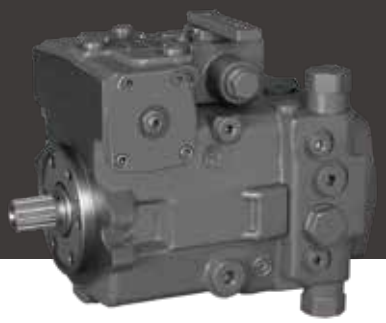
# Axial Piston Variable Pump
# HP4VC Series：0*

Size：28/45/53 mL/r
Rated pressure：30 MPa
Max. pressure：35 MPa



## Features

- Axial piston variable pump in swashplate design for hydrostatic drives in closed circuits
- The flow is proportional to the drive speed and displacement and is infinitely varied
- The output flow increases from zero to the maximum value as the swashplate swivels
- The flow direction changes when the swashplate is moved through the neutral position
- Various mutually compatible control options to provide diverse control and regulation functions
- Two pressure relief valves on each high-pressure side to prevent overload of hydrostatic drives (pump and motor)
- Pressure relief valve with boost function
- Integrated boost pump works as the boost and control pump
- Maximum boost pressure limited by integrated boost-pressure relief valve
- With integrated power cut-off valve as standard

## Contents

## Model Code

| | c | A | B | C | D | E | F | G | H | | I | K | | M | N | P | R | S | T | U | X | | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HP4V | C | | | | | | | | | / | 0* | | - | | | C | | | | | | - | |

### Axial piston unit

| | | |
|---|---|---|
| – | Swashplate design, variable closed circuits | HP4V |

### Operation

| | | | | | |
|---|---|---|---|---|---|
| c | | 28 | 45 | 53 | |
| | Closed circuit | ● | ● | ● | C |

### Displacement

| | | | | | |
|---|---|---|---|---|---|
| A | Geometric displacement, in mL/r | 28 | 45 | 53 | |

### Variable control method

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B | | | | | 28 | 45 | 53 | |
| | Hydraulic control | Pilot pressure control | Without inlet filtration | | ○ | ● | ● | HD1 |
| | | | With inlet filtration | | ● | ● | ● | HD3 |
| | | Mechanical servo | | | ● | ● | ● | HW |
| | Electric control | With proportional solenoid | Without inlet filtration | U=12V DC | ● | ● | ● | EP1 |
| | | | | U=24V DC | ● | ● | ● | EP2 |
| | | | With inlet filtration | U=12V DC | ● | ● | ● | EP3 |
| | | | | U=24V DC | ● | ● | ● | EP4 |
| | | With switching solenoid | Without inlet filtration | U=12V DC | ○ | ● | ● | EZ1 |
| | | | | U=24V DC | ○ | ● | ● | EZ2 |
| | | | With inlet filtration | U=12V DC | ○ | ○ | ○ | EZ3 |
| | | | | U=24V DC | ○ | ○ | ○ | EZ4 |

### Brake valve

| | | | | 28 | 45 | 53 | |
|---|---|---|---|---|---|---|---|
| C | Without brake valve (without code) | | | ● | ● | ● | |
| | only for HW control valve on the HW valve body | NO | U=12V DC | ○ | ● | ● | O1 |
| | | | U=24V DC | ● | ● | ● | O2 |
| | | NC | U=12V DC | ○ | ○ | ○ | C1 |
| | | | U=24V DC | ○ | ● | ● | C2 |
| | all control valve on the back cover | NO | U=12V DC | — | — | — | O3 |
| | | | U=24V DC | — | — | — | O4 |
| | | NC | U=12V DC | — | — | — | C3 |
| | | | U=24V DC | — | — | — | C4 |

### Neutral position switch(only for HW control)

| | | | | | |
|---|---|---|---|---|---|
| D | | 28 | 45 | 53 | |
| | Without neutral position switch (without code) | ● | ● | ● | |
| | With neutral position switch (with DEUTSCH molded connector) | ● | ○ | ● | L |

