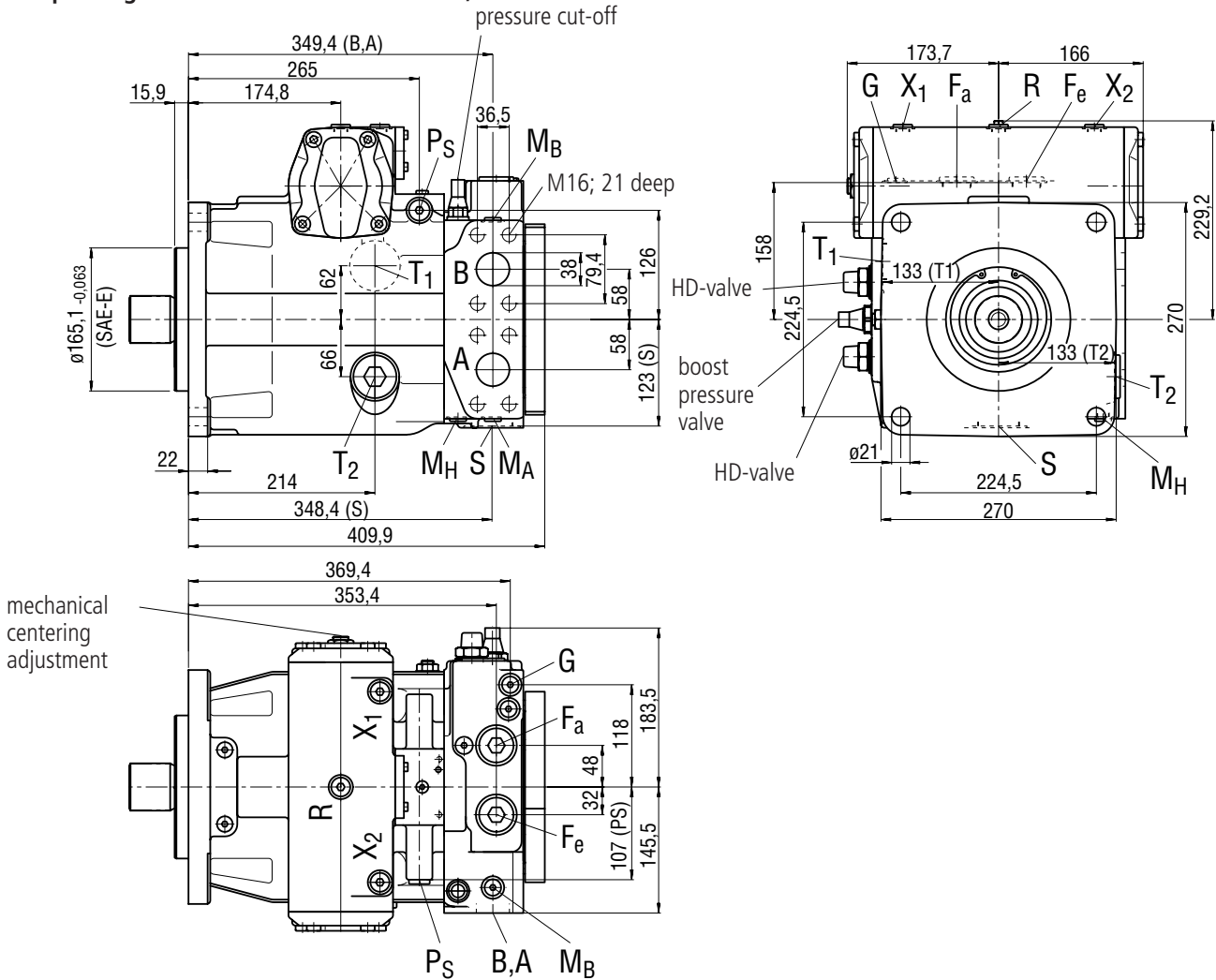




## Unit Dimensions, Size 250

Before finalising your design, please request a certified drawing.

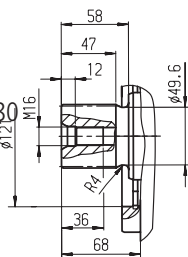
### Pump configuration without control module, NV



### Shaft ends

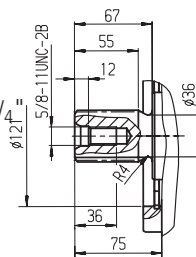
#### Z

Splined shaft, DIN 5480  
W 55x2x30x26x9g



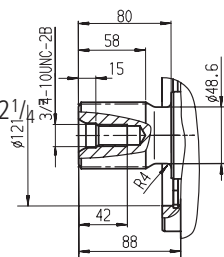
#### S

Splined shaft SAE 1<sup>3</sup>/<sub>4</sub>"  
pressure angle 30°,  
13 teeth, 8/16 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976



#### T

Splined shaft SAE 2<sup>1</sup>/<sub>4</sub>"  
pressure angle 30°,  
17 teeth, 8/16 pitch,  
flat root side fit,  
tolerance class 5  
ANSI B92.1a-1976



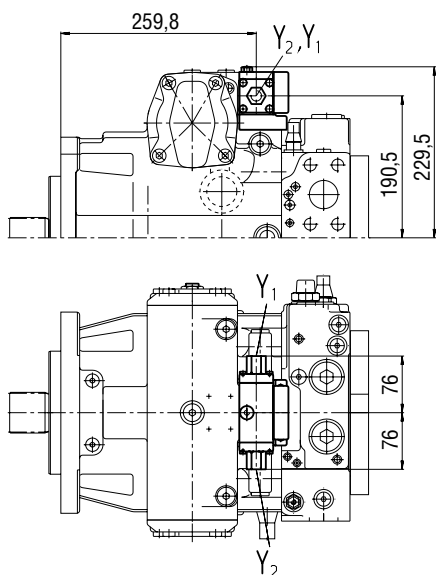
### Connections

A, B	Service line ports SAE 1 <sup>1</sup> / <sub>2</sub> " , high pressure series 420 bar (6000 psi)
T <sub>1</sub>	Case drain or filling port M42x2; 20 deep
T <sub>2</sub>	Case drain M42x2; 20 deep
M <sub>A</sub> , M <sub>B</sub>	Pressure gauge - operating pressure A/B M14x1,5; 12 deep
R	Air bleed M16x1,5; 12 deep
S	Boost suction port M48x2; 22 deep
X <sub>1</sub> , X <sub>2</sub>	Control pressure ports (before the orifice) M16x1,5; 12 deep
G	Pressure port for auxiliary circuit M14x1,5; 12 deep
P <sub>S</sub>	Control pressure supply M18x1,5; 12 deep
F <sub>a</sub>	Filter outlet M33x2; 18 deep
F <sub>e</sub>	Filter inlet M33x2; 18 deep
M <sub>H</sub>	Port for balanced high pressure M14x1,5; 12 deep
Y <sub>1</sub> , Y <sub>2</sub>	Remote control ports (only for HD control) M14x1,5; 12 deep

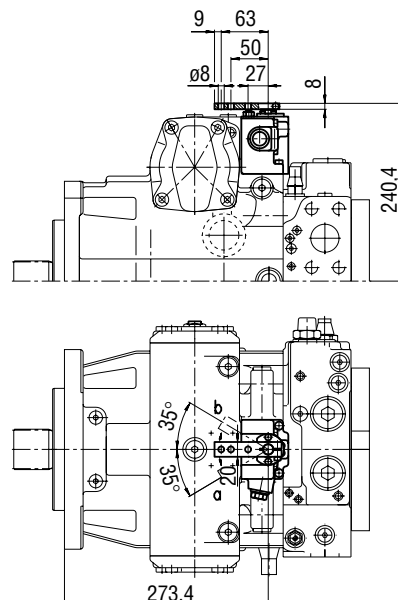
Unit Dimensions, Size 250

Before finalising your design, please request a certified drawing.

