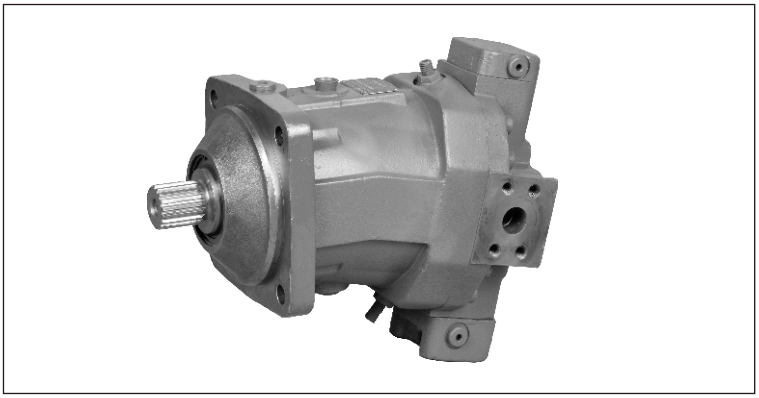
A6VM Series
Axial piston variable motor

Product show and brief introduction

open and colsed circuits

Series 63
Sizes 55,107,160
Nominal pressure 40MPa
Maxmum pressure 45MPa



Features

— Robust motor with long service life

— Approved for very high rotational speeds

— High control range (can be swiveled to zero)

— High torque

— Variety of controls

— Optionally with flushing and boost-pressure valve mounted

— Optionally with integrated or mounted counterbalance valve

— Bent-axis design

Model Code

A6V	M	107	HD1	D	/63	W	-V	Z	B	010	B
Axial piston unit	Operating mode	Size	Control unit	Pressure control/ override	series	Driection of rotation	Sealing material	Drive shaft	Mounting flange	Port plate for working line	Beginning of control
A6V: bent-axis design, variable	M:motor	55 107 160	See below	(only for HD,EP) D: pressure control, fixed setting	63	Viewed on drive shaft, bidirec-tional	FKM (fluo-roelastomer)	See below	B: ISO 3019-2 4-hole	See below	A: at $V_{g\,min}$ (standard for HA) B: at $V_{g\,max}$ (standard for HD,HZ, EP,EZ)

Control Unit

		55	80	107	160	200	
Proportional control, hydraulic	△Pst=10bar	√	√	√	√	√	HD1
	△Pst=25bar	√	√	√	√	√	HD2
Proportional control, electric	U=12V	√	√	√	√	√	EP1
	U=24V	√	√	√	√	√	EP2
Two-point control, electric	U=12V	/	/	/	√	√	EZ1
	U=24V	/	/	/	√	√	EZ2
	U=12V	√	√	√	/	/	EZ3
	U=24V	√	√	√	/	/	EZ4
Two-point control, hydraulic		/	/	/	√	√	HZ1
		√	√	√	/	/	HZ3
Automatic control, high-pressure related	With minimum pressure increase △p≤approx.10bar	√	√	√	√	√	HA1
	With pressure increase △p=100bar	√	√	√	√	√	HA2

Drive shafts

	55	80	107	160	200	
Splined shaft DIN5480	√	√	√	√	√	A
	√	√	√	√	/	Z

Port plate for working line

		55	80	107	160	200	
SAE working ports A and B at rear	without valve	√	√	√	√	√	010
	Flushing and boost-pressure valve, mounted	√	√	√	√	√	017
SAE working ports A and B opposite	without valve	√	√	√	√	√	020
	Flushing and boost-pressure valve, mounted	√	√	√	√	√	027

Technical Data

Hydraulic fluid

The A6VM fixed displacement motor is suitable for use with mineral oil

Viscosity range

We recommend that a viscosity (at operating temperature)for optimum efficiendy and service life purposes of

V_{opt} = optimum viscosity16...36mm²/s

Be chosen,taken the tank temperature(open circuit) into account.

Limits of viscosity range

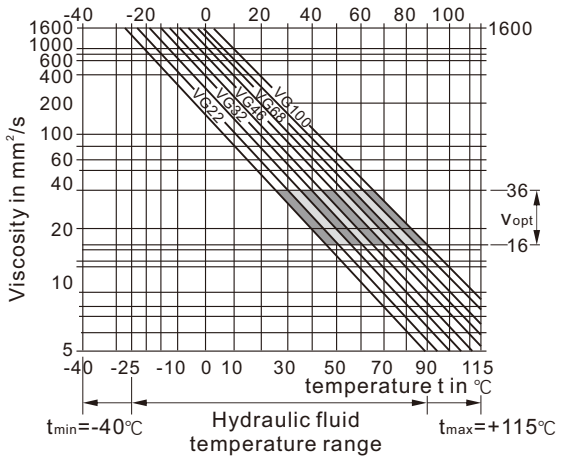
The following values apply in extreme cases:

Vmin = 5 mm²/s
short term(t < 3 min)at max.permitted temperature
tmax=115℃

Vmax = 1600 mm²/s
short term(t < 3 min) with cold start(P < 3MPa,
n≤1000rpm t_{min}=-40℃)

Note that the maximun hydraulic fluid temperature must not be exceeded locally either (e.g.bearing area).The temperature in the bearing area is-depending on pressure and speed-up to 12K higher than the average case drain temperature.

Setlection diagram



Details regarding the choice of hydraulic fluid

The correct selection of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the tank temperature.

The hydraulic fliuid should be selected so that within the operating temperature range, the operating viscosity lies within the optimun 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℃ an operating temperature of 60℃ is set in the circuit. In the optimun operating viscosity range(V_{opt}; shaded area) this corresponds to the viscosity classes VG 46 or VG68; to be selected: VG 68.

Please note: The leakage fluid temperature, which is affected by pressure and rotational spaad,is always higher than the tank temperature . At no point in the system may the temperature be higher than 115℃.

Filtartion

The finer the filtration, the cleaner the fluid and the longer the service life of the axial piston unit.

To ensure proper function of the axial piston unit,the hydraulic fluid must have a cleanliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures
(90℃ to max.115℃),a cleanliness level of at least

19/17/14 according to ISO 4406 is required.

Operational pressure range

maximum pressure in port A or B

Nominal pressure PN	40MPa
Maximum pressure Pmax	45MPa
Total pressure (A+B) Pmax	70MPa

Direction of flow

Direction of rotation,viewed on drive shaft

clockwise	counter-clockwise
A to B	B to A

Speed range

The minimum rotational speed nmin is not restricted.Please consult us regarding applications requiring uniformity of the rotatory motion at low speeds.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the leakage pressure in the housing (case pressure).Momentary (t < 0.1s) pressure peaks of up to1MPa are allowed.Case pressure of a continuous 0.2MPa maximum are permitted to be able to utilize the entire speed range.Higher case pressure are permissible at lower rotational speeds.
The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
The case pressure must be equal to or higher than the ambient pressure.

Temperature range

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

Effect of pressure on beginning of control

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

HA1T: increase
HD,HA,HA.U.EP:increase

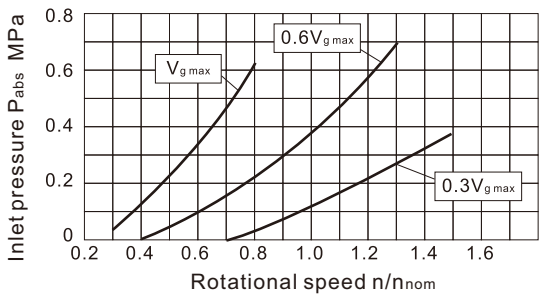
The factory setting for the begining of control are made at Pabs= 0.2MPa case pressure.

Technical Data

Datasheet (theoretical values)

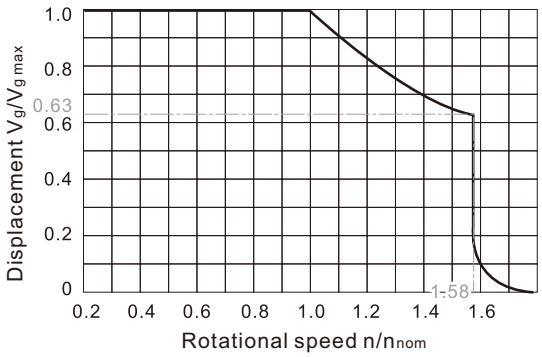
Size			55	107	160
Displacement	$V_{g\,max}$	mL/r	54.8	107	160
	$V_{g\,0}$	mL/r	0	0	0
Maximum rotational speed (while adhering to the maximum permissible inlet flow)	n_{max} at $V_{g\,max}$	rpm	4450	3550	3100
	n_{max1} at $V_g < V_{g\,max}$	rpm	7000	5600	4900
	$V_g = 0.63 \times V_{g\,max}$	mL/r	35	68	101
	n_{max} at $V_{g\,0}$	rpm	8350	6300	5500
Maximum flow	$q_{v\,max}$	L/min	244	380	496
Torque		Nm	349	681	1019
Rotational stiffness	T_{max} at $V_{g\,max}$ 2)	Nm/°	700	1560	2320
Moment of inertia for rotary group	J	kgm^2	0.0042	0.0127	0.0253
Case volume	V	L	0.75	1.5	2.4
Weight approx.	m.	kg	26	47	64

Minimum pressure-operation as a pump(inlet)



In order to prevent damage to the variable motor,it is necessary to ensure a minimum inlet pressusre in the inlet area,which depends on the speed and swivel angle(displacement) of the variable motor.