## Model Code

| | c | A | B | C | D | E | F | G | H | | I | K | | M | N | P | R | S | T | U | X | | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HP4V | C | | | | | | | | | / | 0* | | - | | | C | | | | | | - | |

### Pressure cut-off valve

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| E | Without pressure cut-off valve (without code) | ● | ● | ● | |
| | With pressure cut-off valve(standard) | ● | ● | ● | D |

### Stroke limiter

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| F | Without mechanical stroke limiter (without code) | ● | ● | ● | |
| | With mechanical stroke limiter, externally adjustable | ○ | ● | ● | M |

### Stroking chamber pressure port($X_3$/$X_4$)

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| G | Without port $X_3$/$X_4$ (without code) | ● | ● | ● | |
| | With port $X_3$/$X_4$ | — | — | — | T |

### DA control valve

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| H | Without DA control valve | ● | ● | ● | 1 |
| | With DA control valve | — | — | — | 2 |

### Series

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| I | Series 0* | ● | ● | ● | 0* |

### Direction of rotation (viewed on drive shaft)

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| K | CW (right-hand) | ● | ● | ● | R |
| | CCW (left-hand) | ● | ● | ● | L |

### Sealing material

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| M | NBR seal + FKM Shaft seal | ● | ● | ● | N |
| | NBR seal + NBR Shaft seal | ● | ● | ● | P |

### Drive shaft

| | Splined shaft ANSI B92.1-1976 | | 28 | 45 | 53 | |
|---|---|---|---|---|---|---|
| N | 1″ 15T 16/32DP | For single pump | ● | ● | ● | S |
| | | With connecting flange | ○ | ● | ● | L |
| | 1 1/4″ 14T 12/24DP | For the 1st pump of a combination pump | ○ | ● | ● | T |

### Mounting flange

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| P | SAE J744-101-2（B）(2*Φ15，Φ101.6h8，9.5) | ● | ● | ● | C |

## Model Code

| | c | A | B | C | D | E | F | G | H | | I | K | | M | N | P | R | S | T | U | X | | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HP4V | C | | | | | | | | | / | 0* | | - | | | C | | | | | | - | |

### Working ports (viewed on drive shaft)

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| R | Ports at same side | | | | |
| | Suction port downwards, working port leftwards | ● | ● | ● | 10 |
| | Suction port upwards, working port rightwards | ○ | ○ | ○ | 13 |

### Boost pump and through drive

| | | | | 28 | 45 | 53 | |
|---|---|---|---|---|---|---|---|
| S | | Splined shaftANSI B92.1 | | | | | |
| | Integrated boost pump | Without through drive | | ● | ● | ● | F00 |
| | | Flange SAE J 744-82-2(A) | 5/8″ 9T 16/32DP | ● | ● | ● | F01 |
| | | Flange SAE J 744-101-2(B) | 7/8″ 13T 16/32DP | ●[1)] | ● | ● | F02 |
| | | | 1″ 15T 16/32DP | ○ | ● | ● | F04 |
| | Without integrated boost pump | Without through drive | | ● | ● | ● | N00 |
| | | Flange SAE J 744-82-2(A) | 5/8″ 9T 16/32DP | ● | ● | ● | K01 |
| | | Flange SAE J 744-101-2(B) | 7/8″ 13T 16/32DP | ○ | ● | ● | K02 |
| | | | 1″ 15T 16/32DP | ○ | ● | ● | K04 |

### High-pressure relief valve

| | | | | 28 | 45 | 53 | |
|---|---|---|---|---|---|---|---|
| T | With high-pressure relief valve, direct operated, fixed setting | 35-45MPa | Without bypass | — | ● | — | 2 |
| | | 25-35MPa | Without bypass | ● | ● | ● | 3 |
| | | 10-25MPa | Without bypass | ● | ● | ● | 4 |
| | | 25-35MPa | With bypass | ● | ● | ● | 5 |
| | | 10-25MPa | With bypass | ● | ● | ● | 6 |
| | | 35-45MPa | With bypass | — | ● | — | 7 |