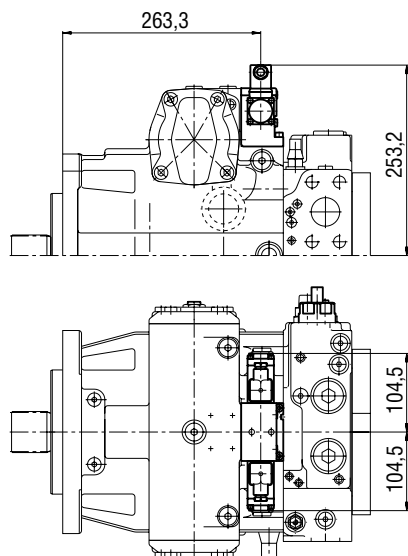
Hydraulic control, pilot pressure related, HD



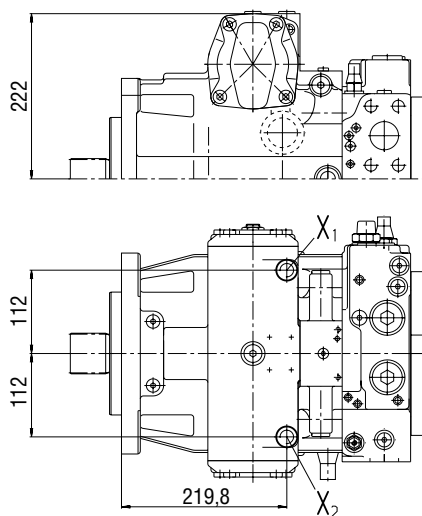
Hydraulic control, mechanical servo, HW



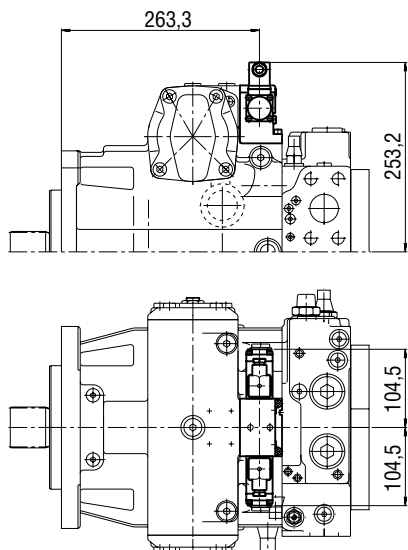
Hydraulic control, speed related, DA  
(dimensions of the DA control valve see pages 33, 34)



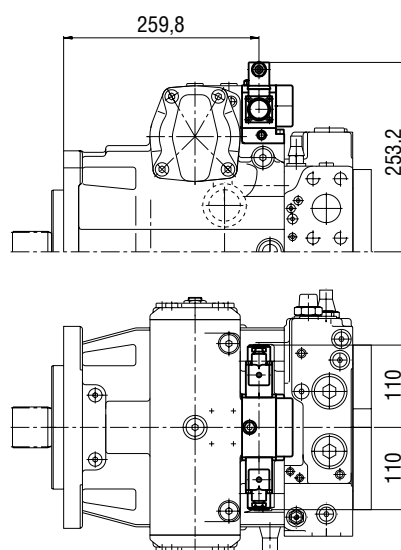
Hydraulic control, direct operated, DG



Electrical two-position control, with switching solenoid, EZ



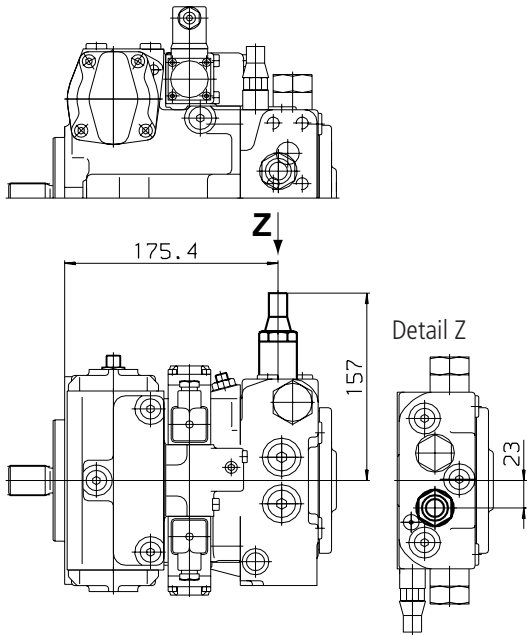
Electrical control, with proportional solenoid, EP



## Unit Dimensions DA Control Valves

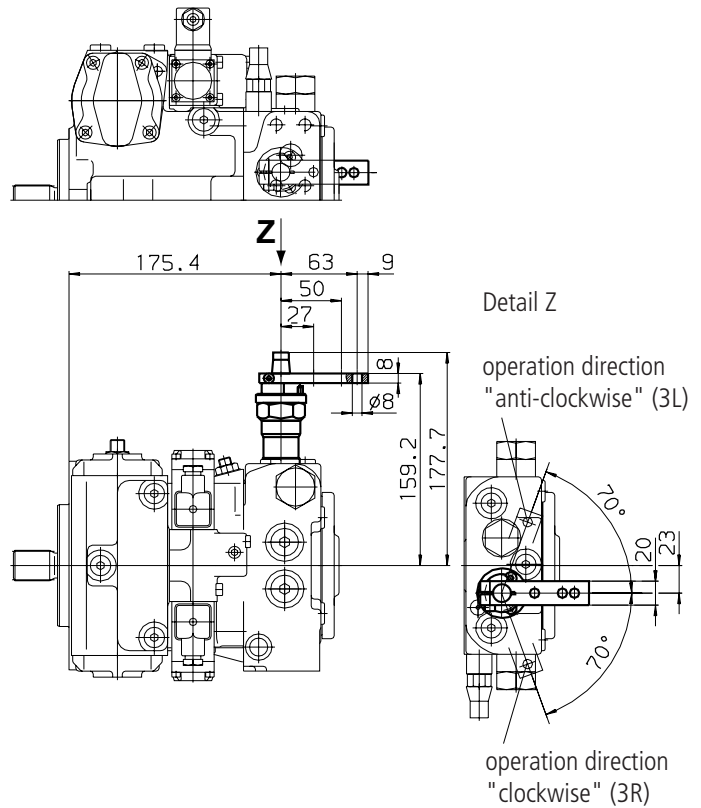
DA control valves, fixed setting, (2)

Size 28



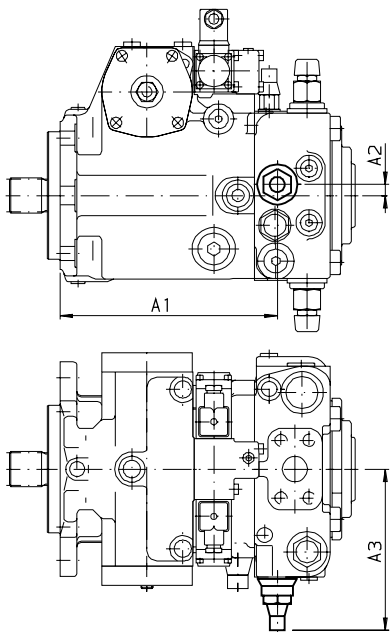
DA control valves, mech. adjustable with lever, (3)

Size 28



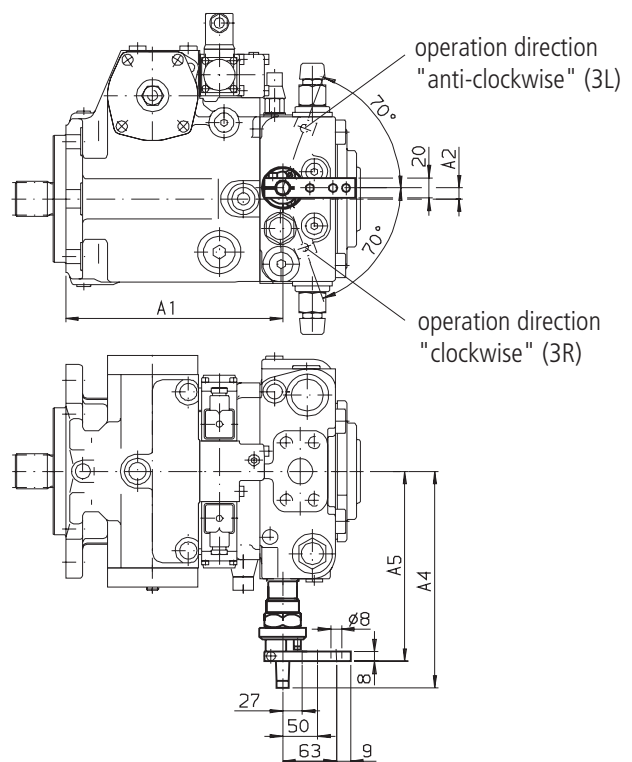
DA control valves, fixed setting, (2)