Permissible displacement in relation to rotational speed



Permissible radial and axial forces of the drive shafts

Size			55	107	160
Maximum radial force at distance a(from shaft collar)	F_q, a	$F_{q\,max}$ N	10440	15278	20320
		a mm	15	20	22.5
Maximum radial force	F_{ax}	$-F_{ax\,max}$ N	500	900	1120
		$+F_{ax\,max}$ N	500	900	1120
Permissible axial force per bar working pressure		$-F_{ax}$/bar N/bar	7.5	11.3	15.1

Determining the size

Flow $q_v = \dfrac{V_g \times n}{1000 \times \eta_v}$ (L/min)

Output speed $n = \dfrac{q_v \times 1000 \times \eta_v}{V_g}$ (rpm)

Torque $T = \dfrac{V_g \times \triangle P \times \eta_{mh}}{20\pi}$ (Nm)

Power $P = \dfrac{2\pi \times T \times n}{60000} = \dfrac{q_v \times \triangle P}{600 \times \eta_t}$ (kW)

V_g = Displacement per revolution in mL/r
T = Torque in Nm
$\triangle$P. = Differential pressure in MPa
n = Speed in rpm
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Overall efficiency

HD - Proportional control,hydraulic

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

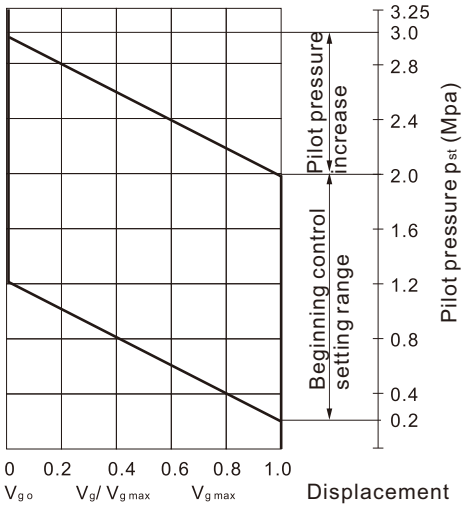
Standard configuration:
- Beginning of control at Vg max (maximum torque, minimum rotational speed at minimum pilot pressure).
- End of control control at Vg min(minimum torque. maximum permissible rotational speed,at maximum pilot pressure).

Notice:
- Maximum permissible pilot pressure:P_{st}=10MPa.
- The control oil is internally taken out of the high pressure side of the motor (A or B).For reliable control ,a working pressure of at least 3 Mpa is necessary in A (B).If a control peration is performed at a working pressure ＜3MPa,an auxiliary pressure of at least 3 Mpa must be applied at port G using an external check valve.For lower pressure,please contact us.
-Specify the desired beginning of control in plain text when ordering,e.g.:beginning of control at 1MPa.

HD1,pilot pressure increase △p_{st}=1MPa

A pilot pressure increase of 1MPa at port X will cause a reduction in displacement from $V_{g\,max}$ to 0 mL/r.
Beginning of control,setting range 0.2 to 2 Mpa.
Standard setting:beginning of control at 0.3 MPa (end of control at 1.3 MPa)

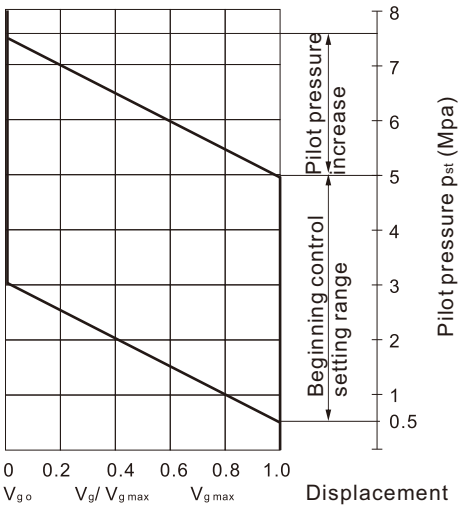
Characteristic cure



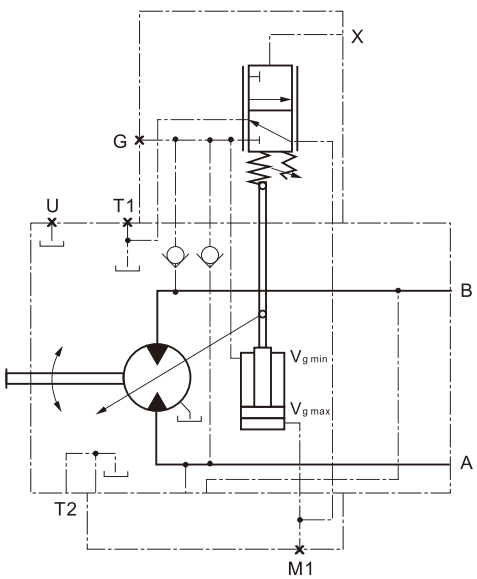
HD2,pilot pressure increase △p_{st}=2.5MPa

A pilot pressure increase of 2.5 MPa at port X results in a reduction in displacement from $V_{g\,max}$ to 0 mL/r.
Beginning of control,setting range 0.5 to 3.5 MPa.
Standard setting:beginning of control at 1 MPa (end of control at 3.5 MPa)

Characteristic cure



Circuit diagram HD1,HD2

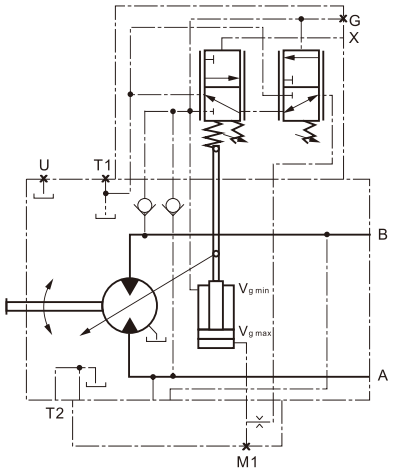


HD - Proportional control,hydraulic

HD.D Pressure control,fixed setting

The pressure control overrides the HD control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control,the motor will swivel towards a larger angle.
The increase in displacement and the resulting reduction in pressure cause the control deviation to decrease.With the increase in displacement the motor develops more torque,while the pressure remains constant.
Setting range of the pressure control valve 8 to 40 Mpa.

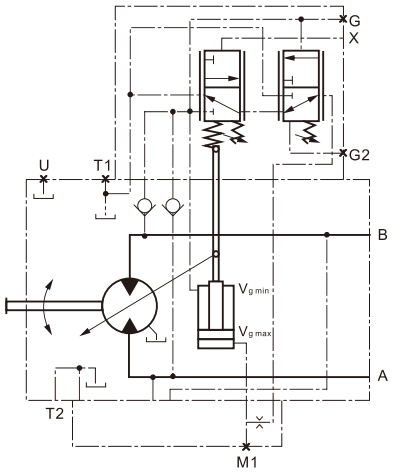
Circuit diagram HD.D



HD.E Pressure control,hydraulic override, two-point

The pressure control setting can be overridden by applying an external pilot pressure at port G2,realizing a 2nd pressure setting.
Necessary pilot pressure at port G2:
pst=2 to 5 MPa
When ordering,please specify the 2nd pressure setting in plain text.

Circuit diagram HD.E

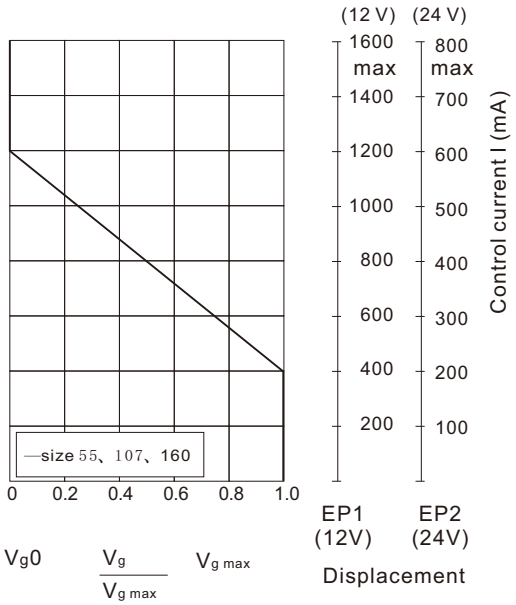


EP - Proportional control,electric

The electric control with proportional solenoid enable the displacement to be steplessly adjusted.Control is proportional to the electric control current applied to the solenoid.