### Filtration

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| U | External suction filter (not included in delivery, to be selected by customer) | ● | ● | ● | S |
| | External pressure filter (not included in delivery, to be selected by customer) | ● | ● | ● | D |
| | External fluid supply (optional, only for N00, K**) | ● | ● | ● | E |

### Solenoid connector

| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| X | Without solenoid (without code) | ● | ● | ● | |
| | DEUTSCH molded connector, 2-pin, without suppressor diode<br>Connector model: Deutsch DT04-2p (for HWO/HWC/EP/EZ) | ● | ● | ● | P |

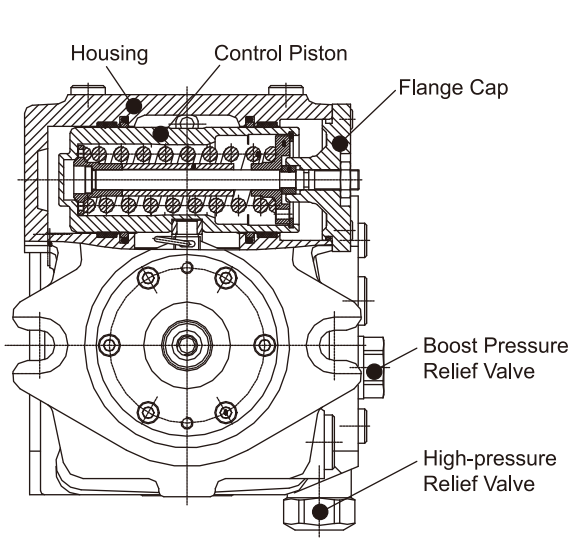
### Special configuration

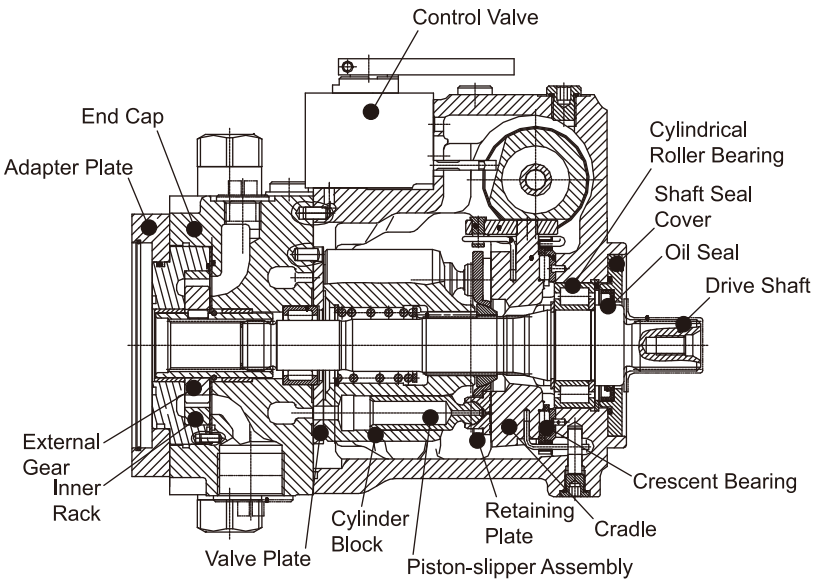
| | | 28 | 45 | 53 | |
|---|---|---|---|---|---|
| Z | Without special configuration(without code) | ● | ● | ● | |
| | Special configuration | ● | ● | ● | *** |

1)Splined shaft 7/8″ 13T 16/32DP only used for 13.8mL/r Boost pump.