Sizes 40...180



DA control valves, mech. adjustable with lever, (3)

Sizes 40...180

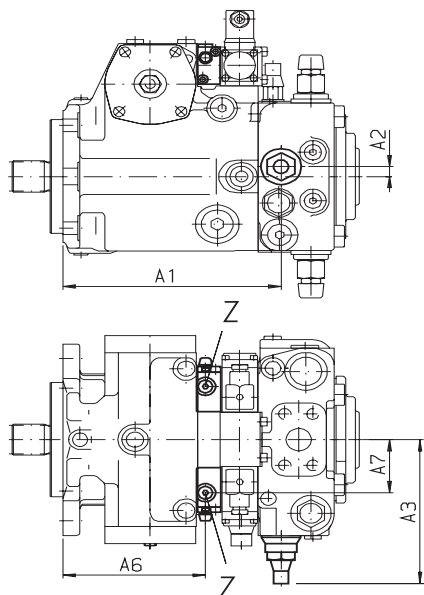


## Unit Dimensions DA Control Valves

### DA control valve, fixed setting and hydraulic inch valve built-on (only for pumps with DA control device), (4/8)

Z pilot pressure port M10x1; 8 deep  
(plugged by supplier on delivery)

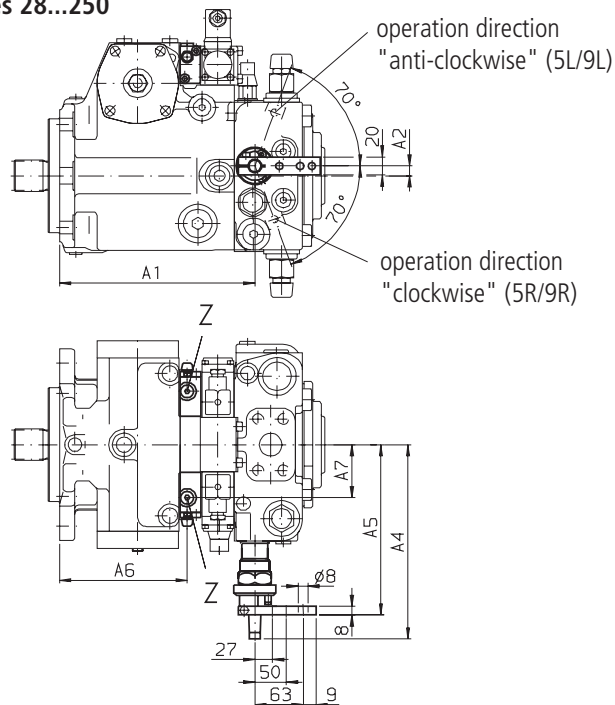
Sizes 28...250



### DA control valve, mechanically adjustable with lever and built-on hydraulic inch valve, (only for pumps with DA control device), (5/9)

Z pilot pressure port M10x1; 8 deep  
(plugged by supplier on delivery)

Sizes 28...250

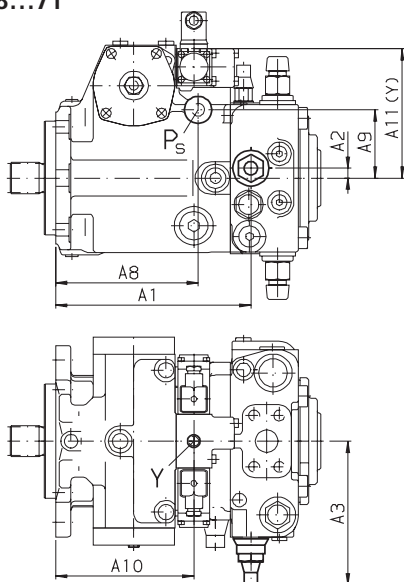


### DA control valve, fixed setting and connections for master controller, (7)

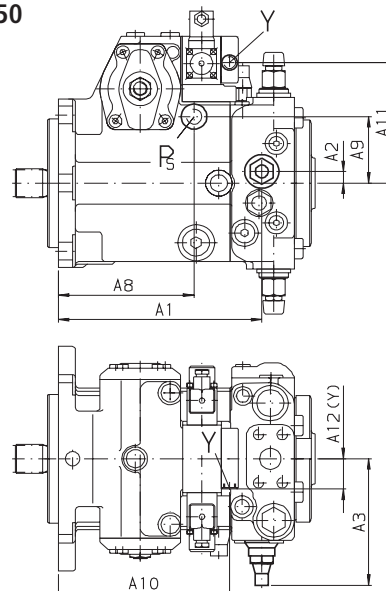
(order master controller separately)

P<sub>5</sub> and Y pilot pressure ports for master controller

Sizes 28...71



Sizes 90...250

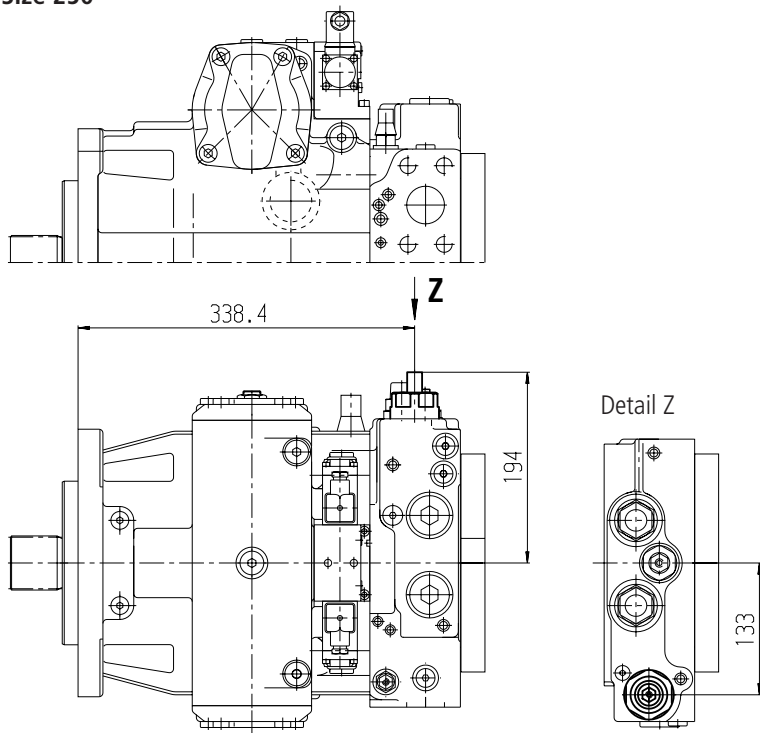


Size	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Y
28	Variation 2 and 3, dimensions see page 32					90,9	59	111,5	67	93,9	119,6	–	M14x1,5; 12 deep
40	181,7	23	157	177,7	159,2	88,9	59	125	67	91,9	119,6	–	M14x1,5; 12 deep
56	197,4	24,5	149,5	172	153,5	97,8	59	129,5	76	100,8	132,1	–	M14x1,5; 12 deep
71	215,5	11	160	197	170	141	59	157,3	76	144,8	143,5	–	M14x1,5; 12 deep
90	237,5	14	145,5	182,5	154,5	185,6	66,5	159	79	201,6	122,5	48,5	M14x1,5; 12 deep
125	266,9	17	163,5	181	162,5	198,5	66,5	184,5	91	214,5	135	48,5	M14x1,5; 12 deep
180	292,9	16	164,5	187,5	169	237,7	66,5	219	93	253,7	141	48,5	M14x1,5; 12 deep
250	Variation 2 and 3, dimensions see page 34												