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

Characteristic cure

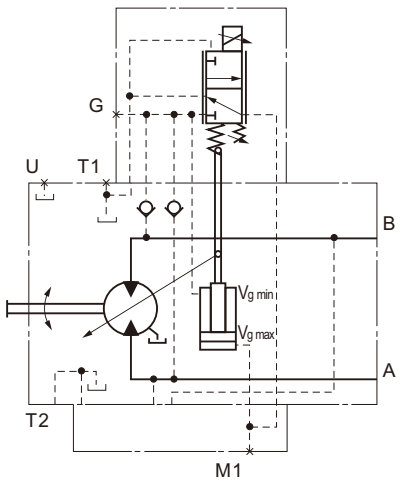


Notice:
The control oil is internally taken out of the high pressure side of the motor (A or B).For reliable control,a working pressure of at least 3 Mpa is necessary in A (B).If a control operation is performed at working pressure ＜3MPa,an auxiliary pressure of at least 3 Mpa must be applied at port G using an external check valve.For lower pressure at port G,please contacu us. Please note that at port G up to 45 Mpa can occur.

Technical data,solenoid

	EP1	EP2
Voltage	12V(±20%)	24V(±20%)
Control current		
Beginning of congrol	400mA	200mA
End of control	1200mA	600mA
Current limit	1.54A	0.77A
Nominal resistance(at 20℃)	5.5Ω	22.7Ω
Frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Protection class	IP 65	

Circuit diagram EP1,EP2

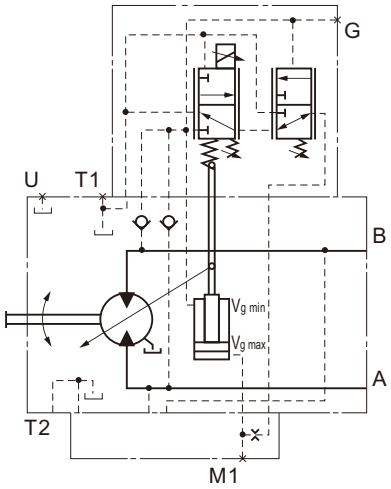


EP - Proportional control,electric

EP.D electrical control,fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint value of the pressure control,the motor will swivel towards a larger angle.
The increase in displacement and the resulting reduction in pressure cause the control deviation to decrease,With the increase in displacement the motor develops more torque,while the pressure remains constant.
Setting range of the pressure control valve 8 to 40MPa.

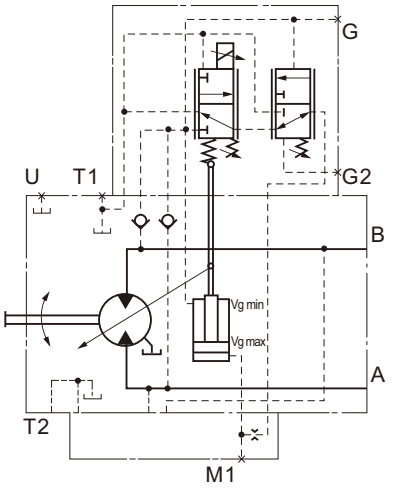
Circuit diagram EP.D



EP.E electrical control,hydraulic override, two-point

The pressure control setting can be overridden by applying an external pilot pressure at port G2,realizing a 2nd pressure setting realized.
Necessary pilot pressure at port G2:
pst=2 to 5 MPa
When ordering,please specify the 2nd pressure setting in plain text.

Circuit diagram EP.E



EZ - Two-poilt control,electric

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

Notice:
The control oil is internally taken out of the high pressure side of the motor (A or B).For reliable control,a working pressure of at least ＜3 MPa is necessary in A (B).If a control operation is performed at a working pressure 3 MPa,an auxiliary pressure of at least 3 MPa must be applied at port G using an external check valve .For lower pressure,please contact us.
Please note that at port G up to 45 MPa can occur.

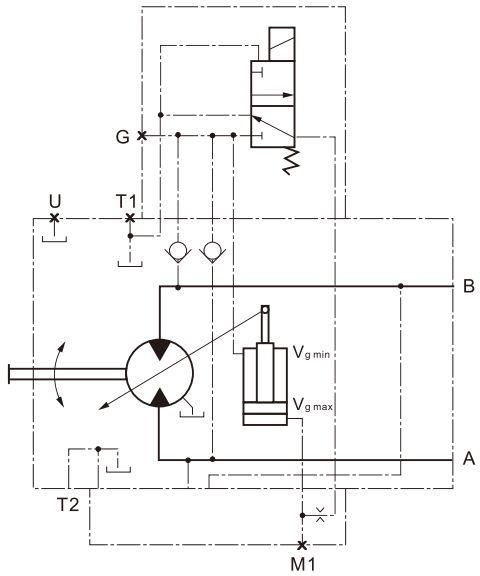
Technical data,solenoid with ϕ37

Size 160	EP1	EP2
Voltage	12V(±20%)	24V(±20%)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance(at 20℃)	5.5Ω	22.7Ω
Nominal power	26.2 W	26.5W
Minimum active current required	1.32A	0.67A
Duty cycle	100%	100%
Type of protection	IP 65	

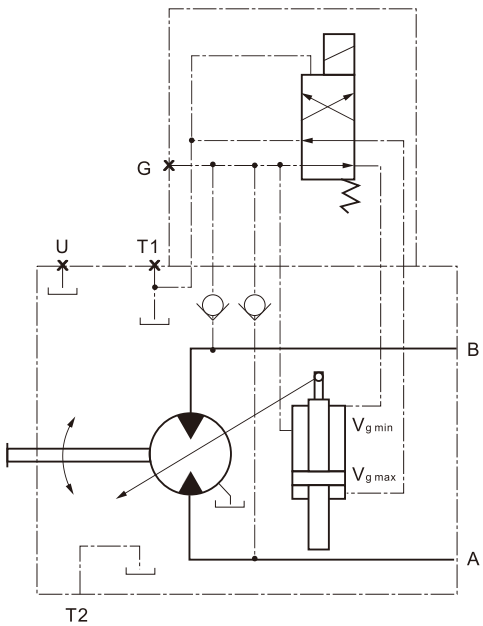
Technical data,solenoid with ϕ45

Size 160	EP1	EP2
Voltage	12V(±20%)	24V(±20%)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance(at 20℃)	4.8Ω	19.2Ω
Nominal power	30W	30W
Minimum active current required	1.5A	0.75A
Duty cycle	100%	100%
Type of protection	IP 65	

Circuit diagram EZ1,EZ2
Size 160



Size 55,107



HA - Automatic high-pressure related control

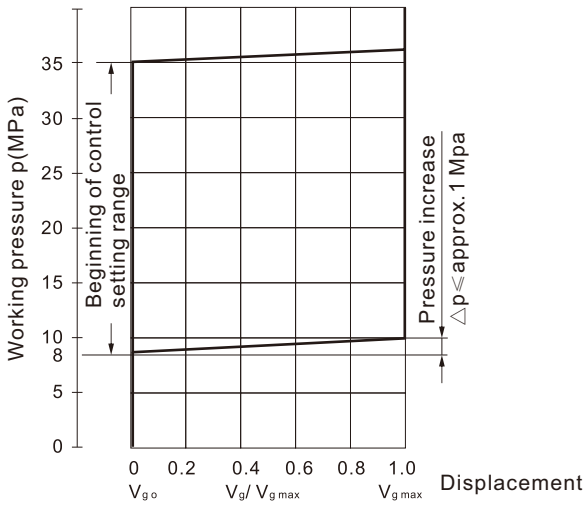
The automatic high-pressure related control adjusts the displacement automatically depending on the working pressure.
The displacement of the A6VM motor with HA control is $V_{g\,min}$ (maximum rotational speed and minimum torque). The control device measures internally the working pressure at A to B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

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

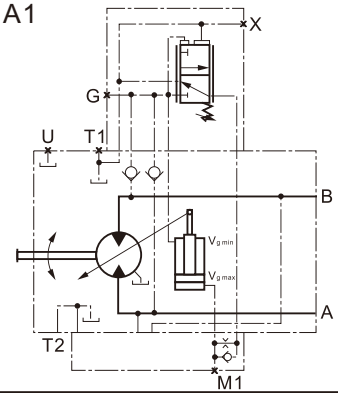
HA1 with minimum pressure increase , positive control

A working pressure increase of △p⩽approx.1 MPa results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.
Setting range of pressure control valve 8 to 35 MPa.
Please state the desired beginning of control in plain text when ordering,e.g.:beginning of control at 30 MPa.