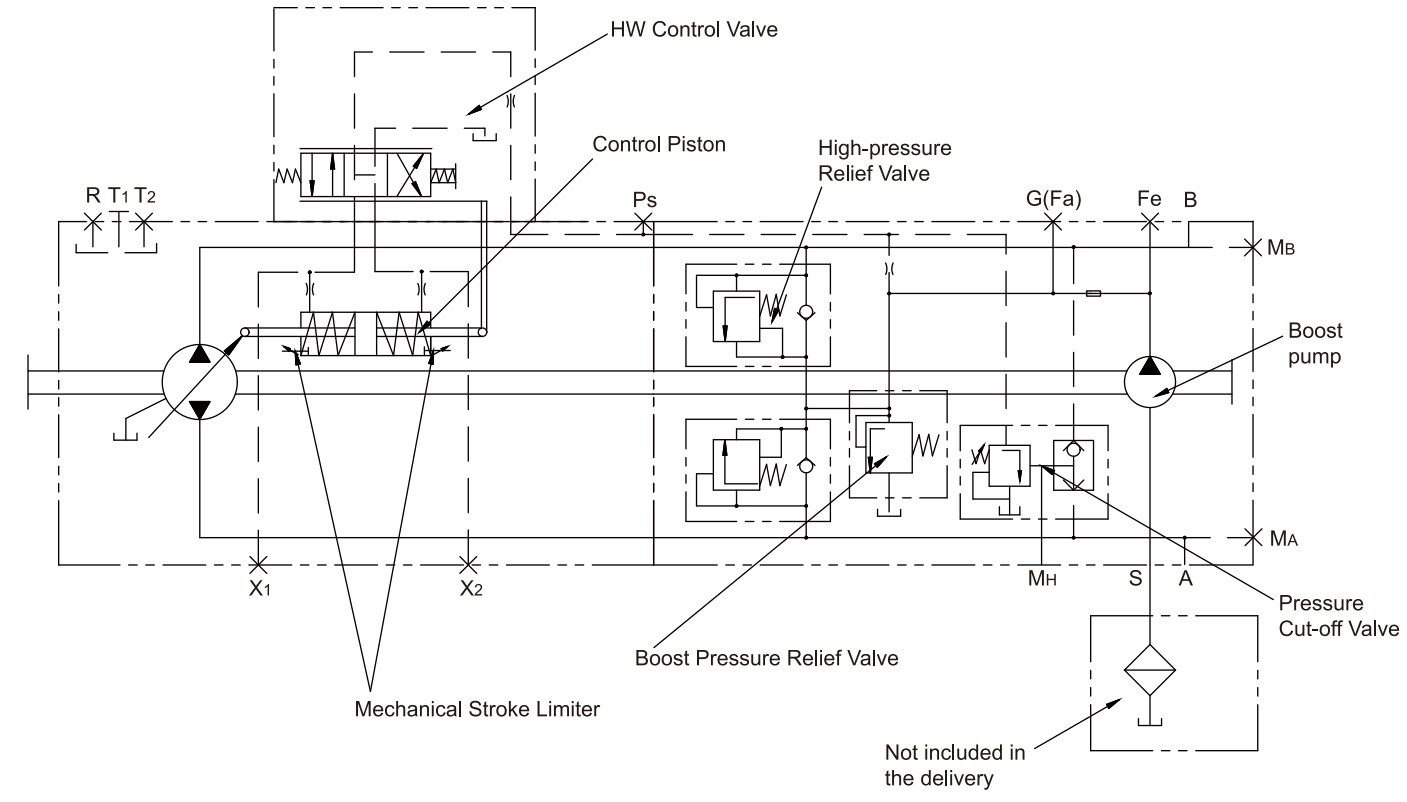
● Available ○ On request — Not available ▭ Recommended model

## Structure




## Circuit diagram



## Hydraulic Fluids

Mineral oil

## Working Viscosity

In order for the optimum efficiency and service life, it is recommended to select the working viscosity at working temperature within the range below:

$V_{opt}$= optimal working viscosity 16...36 $mm^2/s$

It is subject to the temperature of a closed circuit.