## Unit Dimensions DA Control Valves

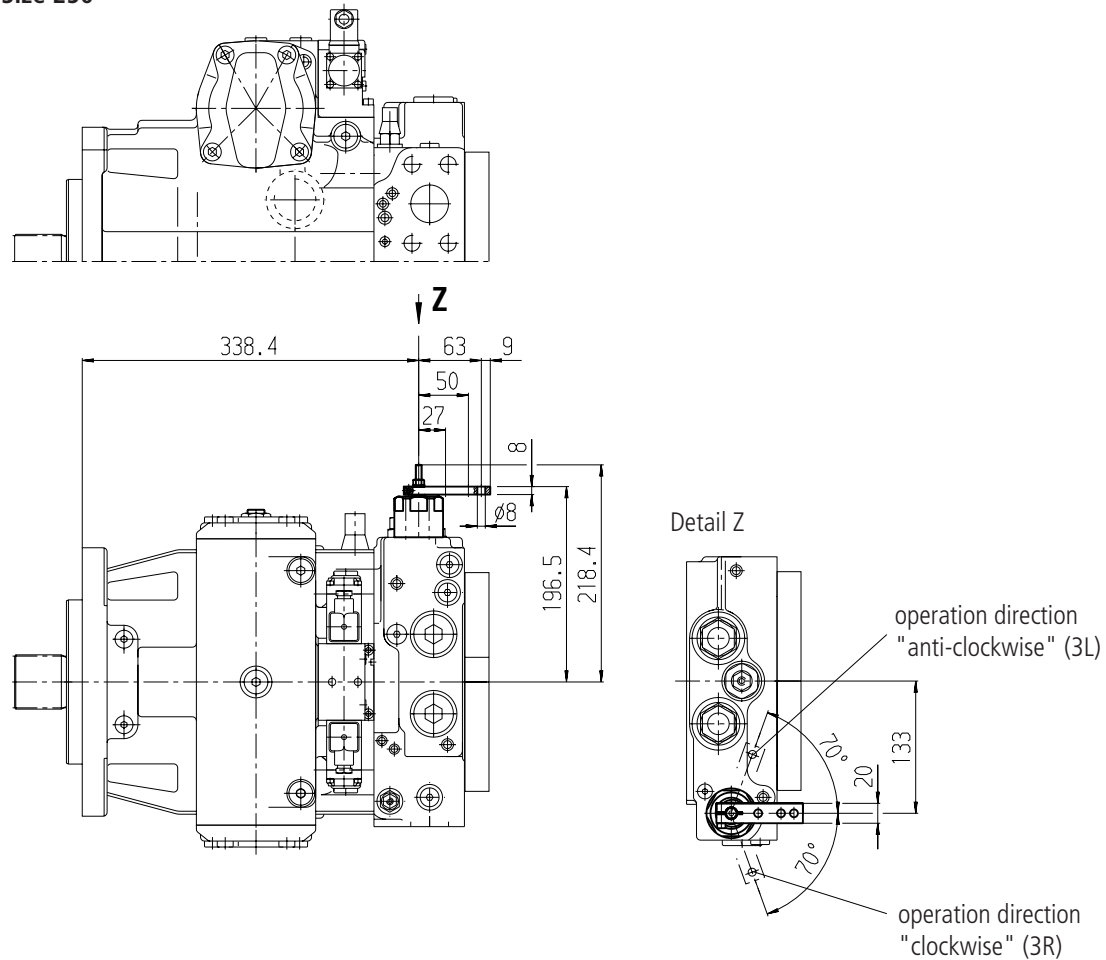
### DA control valves, fixed setting, (2)

Size 250



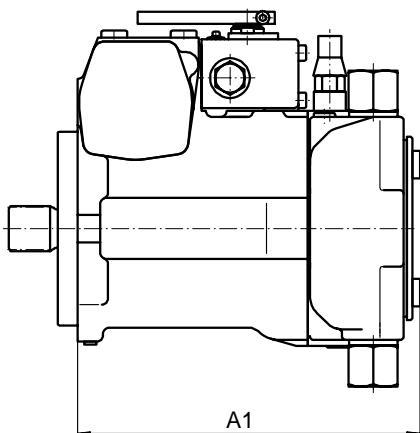
### DA control valves, mech. adjustable with lever, (3)

Size 250



## Dimensions for Through Drives

### Without auxiliary pump, without through drive, (N00)

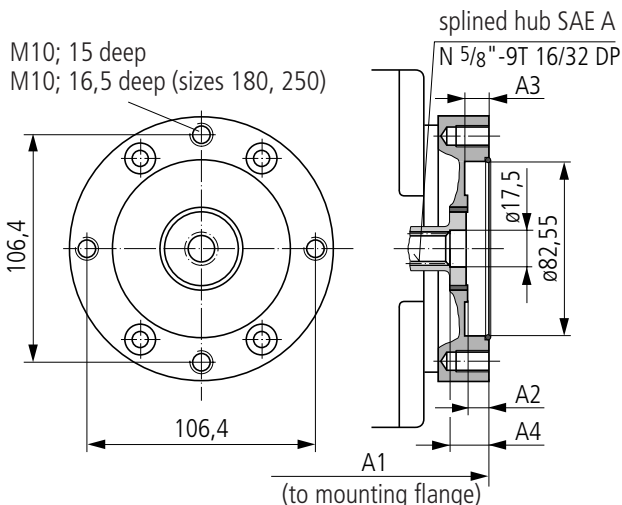


Size	A1
28	213,9
40	220,2
56	239,4
71	279,1
90	287
125	320,9
180	370,9
250	398,2

### With auxiliary pump, without through drive, (F00)

standard model, see unit dimensions pages 16...31

### Through drive SAE A (F01/K01)



Size	A1 (F01)	A1 (K01)	A2	A3	A4
28	227,9	227,9	7,5	7,5	
40	239,7	234,2	9	10	18
56	261,4	254,9	10	11	19
71	297,6	297,6	9	10	17
90	304	304	9	8	
125	330,9	330,9	10,5	9	
180	378,4	378,4	7,5	7,5	15,5
250	426,9		11	11	18

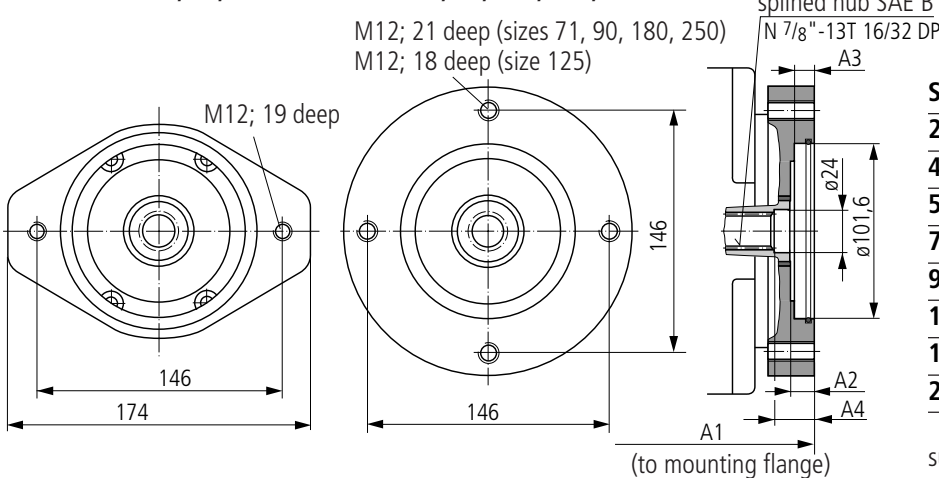
suitable for connection of:

- gear pump G2 (RE 10030)
- variable pump A10VSO10 (RE 92713)
- variable pump A10VSO18 (RE 92712)

### Through drive SAE B (F02/K02)

Sizes 28, 40, 56

Sizes 71, 90, 125, 180, 250



Size	A1	A2	A3	A4
28	230,4	9,7	9,7	
40	240,7	11	11	17
56	262,4	12	11	19,5
71	300,6	13	9,8	17
90	305	9	11	17
125	330,9	10	11	17
180	381,4	11	11	19
250	428,9	11	11	16

suitable for connection of:

- gear pump G3 (RE 10038)
- gear pump G4 (RE 10042)
- variable pump A10VG18 (RE 92750)
- variable pump A10VO28 (RE 92701/RE 92703)

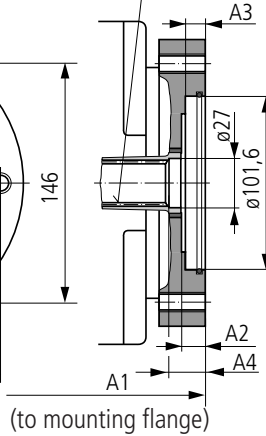
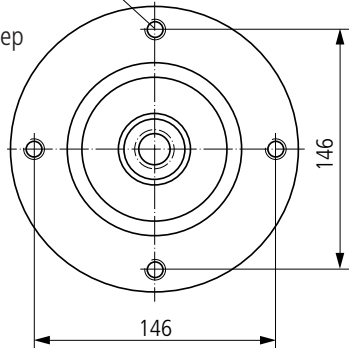
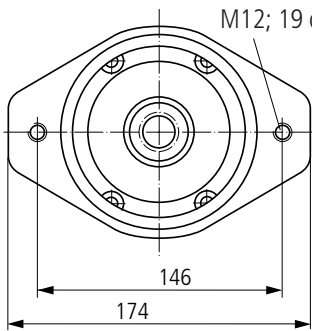
**Through drive SAE B-B (F04/K04)**

**Sizes 28, 40, 56**

**Sizes 71, 90, 125, 180, 250**

M12; 21 deep (sizes 71, 90, 180, 250)  
M12; 18 deep (size 125)

splined hub SAE B-B  
N 1" -15T 16/32 DP

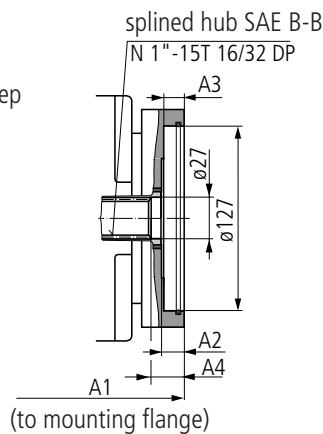
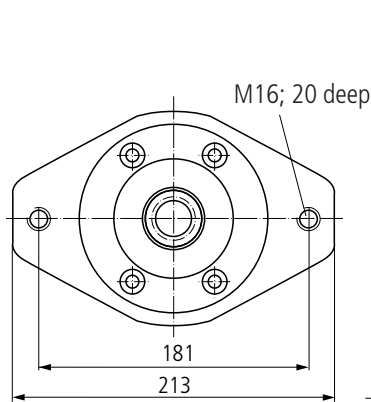


Size	A1	A2	A3	A4
28	230,4	9,7	9,7	
40	240,7	11	9,7	16
56	262,4	13	11	18,5
71	300,6	13	9,8	15,5
90	305	9	11	15
125	330,9	10	11	16,5
180	381,4	11	11	18
250	428,9	11	11	15,5

suitable for connection of:

- variable pump A4VG28
- variable pump A10VG28 (RE 92750)
- variable pump A10VG45 (RE 92750)
- variable pump A10VO45 (RE 92701/RE 92703)
- variable pump A11VO40 (RE 92500)

**Through drive: flange SAE C, 2-hole; hub SAE B-B (F09/K09)**



Size	A1	A2	A3	A4
40	244,7	11	11	

suitable for connection of:

- variable pump A4VG40

**Through drive SAE C (F07/K07)**

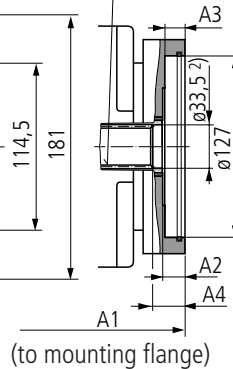
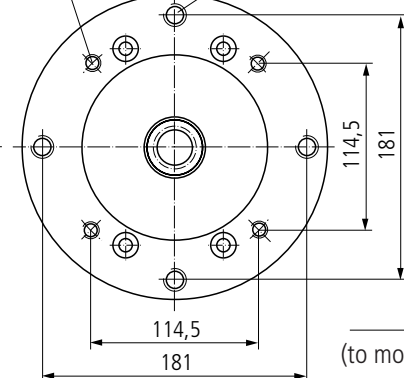
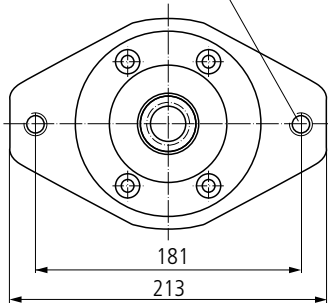
**Size 56, 71**

**Size 90, 125, 180, 250<sup>1)</sup>**

M16; 20 deep (size 56)  
M16; 20 deep (size 71)

M12; 18 deep M16; 23 deep

splined hub SAE C  
N 1 1/4" -14T 12/24 DP



Size	A1	A2	A3	A4
56	266,4	15	14	
71	303,6	16	13,5	20
90	309	13	14	20,5
125	335,9	15	15,5	22,5
180	384,4	14	14	19
250	425,9	11	11	16

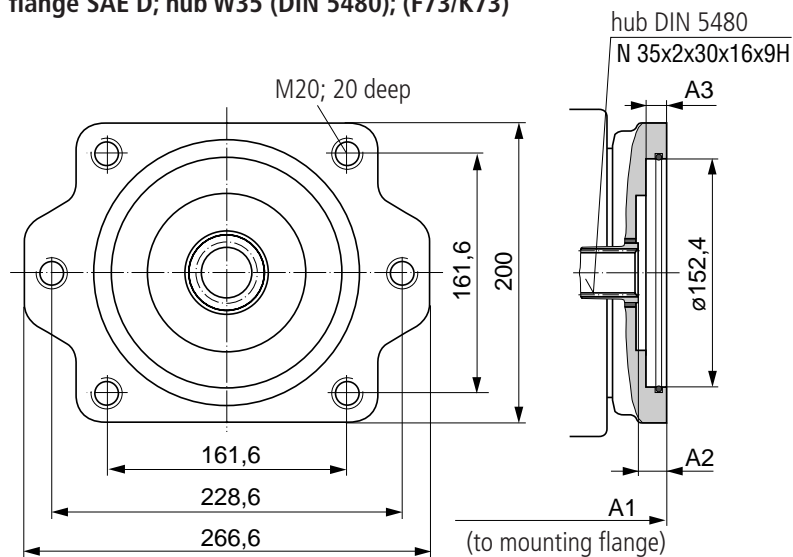
suitable for connection of:

- variable pump A4VG40
- variable pump A4VG56
- variable pump A4VG71
- variable pump A10VO71 (RE 92701)
- variable pump A11VO60 (RE 92500)

<sup>1)</sup> size 180 only with SAE 2-hole flange  
<sup>2)</sup> size 56:  $\phi 32,7$