Characteristic curve HA1



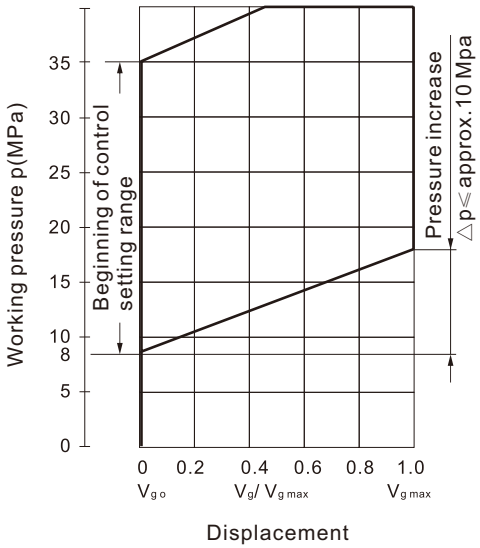
Circuit diagram HA1



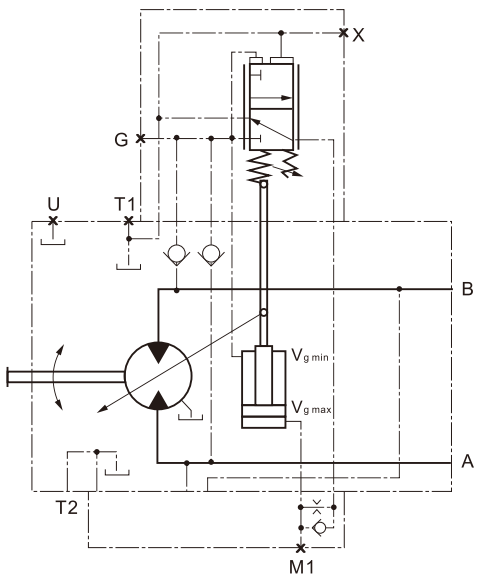
HA2 with pressure increase,positive control

A working pressure increase of △p⩽approx.10 MPa results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.
Setting range of pressure control valve 8 to 35 MPa.
Please state the desired beginning of control in plain text when ordering,e.g.:beginning of control at 20 MPa.

Characteristic curve HA2



Circuit diagram HA2



HA - Automatic high-pressure related control

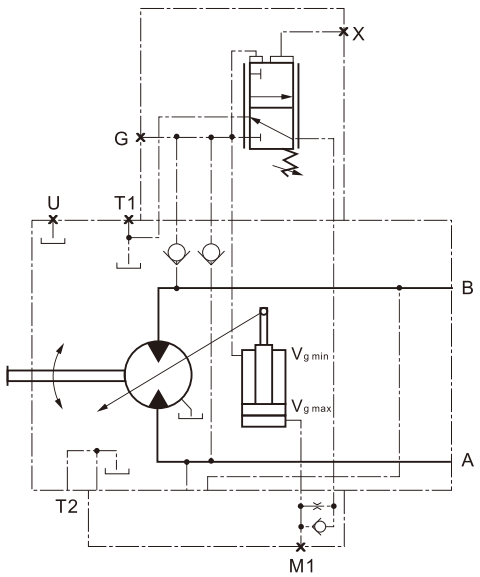
HA.T Hydraulic override,remote control, proportional

With the HA.T control,the beginning of control can be influenced by applying a pilot pressure to port X.
For every 0.1 MPa of pilot pressure,the beginning of control is reduced by 1.7 Mpa.

Example:

Settings for the beginning of control	30 MPa	30 MPa
Pilot pressure at port X	0 MPa	1 MPa
Beginning of control at	30 MPa	13 MPa

Characteristic curve HA.T



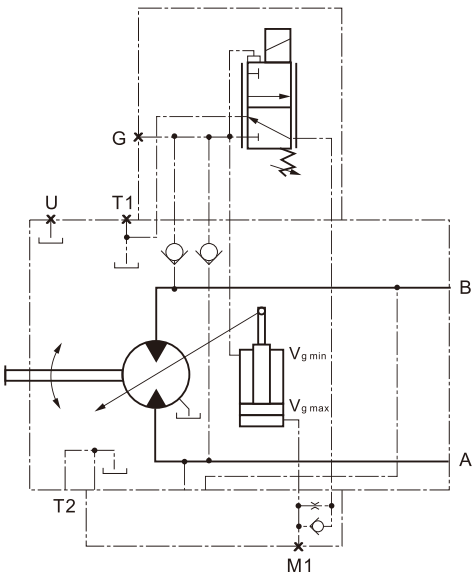
HA.U1,HA.U2 electrc override,two-point

With the HA.U1 and HA.U2 control,the beginning of control can be overridden by an electric signal to a switching solenoid.When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position.
The beginning of control can be set between 8 an 35 MPa. (specify required setting in plain text when ordering).

Technical data,solenoid with ϕ45

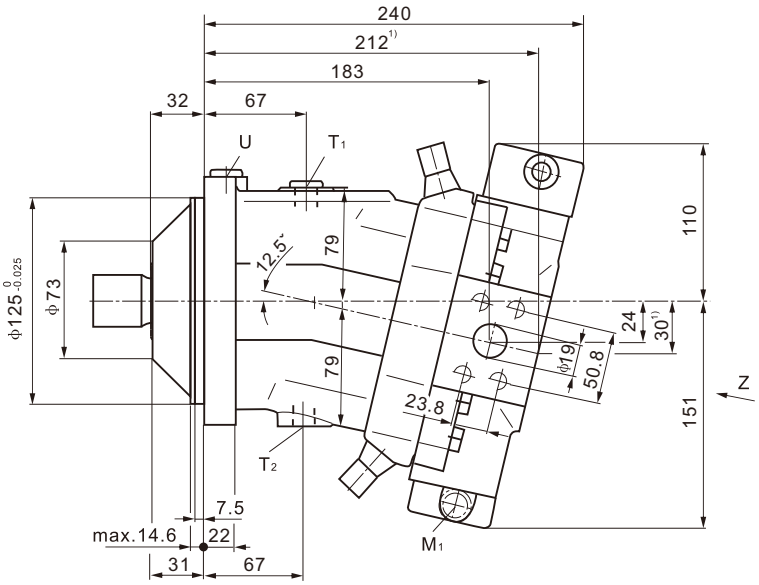
Size 160	EP1	EP2
Voltage	12V(±20%)	24V(±20%)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance(at 20℃)	4.8Ω	19.2Ω
Nominal power	30W	30W
Minimum active current required	1.5A	0.75A
Duty cycle	100%	100%
Type of protection	IP 65	

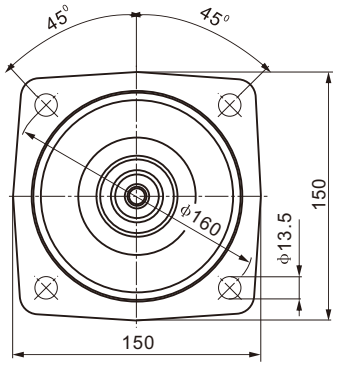
Characteristic curve HA.U1,HA.U2



Installation dimensions Size 55

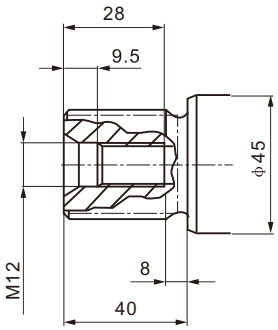
SAE working ports A and B lateral,opposing