## Limit Viscosity

Limit viscosity:

$V_{min}$=5$mm^2/s$

Short-term operation(t<3min)

Permissible maximum temperature $t_{max}$=+115℃

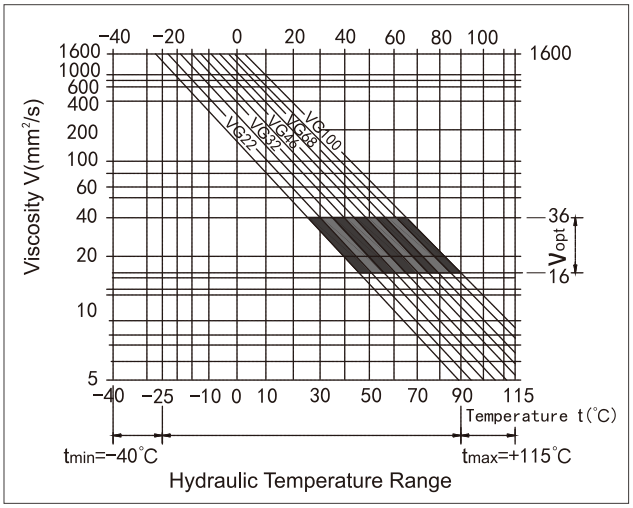
$V_{max}$=1600$mm^2/s$

Short-term operation(t<3min)

Cold start(p≤3Mpa, n≤1000rpm, $t_{min}$=-40℃)

Only for no-load start, it must reach the optimum working temperature in 15 min.

## Selection Diagram




## Instructions on Selection of Hydraulic Fluid

The working temperature dependent on the ambient temperature is required for correct selection of hydraulic fluid. It refers to the circuit temperature of a closed circuit and the reservoir temperature of an open circuit.

The hydraulic fluid should be so selected that the working viscosity in the working range is within the optimum range ($V_{opt}$ ,the shaded area on the selection diagram). The higher viscosity is recommended under the same conditions.

For example:

At an ambient temperature of X ℃, the working temperature of the circuit is 60 ℃. The viscosity within the optimum range ( $V_{opt}$ ,shaded area) is VG46 or VG68 and the latter should be selected.

Note:

The case drain temperature depends on the pressure and speed, and it is always higher than the circuit temperature. The temperature at any point within the system should not exceed +115 ℃. Please contact us if the above condition cannot be maintained due to extreme working conditions.

## Filtration

Finer filtration improves the cleanliness level of the hydraulic fluid, thus increasing the service life of the axial piston unit. To ensure normal operation of the axial piston unit, a cleanliness level of at least 20/18/15 according to ISO 4406 is to be maintained.

Based on the system and application, we recommend for HP4VC:

filter element $\beta_{20} \geq 100$

β should not decrease as differential pressure of the filter element increases.

When the hydraulic fluid has a high temperature (+90 ℃ to +115 ℃), the cleanliness level should at least reach 19/17/14 according to ISO 4406.

Please contact us if the above cleanliness level cannot be maintained.

## Working Pressure Range

Input

Variable pump (with external fluid supply,E):

For EP, HW and HD controllers

Boost pressure(n=2000rpm)$P_{sp}$ =1.8MPa

For DG controller

Boost pressure(n=2000rpm)$P_{sp}$ =2.5MPa

Boost pump

Suction pressure $P_{s\,min}$($V \leq 30mm^2/s$) ≥0.08MPa

At short-term cold start(t<3min) ≥0.05MPa

Output

Variable pump:

Pressure at port A or B

Rated pressure $P_{NX}$ 35MPa

Max. pressure $P_{max}$ 40MPa

Total pressure(A+B)$P_{max}$ 60MPa

Boost pump

Max. pressure $P_{sp\,max}$ 4MPa

## Oil Seal

Permissible pressure load

The service life of the shaft seal depends on the pump speed and case drain pressure. It is recommended that the average lasting case drain pressure at working temperature is no greater than 0.3MPa absolute pressure (as the speed falls, the maximum permissible case drain pressure is 0.6MPa) and the short-term (t < 0.1s) permissible absolute pressure peak may reach 1MPa.