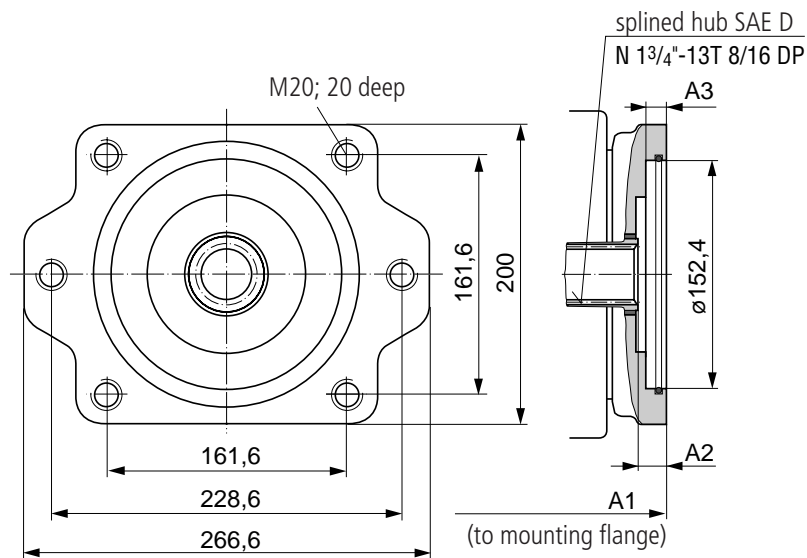
**Through drive:  
flange SAE D; hub W35 (DIN 5480); (F73/K73)**



Size	A1	A2	A3
90	309	12	14

suitable for connection of:  
– variable pump A4VG90

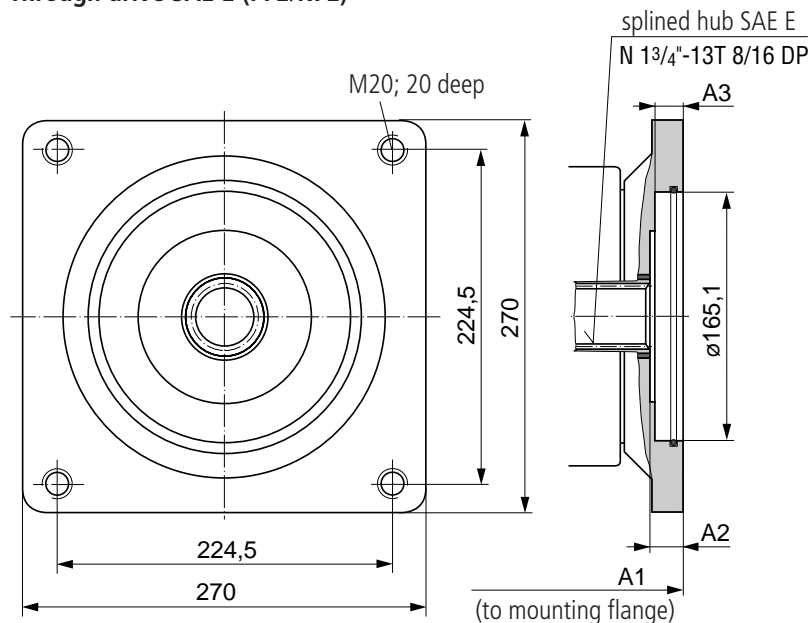
**Through drive SAE D (F69/K69)**



Size	A1	A2	A3
125	343,9	18	14
180	391,9	20,9	18
250	444,9		17

suitable for connection of:  
– variable pump A4VG90  
– variable pump A4VG125  
– variable pump A10VO140 (RE 92701)  
– variable pump A11VO95 (RE 92500)  
– variable pump A11VO130 (RE 92500)

**Through drive SAE E (F72/K72)**



Size	A1	A2	A3
180	391,9	20,9	18
250	444,9		17

suitable for connection of:  
– variable pump A4VG180  
– variable pump A4VG250  
– variable pump A11VO190 (RE 92500)  
– variable pump A11VO260 (RE 92500)

**Permissible Input and Through Drive Rotation Torques**

Size		28	40	56	71	
Corner torque (when $V_{gmax}$ a. $\Delta p = 400$ bar) <sup>1)</sup>	$T_{max}$	Nm	178	254	356 451	
Max. perm. through drive rotation torque	$T_{D perm.}$	Nm	231	314	521 660	
Max. permissible input torque <sup>2)</sup>						
at shaft end Z (DIN 5480)	$T_{E perm.}$	Nm	352 (W25x1,25x30x18x9g)	522 (W30x2x30x14x9g)	522 (W30x2x30x14x9g)	912 (W35x2x30x16x9g)
at shaft end A (DIN 5480)	$T_{E perm.}$	Nm	–	912 (W35x2x30x16x9g)	912 (W35x2x30x16x9g)	1460 (W40x2x30x18x9g)
at shaft end S SAE (ANSI B92.1a-1976)	$T_{E perm.}$	Nm	314 (SAE B-B) (W1"-15T 16/32DP)	602 (SAE C) (W1 1/4"-14T 12/24DP)	602 (SAE C) (W1 1/4"-14T 12/24DP)	602 (SAE C) (W1 1/4"-14T 12/24DP)
at shaft end T SAE (ANSI B92.1a-1976)	$T_{E perm.}$	Nm	–	–	970 (W1 3/8"-21T 16/32DP)	970 (W1 3/8"-21T 16/32DP)
at shaft end U <sup>3)</sup> SAE (ANSI B92.1a-1976)	$T_{E perm.}$	Nm	–	314 (SAE B-B) (W1"-15T 16/32DP)	–	–
Size		90	125	180	250	
Corner torque (when $V_{gmax}$ a. $\Delta p = 400$ bar) <sup>1)</sup>	$T_{max}$	Nm	572	795	1144 1590	
Max. perm. through drive rotation torque	$T_{D perm.}$	Nm	822	1110	1760 2230	
Max. permissible input torque <sup>2)</sup>						
at shaft end Z (DIN 5480)	$T_{E perm.}$	Nm	912 (W35x2x30x16x9g)	1460 (W40x2x30x18x9g)	3140 (W50x2x30x24x9g)	4350 (W55x2x30x26x9g)
at shaft end A (DIN 5480)	$T_{E perm.}$	Nm	2190 (W45x2x30x21x9g)	2190 (W45x2x30x21x9g)	–	–
at shaft end S SAE (ANSI B92.1a-1976)	$T_{E perm.}$	Nm	1640 (SAE D) (W1 3/4"-13T 8/16DP)	1640 (SAE D) (W1 3/4"-13T 8/16DP)	1640 (SAE D) (W1 3/4"-13T 8/16DP)	1640 (SAE D) (W1 3/4"-13T 8/16DP)
at shaft end T SAE (ANSI B92.1a-1976)	$T_{E perm.}$	Nm	–	2670 (SAE F) (W2"-15T 8/16DP)	4070 (W2 1/4"-17T 8/16DP)	4070 (W2 1/4"-17T 8/16DP)

<sup>1)</sup> efficiency not taken into consideration

<sup>2)</sup> drive shaft without side load

<sup>3)</sup> shaft „U“ is only permissible as the shaft end in the **2nd pump** of a combination pump of the same size

**Code explanations**

$T_{D perm.}$  = max. permissible through drive torque in Nm

$T_{E perm.}$  = max. permissible input torque at the drive shaft in Nm

$T_1$  = take off torque at 1st pump =  $\frac{1,59 \cdot V_{g1} \cdot \Delta p_1}{100 \cdot \eta_{mh}}$  in Nm

$T_2$  = take off torque at 2nd pump =  $\frac{1,59 \cdot V_{g2} \cdot \Delta p_2}{100 \cdot \eta_{mh}}$  in Nm

$V_{g1}$  = pump displacement per rev. 1st pump in cm<sup>3</sup>

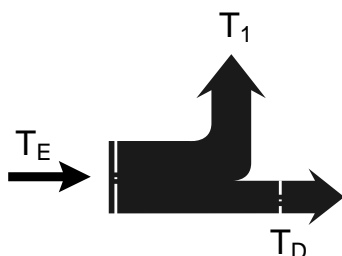
$V_{g2}$  = pump displacement per rev. 2nd pump in cm<sup>3</sup>

$\Delta p_1$  = differential pressure 1st pump in bar

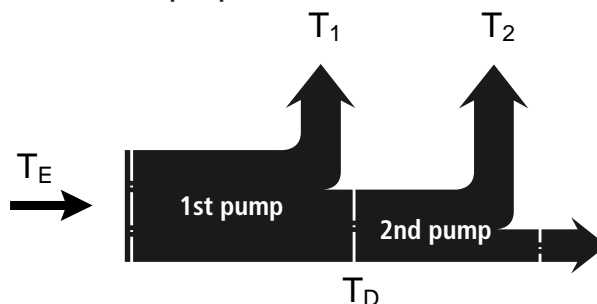
$\Delta p_2$  = differential pressure 2nd pump in bar

$\eta_{mh}$  = mechanical-hydraulic efficiency

**Single pump**



**Combination pump**



## Combination Pumps

Combination pumps offer the facility of independent circuits without the need to fit splitter boxes.