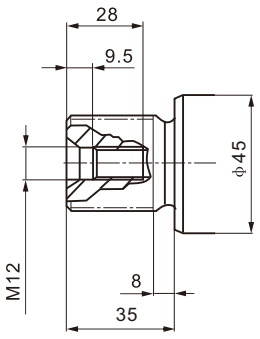


Shaft ends

A Splined shaft DIN5480
W35×2×30×16×9g

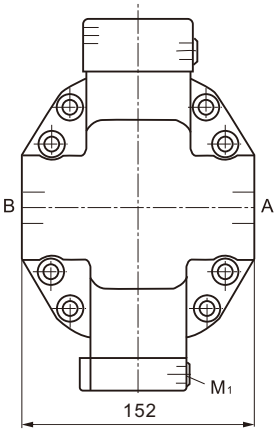


Z Splined shaft DIN5480
W30×2×30×14×9g

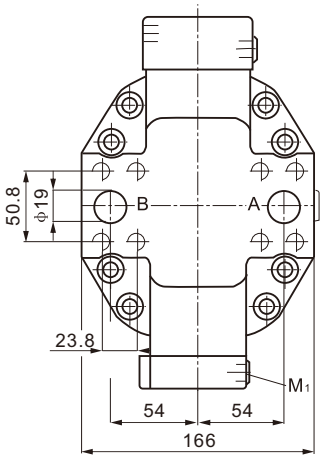


Detail Z

02 SAE working ports A and B lateral,opposite



01 SAE working ports A and B at rear

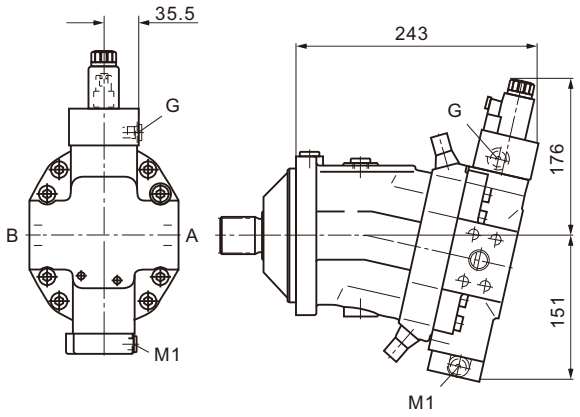


Ports

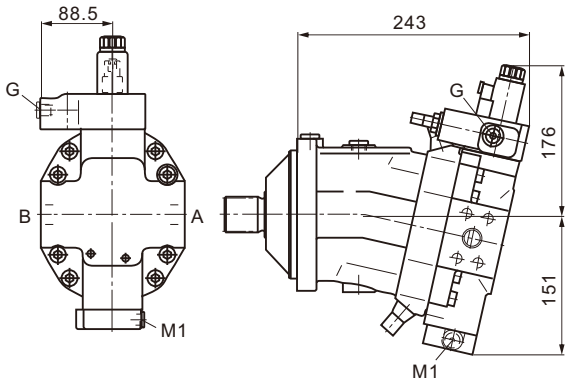
A,B	Working port	3/4in
	Fastensing thread A/B	M10,17 deep
T_1	Drain port	M18×1.5,12 deep
T_2	Drain port	M18×1.5,12 deep
U	Bearing flushing	M18×1.5,12 deep
M_1	Stroking chamber measurement	M14×1.5,12 deep
G	Synchronous control	M14×1.5,12 deep

Installation dimensions Size 55

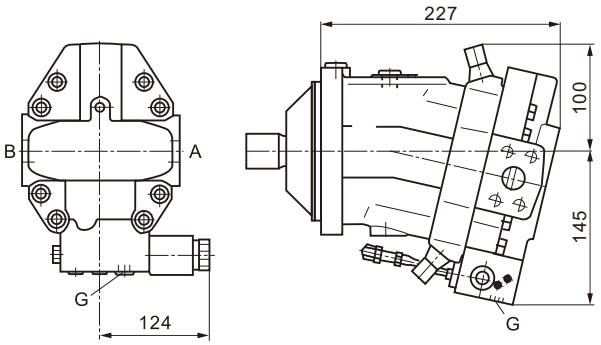
EP1,EP2:Proportional control,electric



EP.D:Proportional control,electric
with pressure control fixed setting

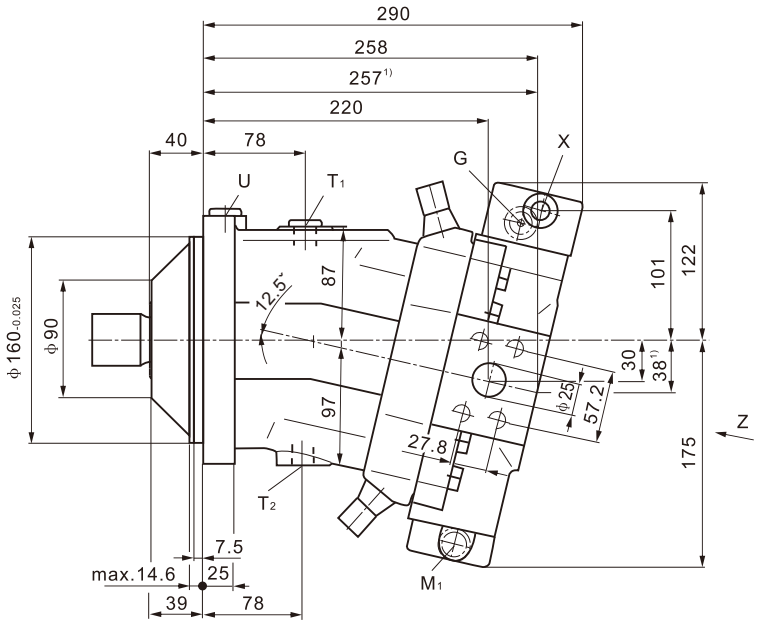


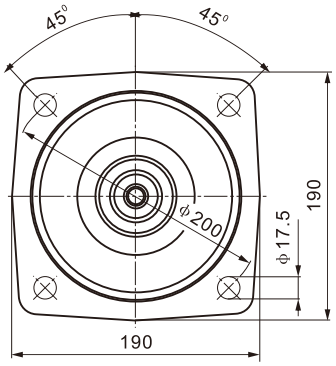
EZ1,EZ2:
Two-point control,electric



Installation dimensions Size 107

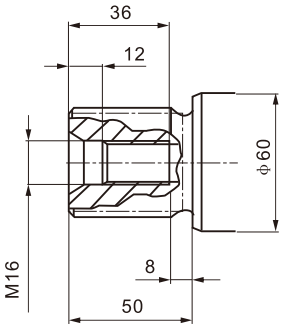
HD1,HD2 control
SAE working ports A and B lateral,opposing



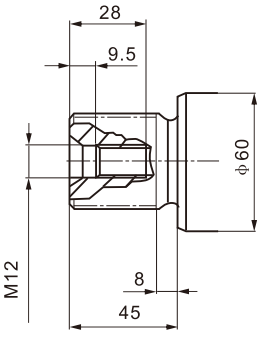


Shaft ends

A Splined shaft DIN5480
W45×2×30×21×9g

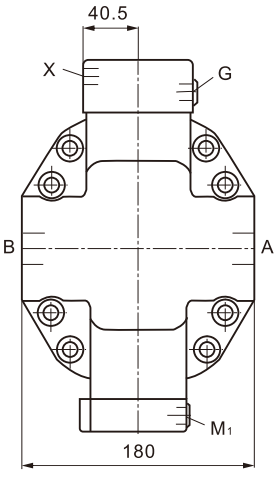


Z Splined shaft DIN5480
W40×2×30×18×9g

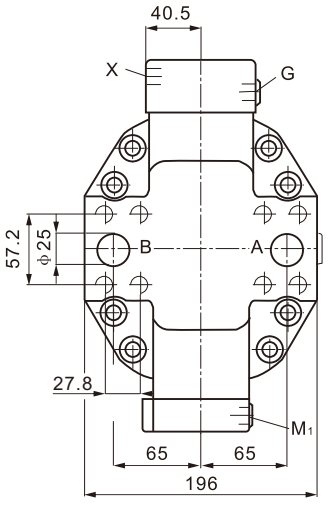


Detail Z

02 SAE working ports A and B lateral,opposite



01 SAE working ports A and B at rear



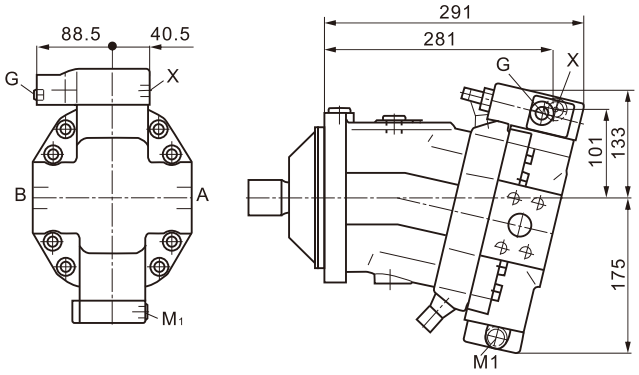
Ports

A,B	Working port	1in
	Fastensing thread A/B	M12,17 deep
T_1	Drain port	M18×1.5,12 deep
T_2	Drain port	M18×1.5,12 deep
X	Pilot signal	M14×1.5,12 deep
U	Bearing flushing	M18×1.5,12 deep
M_1	Stroking chamber measurement	M14×1.5,12 deep
G	Synchronous control	M14×1.5,12 deep
G_2	2nd pressure setting	M14×1.5,12 deep