The service life of the shaft seal decreases with increasing frequency of pressure peaks.

The case pressure must be equal to or greater than the external pressure at the shaft seal.

Temperature range

The FKM shaft seal may be used for case temperatures from -25 ℃ to +115 ℃.

The NBR shaft seal may be used for case temperatures from -40 ℃ to +90 ℃.

## Technical Data

| Size | | | Unit | 28 | 45 | 53 |
|---|---|---|---|---|---|---|
| Displacement | Variable pump | $V_{g\ max}$ | mL/r | 29 | 45 | 52 |
| | Boost pump(△p=2MPa)[1] | $V_{g\ SP}$ | mL/r | 5. 8 | 8. 6 | 8. 6 |
| | Large displacement Boost pump(△p=2MPa) | $V_{g\ SP}$ | mL/r | 13. 8 | 13. 8 | 13. 8 |
| Speed | Maximum speed at $V_{g\ max}$ | $n_{max\ cont}$ | rpm | 3900 | 3300 | 3300 |
| | Limit maximum[2] | $n_{min\ limit}$ | rpm | 4200 | 3550 | 3550 |
| | Intermittent maximum[3] | $n_{max\ interm}$ | rpm | 4500 | 3800 | 3800 |
| | Minimum | $n_{min}$ | rpm | 500 | 500 | 500 |
| Flow | At $n_{max\ cont}$ and $V_{g\ max}$ | $q_{v\ max}$ | L/min | 113 | 149 | 172 |
| Power[4] | At $n_{max\ cont}$ and $V_{g\ max}$, △p=30MPa | $P_{max}$ | KW | 57 | 75 | 86 |
| Torque[5] | At $V_{g\ max}$, △p=30MPa | $T_{max}$ | Nm | 139 | 215 | 248 |
| | At $V_{g\ max}$, △p=10MPa | T | Nm | 46 | 72 | 83 |
| Moment of inertia of drive shaft | | J | $Kgm^2$ | 0. 0017 | 0. 0033 | 0. 0042 |
| Max. angular acceleration[4] | | | $rad/s^2$ | 5500 | 4000 | 3500 |
| Case volume | | V | L | 0. 64 | 0. 75 | 0. 75 |
| Weight (without through drive) | | m | KG | 25 | 27 | 29 |

1) Factory default
2) Power at half corner power (e.g. at $V_{g\ max}$ and $P_n/2$)
3) At high-speed no-load operation; at overspeed, Δp =7-15MPa and $V_{g\ max}$; at reverse peak load, Δp<30MPa, t<0.1s
4) Without boost pump
5) Only valid for a single pump

## Specification Calculation

Flow $q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$ [L/min]

Torque $T = \frac{V_g \cdot \Delta p}{2 \cdot \pi \cdot \eta_{mh}}$ [Nm]

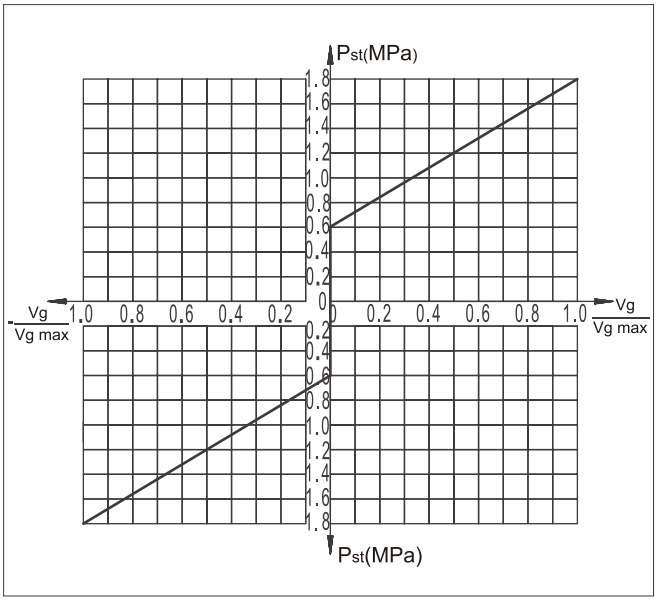
Power $P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{60 \cdot \eta_t}$ [KW]