When ordering combination pumps the model descriptions have to be connected by a „+“ sign:

Code 1st pump (front pump) + Code 2nd pump (rear pump)

order example: A4VG56EP1D1/32R-PAC02F073S + A4VG56EP1D1/32R-P5C02F003S

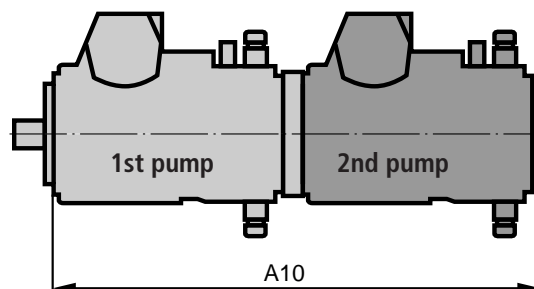
The series connection of two single pumps of the same size is permissible without additional supports where the dynamic acceleration does not exceed 10 g (= 98,1 m/s<sup>2</sup>).

We recommend the use of 4-hole connection flanges from size 71 onwards.

### Combination pump of the same size

(2nd pump without through drive and with auxiliary pump, F00)

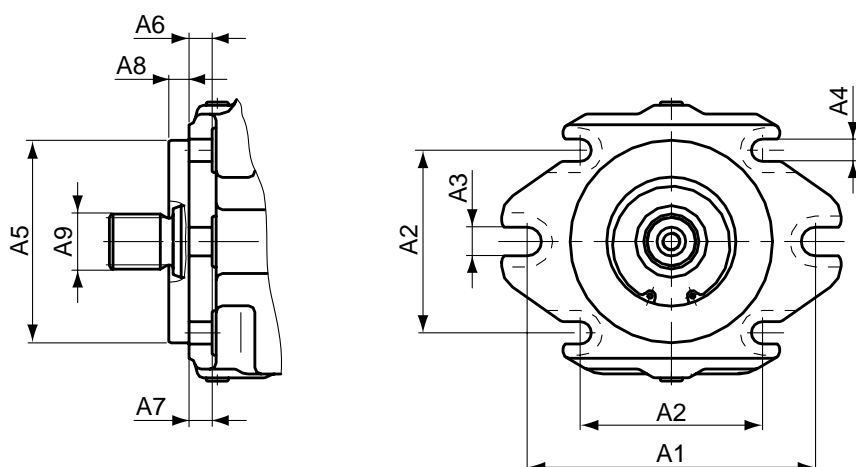
Size	28	40	56	71	90	125	180	250
A10	453,8	476,4	522,8	597,2	610,0	670,3	762,8	854,8



### Mounting flange - shaft ends (of single and combination pumps)

Size	Mount. flange	Single pump										Combination pump of the same size		
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A9	Through drive	A9	
28	SAE B-B, 2-hole	146	-	15	-	ø101,6	-	15	9,5	Z (W25) S (SAE 1")	Z (W25) S (SAE 1")	F04/K04 F04/K04	S (SAE 1") S (SAE 1")	
40	SAE C, 2-hole	181	-	18	-	ø127	-	15	12,7	Z (W30) S (SAE 1 1/4")	A (W35) S (SAE 1 1/4")	F09/K09 F09/K09	U (SAE 1") U (SAE 1")	
56	SAE C, 2-hole	181	-	18	-	ø127	-	18	12,7	Z (W30) S (SAE 1 1/4")	A (W35) T (SAE 1 3/8")	F07/K07 F07/K07	S (SAE 1 1/4") S (SAE 1 1/4")	
71	SAE C, 2+4-hole	181	114,5	18	14,4	ø127	15	15	12,7	Z (W35) S (SAE 1 1/4")	A (W40) T (SAE 1 3/8")	F07/K07 F07/K07	S (SAE 1 1/4") S (SAE 1 1/4")	
90	SAE D, 2+4-hole	228,6	161,5	21	21	ø152,4	17	20	12,7	Z (W35) S (SAE 1 3/4")	A (W45) S (SAE 1 3/4")	F73/K73 F73/K73	Z (W35) Z (W35)	
125	SAE D, 2+4-hole	228,6	161,6	21	21	ø152,4	20	20	12,7	Z (W40) S (SAE 1 3/4")	A (W45) T (SAE 2")	F69/K69 F69/K69	S (SAE 1 3/4") S (SAE 1 3/4")	
180	SAE E, 4-hole	-	224,5	-	21	ø165,1	22	-	15,9	Z (W50) S (SAE 1 3/4")	Z (W50) T (SAE 2 1/4")	F72/K72 F72/K72	S (SAE 1 3/4") S (SAE 1 3/4")	
250	SAE E, 4-hole	-	224,5	-	21	ø165,1	22	-	15,9	Z (W55) S (SAE 1 3/4")	Z (W55) T (SAE 2 1/4")	F72/K72 F72/K72	S (SAE 1 3/4") S (SAE 1 3/4")	

### Mounting flange

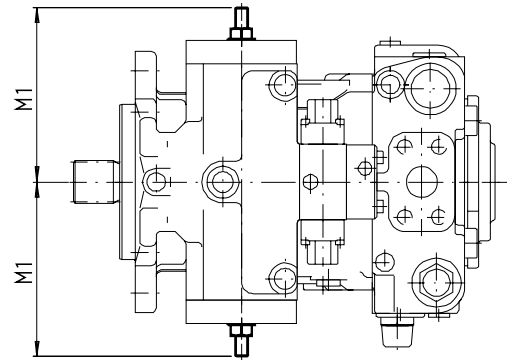
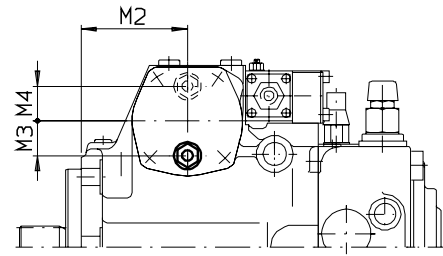


## Mechanical Stroke Limiter, M

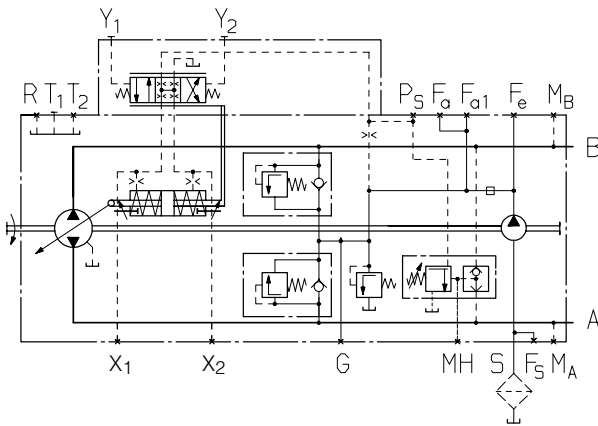
Adjustment screws to both  $V_{g \max}$  – values

### Dimensions

Size	M1	M2	M3	M4
28	110,6 max.	40,1	24	–
40	110,6 max.	38,1	24	–
56	130,5 max.	44	25,5	–
71	135,4 max.	86,3	–	28,5
90	147 max.	95,7	31,5	–
125	162 max.	104,5	–	35,5
180	181,6 max.	138,7	38	–
250	198,9 max.	174,8	39,5	–