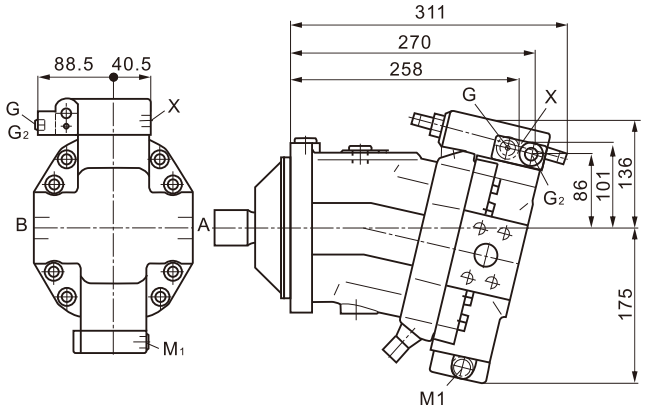
1、Working ports A and B at side,(01)

Installation dimensions Size 107

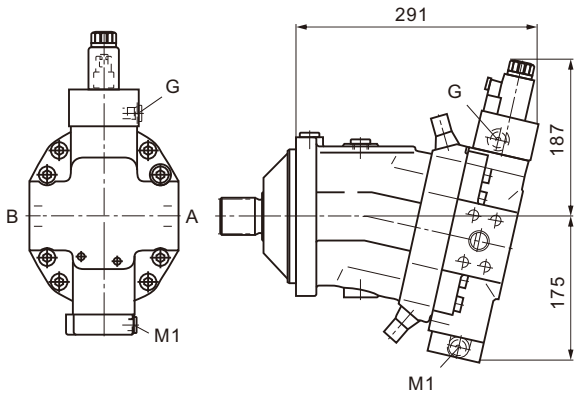
HD.D:Proportional control hydraulic
with pressure control fixed setting



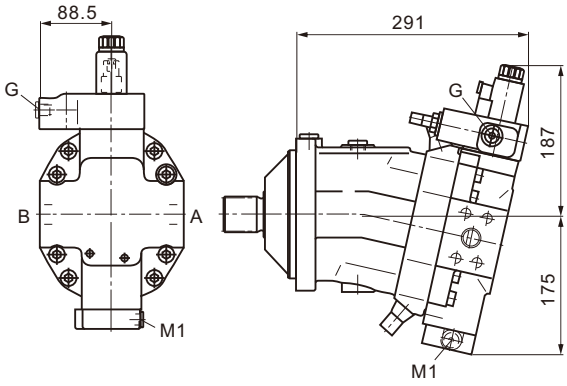
HD.E:Proportional control hydraulic
with pressure control hydraulic override,two-point



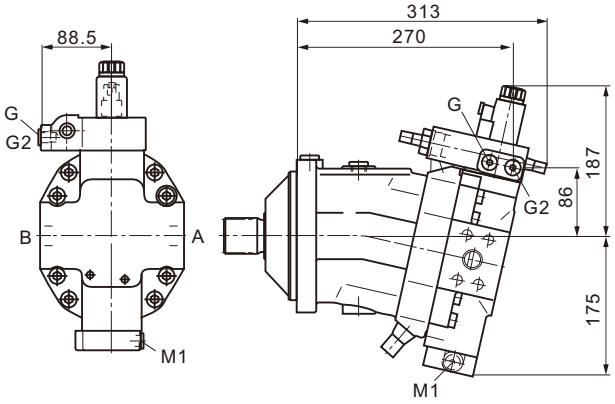
EP1,EP2:Proportional control,electric



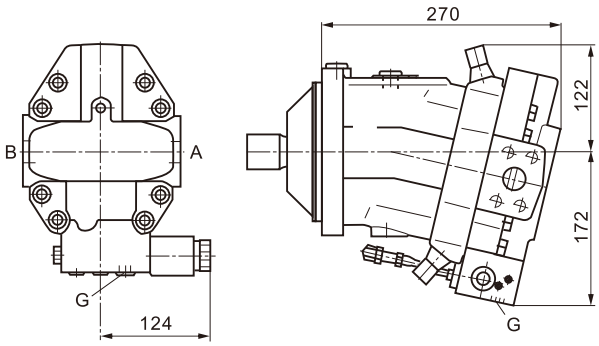
EP.D:Proportional control,electric
with pressure control fixed setting



EP.E:Proportional control,electric,
with pressure control hydraulic override,two-point

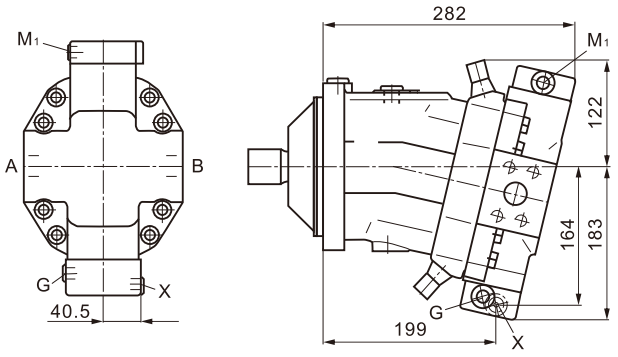


EZ3,EZ4:Two-point control,electric



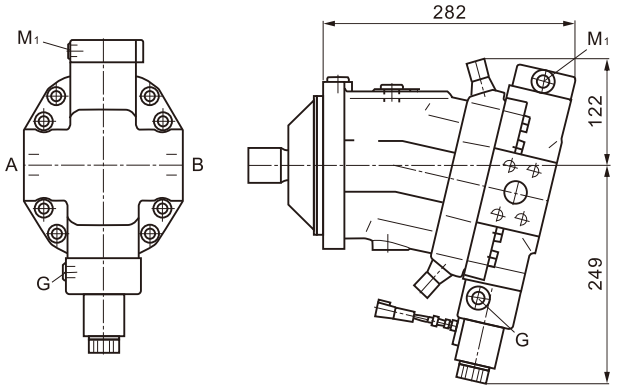
Installation dimensions Size 107

HA1,HA2/HA1T,HA2T:Automatic high-pressure related control,with override,hydraulic remotecontrol, proportional



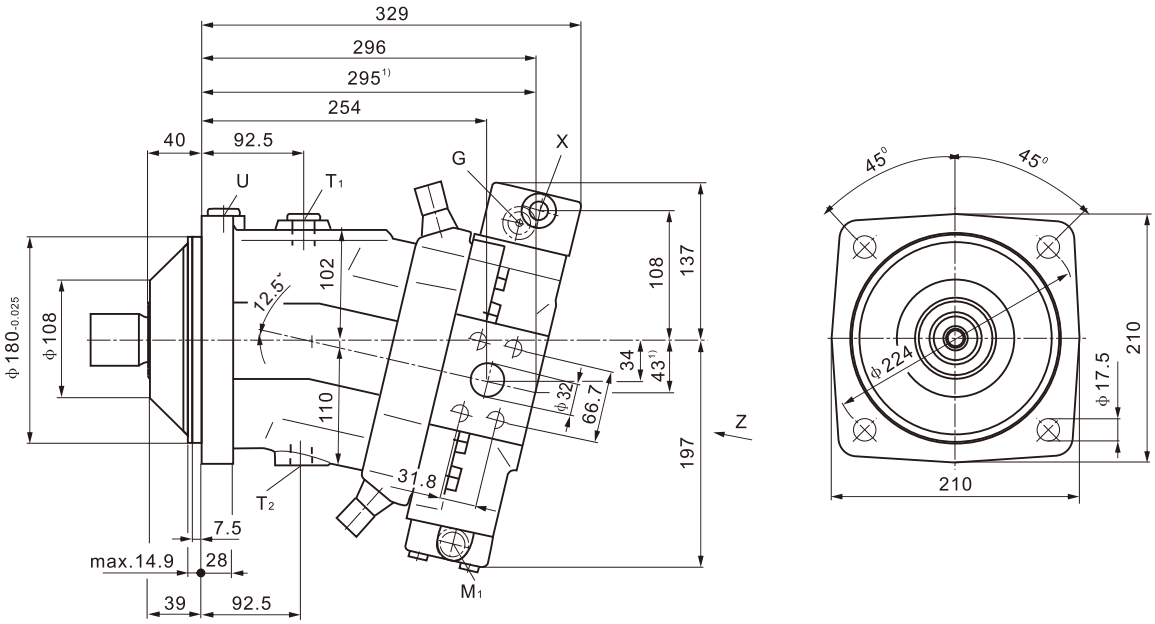
HA1 and HA2,X plugged
HA1T and HA2T,X open