$V_g$ = Displacement,mL/r
$\Delta p$ = Differential pressure,MPa
$n$ = Speed,rpm
$\eta_v$ = Volumetric efficiency
$\eta_{mh}$ = Mechanical-hydraulic efficiency
$\eta_t$ = Total efficiency

## HD - Pilot Pressure Control

Dependent on the difference between the pilot pressure $P_{st}$ (at ports $Y_1$ and $Y_2$) of two control lines, the variable cylinder of the pump obtains control pressure via the HD controller so that the swashplate moves to infinitely adjust the displacement. Each control line corresponds to one flow direction.

HD1：without inlet filter
HD3：with inlet filter (standard)




$V_g$ Displacement at $P_{St-}$=0.6MPa

$V_{g\,max}$ Displacement at $P_{St}$=1.67MPa

Pilot pressure at port $Y_1$ and $Y_2$ $P_{St-}$=0.6-1.67MPa

Start of control 0.6MPa

End of control 1.67MPa（maximum displacement $V_{g\,max}$）

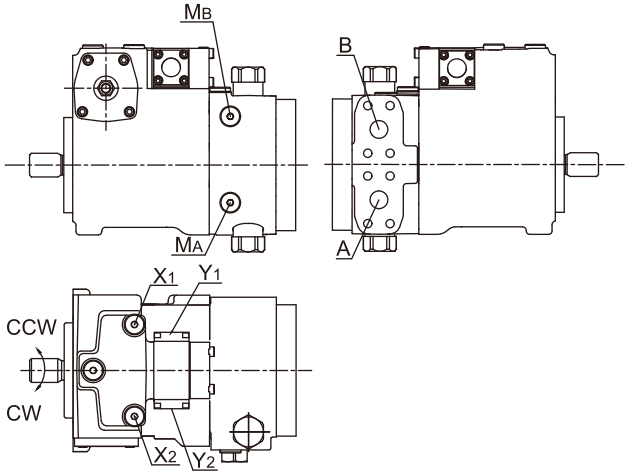
Note:
The HD controller must be unloaded to the neutral position with the external pilot control device on the reservoir.

| Thread, control port | |
|---|---|
| 14x1.5-6H | ED seal |
| 9/16-18UNF-2B | ED seal |
| 9/16-18UNF-2B | Corner seal |

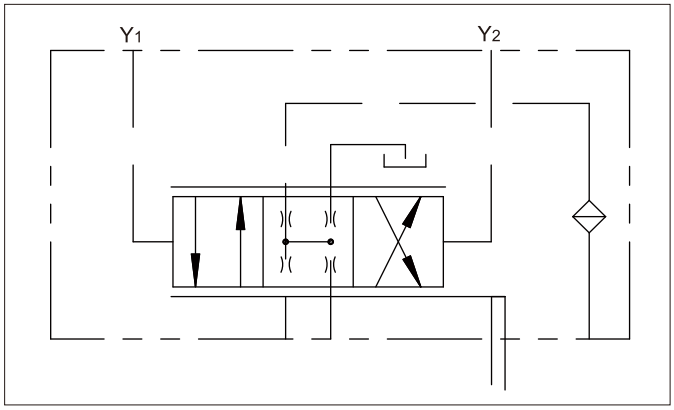
The spring at the center of the pilot control device is not a safety device.
The spool may get stuck at any position due to contamination of the control device, such as hydraulic fluid pollutant, wear debris and foreign matters in the system, etc.
In this case, the pump flow no longer observes the operator's instructions.
- Make sure the driven device can promptly reach a safety state (e.g. stop) with the emergency stop module.
- Always observe the cleanliness level according to ISO 4406: 20/18/15 (< 90 ˚C) or 19/17/14 (> 90 ˚C)