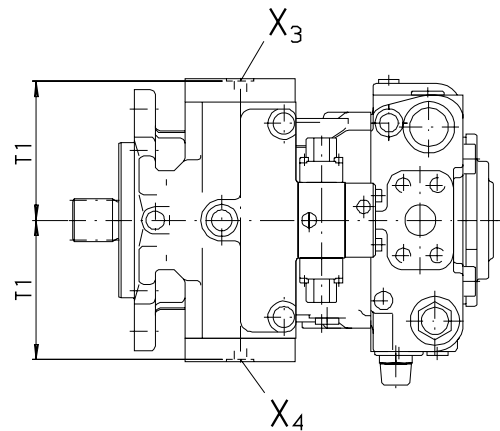
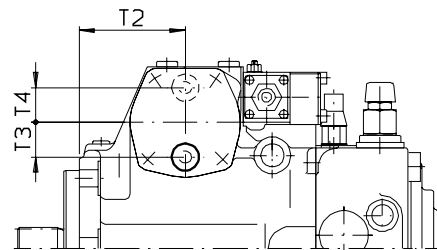
### Circuit diagram 1)



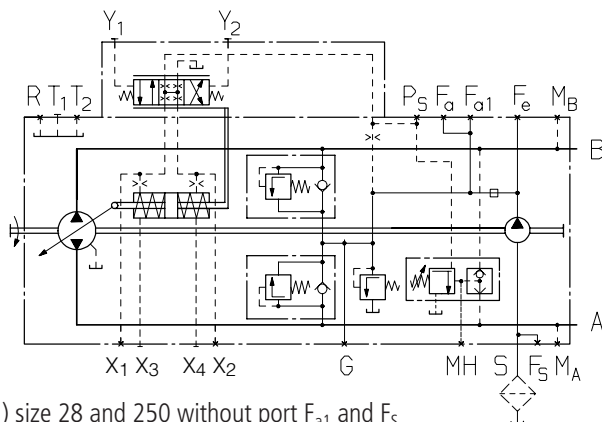
## Ports $X_3$ and $X_4$ for Positioning Pressure, T

### Dimensions

Size	T1	T2	T3	T4	$X_3, X_4$
28	92	40,1	–	24	M12x1,5
40	92	38,1	–	24	M12x1,5
56	104,5	44	–	25	M12x1,5
71	113,5	86,3	28	–	M12x1,5
90	111,5	95,7	–	30	M12x1,5
125	136	104,5	34	–	M12x1,5
180	146,5	138,7	–	35	M12x1,5
250	164,5	174,8	–	38	M16x1,5



### Circuit diagram 1)



1) size 28 and 250 without port  $F_{a1}$  and  $F_5$



## Installation Situation for Coupling Assembly

In order to assure that rotating parts (coupling hub) and fixed parts (housing, circlip) do not contact each other the installation situations are described in this leaflet have to be observed. The installation situation depend upon the sizes and the spline.

### Size 28 and 40 (with free turning):

Please observe diameter of the free turning.

### Size 56 to 250 (without free turning):

For *SAE spline* (shaft S or T) the outer diameter of the coupling hub must be smaller than the inner diameter of the circlip  $d_2$  at the zone of the drive shaft collar (measure  $x_2 - x_3$ ).

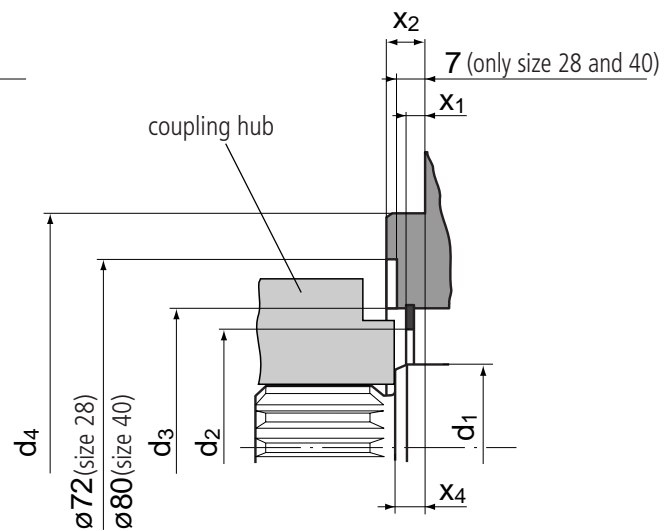
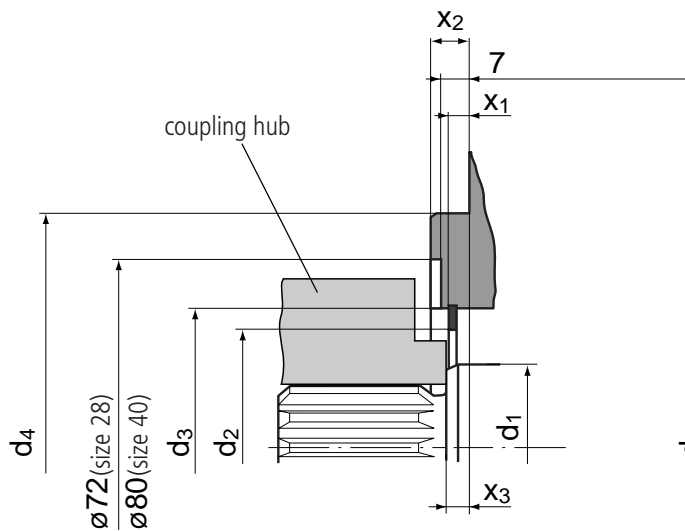
For *DIN spline* (shaft Z or A) the outer diameter of the coupling hub must be smaller than the housing diameter  $d_3$  at the zone of the drive shaft collar (measure  $x_2 - x_4$ ).

### SAE spline

(to ANSI B92.1a-1976)

### DIN spline

(to DIN 5480)



Size	$\text{ø}d_1$	$\text{ø}d_{2 \text{ min}}$	$\text{ø}d_3$	$\text{ø}d_4$	$x_1$	$x_2$	$x_3$	$x_4$
28	35	43,4	$55_{\pm 0,1}$	101,6	$3,3^{+0,2}$	$9,5_{-0,5}$		
40	40	51,4	$63_{\pm 0,1}$	127	$4,3^{+0,2}$	$12,7_{-0,5}$		
56	40	54,4	$68_{\pm 0,1}$	127	$7,0^{+0,2}$	$12,7_{-0,5}$		
71	45	66,5	$81_{\pm 0,1}$	127	$7,0^{+0,2}$	$12,7_{-0,5}$	$8^{+0,9}_{-0,6}$	$10^{+0,9}_{-0,6}$
90	50	66,5	$81_{\pm 0,1}$	152,4	$6,8^{+0,2}$	$12,7_{-0,5}$		
125	55	76,3	$91_{\pm 0,1}$	152,4	$7,0^{+0,2}$	$12,7_{-0,5}$		
180	60	88	$107_{\pm 0,1}$	165,1	$7,4^{+0,2}$	$15,9_{-0,5}$		
250	75	104,6	121	165,1	$6,3^{+0,2}$	$15,9_{-0,5}$		

## Preferred Types

Type	Ident-No.	Type	Ident-No.
A4VG28DA1D2/32R-NZC10F005S	2036417	A4VG71DA2D2/32R-NZF02F001S	2022720
A4VG28DA1D2/32R-NZC10F015S	2019607	A4VG71DA2D2/32R-NZF02F011S	2022722
A4VG28DA2D2/32R-NZC10F005S	2019503	A4VG71DA2D2/32R-NZF02F021S	2022529
A4VG28DA2D2/32R-NZC10F015S	2036419	A4VG71DGD1/32R-NZF02F001S	2022052
A4VG28DGD1/32R-NZC10F005S	2036421	A4VG71DGD1/32R-NZF02F011S	2036478
A4VG28DGD1/32R-NZC10F015S	2036423	A4VG71DGD1/32R-NZF02F021S	2036480
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Bei Bestellung bitte Typ und Ident-Nr. angeben.



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