HA1U1,HA2U2:Automatic high-pressure related control, with electric override,two-point



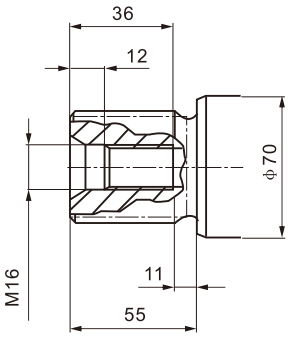
Installation dimensions Size 160

HD1,HD2 control
SAE working ports A and B lateral,opposing

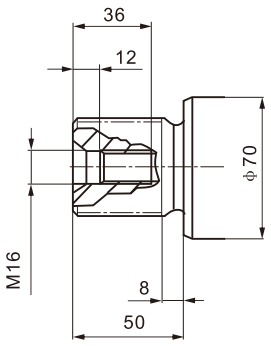


Shaft ends

A Splined shaft DIN5480
W50×2×30×24×9g

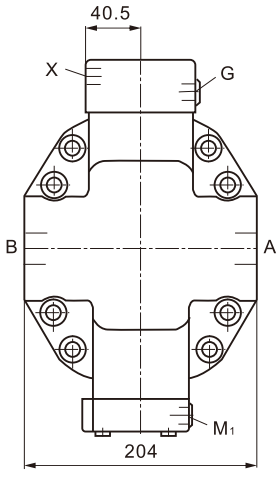


Z Splined shaft DIN5480
W45×2×30×21×9g

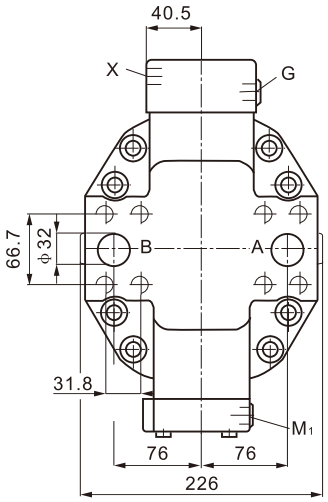


Detail Z

02 SAE working ports A and B lateral,opposite



01 SAE working ports A and B at rear



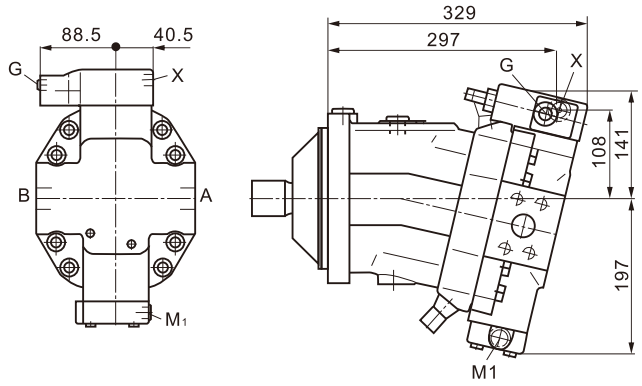
Ports

A,B	Working port	1 1/4in
	Fastensing thread A/B	M14,19 deep
T_1	Drain port	M26×1.5,12 deep
T_2	Drain port	M26×1.5,12 deep
X	Pilot signal	M14×1.5,12 deep
U	Bearing flushing	M22×1.5,12 deep
M_1	Stroking chamber measurement	M14×1.5,12 deep
G	Synchronous control	M14×1.5,12 deep
G_2	2nd pressure setting	M14×1.5,12 deep

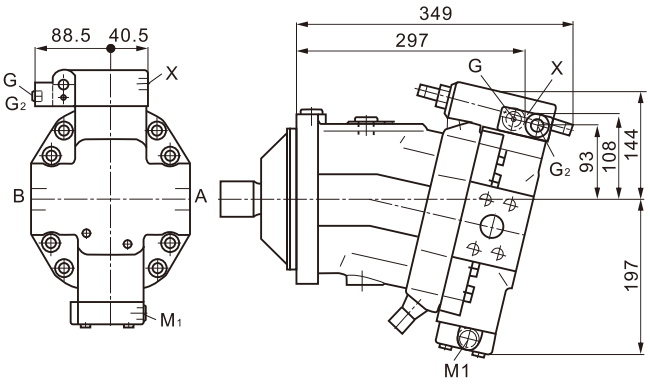
1、Working ports A and B at side,(01)

Installation dimensions Size 160

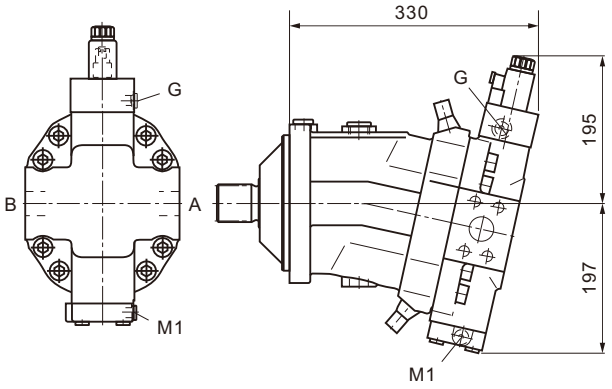
HD.D:Proportional control hydraulic
with pressure control fixed setting



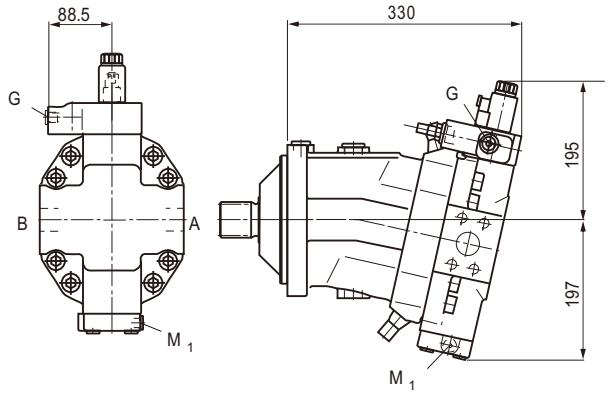
HD.E:Proportional control hydraulic
with pressure control hydraulic override,two-point



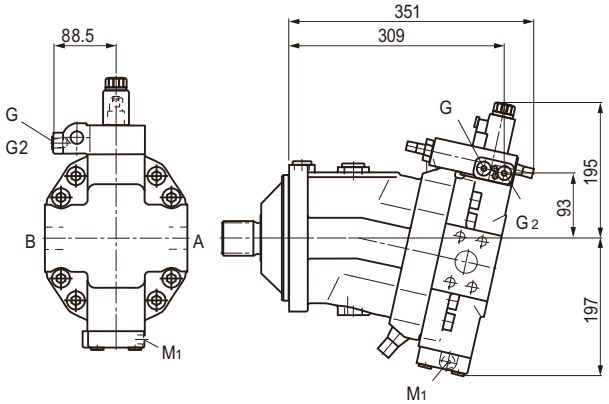
EP1,EP2:Proportional control,electric



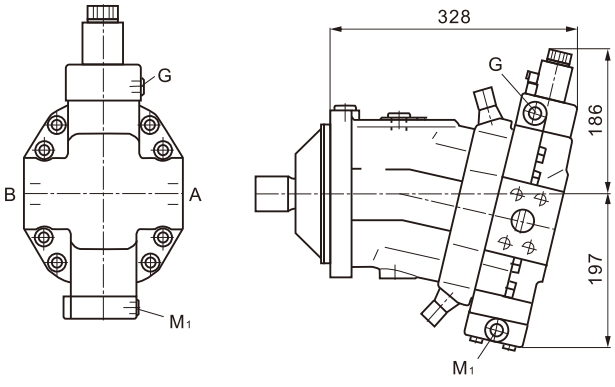
EP.D:Proportional control,electric
with pressure control fixed setting



EP.E:Proportional control,electric,
with pressure control hydraulic override,two-point

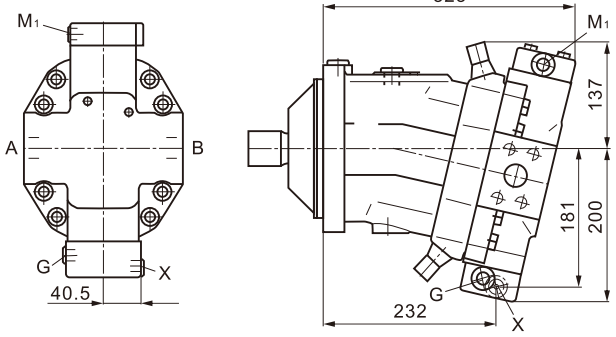


EZ3,EZ4:Two-point control,electric



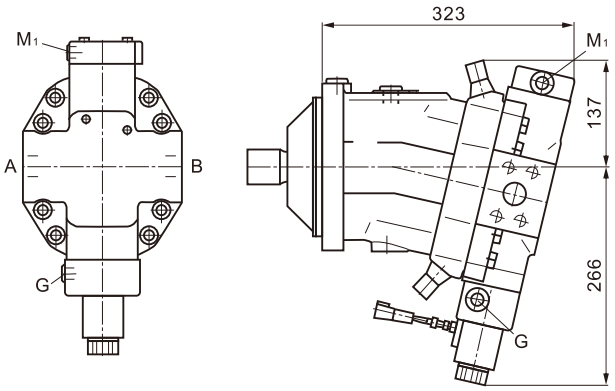
Installation dimensions Size 160

HA1,HA2/HA1T,HA2T:Automatic high-pressure related control,with override,hydraulic remotecontrol, proportional



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

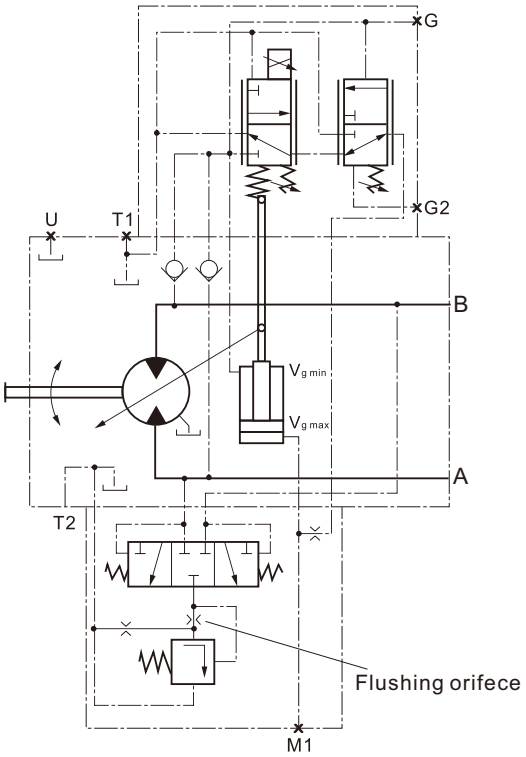
HA1U1,HA2U2:Automatic high-pressure related control, with electric override,two-point



Installation dimensions

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

Characteristic curve

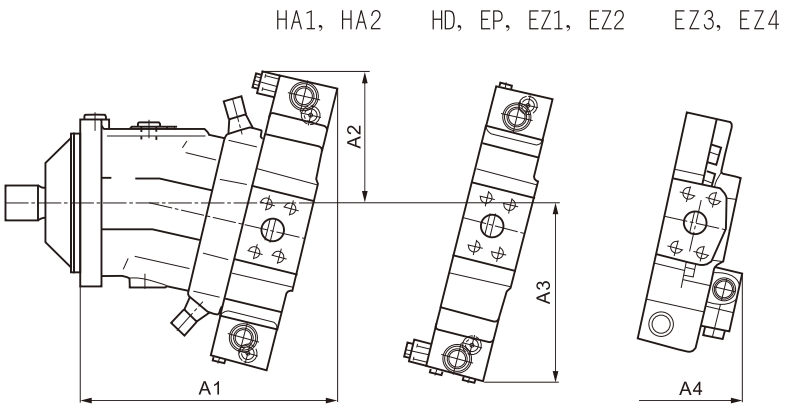


Flushing flow(at low pressure P_{lp}=2.5MPa)

Size	Flow
55	3.5L/min
107	8L/min
160	10L/min

The flushing flows deviating from the values in the table,please state the required flushing flow when ordering.
The flushing flow without orifice is approx.12 to 14 L/min.

Installation dimensions



Size	A1	A2	A3	A4
55	-	-	176	176
107	288	144	200	269
160	328	154	220	-

Installation instructions

General

The axial piston unti must be filled with hydraulic fluid and air bled during commissioning and operation.This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines. Partcularly in the installation position ”drive shaft upwards”,filling and air bleeding must be carried out completely as there is ,for example,a danger of dry running.
The leakage in the housing area must be directed to the reservoir via the highest drain port.

Installation position

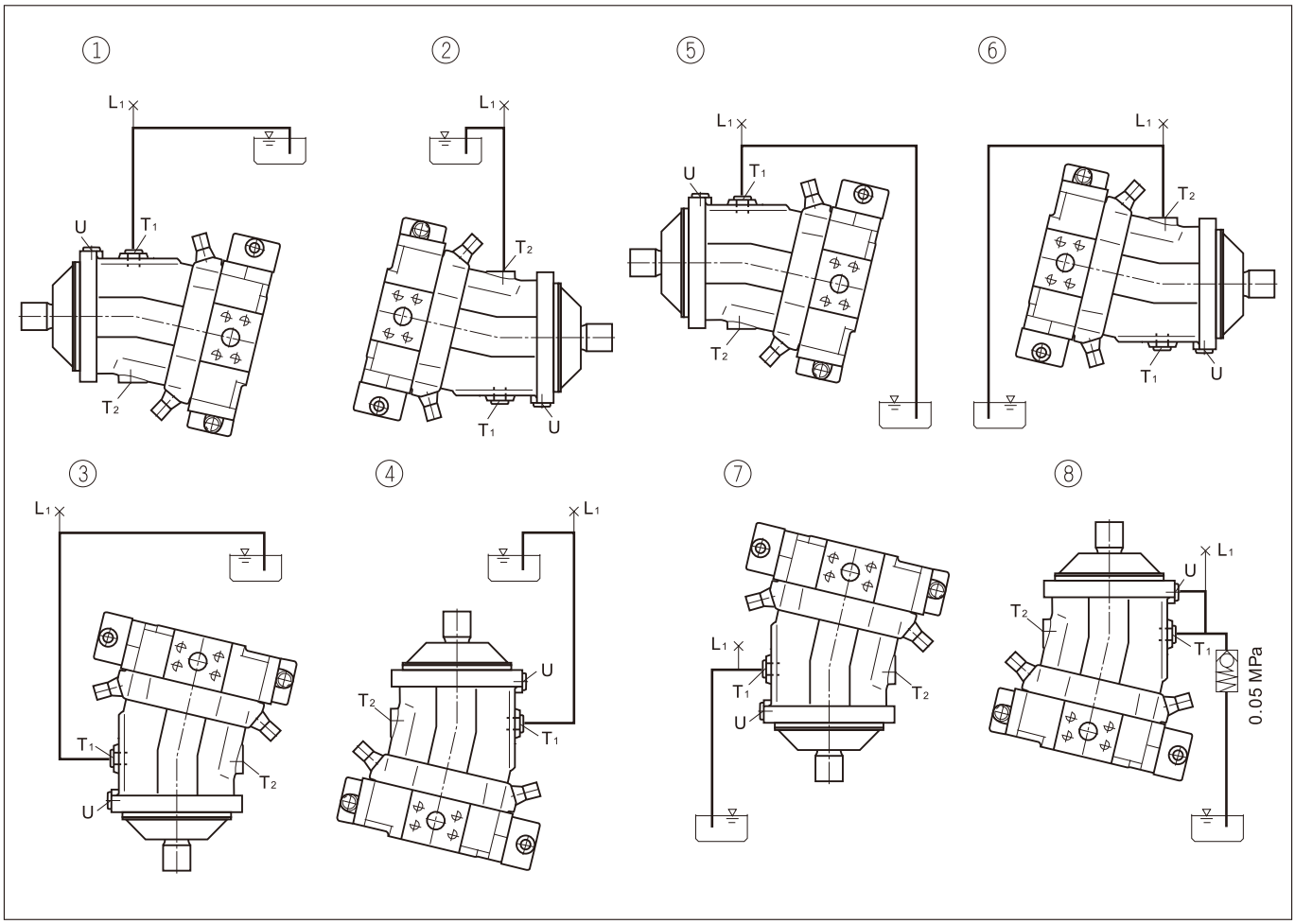
See the following examples.Further installation positons are available upon request .

Below-reservoir installation(standard)

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

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.
A check valve in the reservoir line(cracking pressure 0.05 Mpa) can prevent draining of the housing area.



Installation location	Exhaust port	Oil filling port
1	-	T1(L1)
2	-	T2(L1)
3	-	T1(L1)
4	U	T1(L1)

Installation location	Exhaust port	Oil filling port
5	-	T1(L1)
6	-	T2(L1)
7	-	T1(L1)
8	U	T1(L1)