### Correlation of Direction of rotation, Control and Flow direction

| Direction of rotation (viewed on drive shaft) | | | | |
|---|---|---|---|---|
| | Pilot Pressure | Control Pressure | Flow Direction | Working Pressure |
| CW | $Y_1$ | $X_1$ | A to B | $M_B$ |
| | $Y_2$ | $X_2$ | B to A | $M_A$ |
| CCW | $Y_1$ | $X_1$ | B to A | $M_A$ |
| | $Y_2$ | $X_2$ | A to B | $M_B$ |

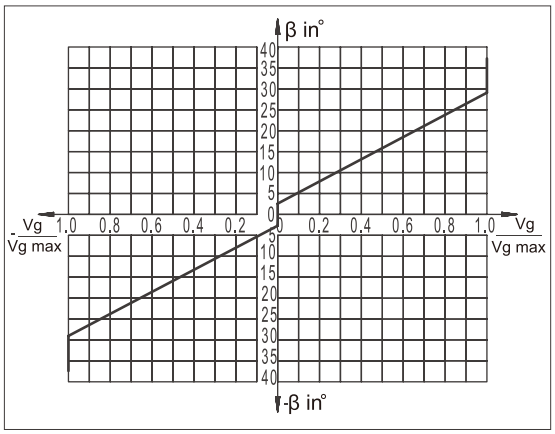



### Circuit diagram,HD3



## HW - Mechanical Servo Control

Dependent on the moving direction a or b of the control lever, the variable cylinder of the pump obtains control pressure via the HW controller so that the swashplate moves to infinitely adjust the displacement. Each moving direction of the control lever corresponds to one flow direction.



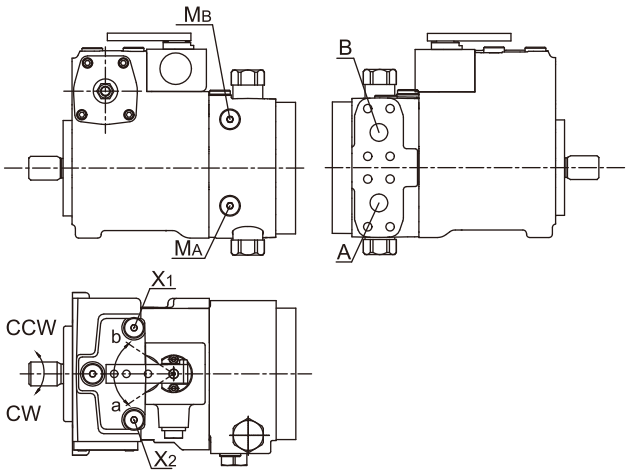

Swivel angle β of control lever：
Start of control β=3°
End of control β=29°(maximum displacement $V_{g\,max}$)
Mechanical limit：±40°

The maximum required torque at the control lever is 170 Ncm.
The rotation of HW control lever must be limited with an external position sensor (set point device).

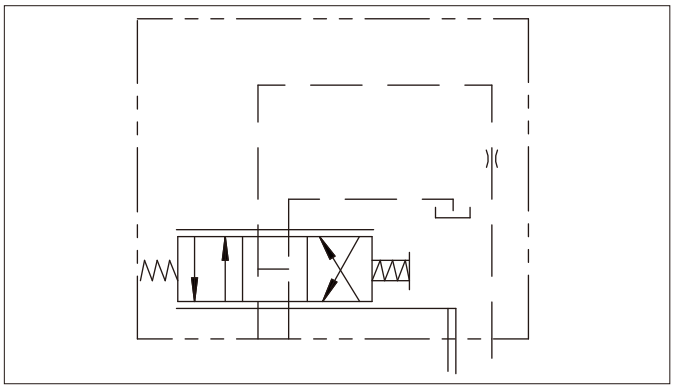
Note:
When there is no torque on the HW control lever, spring centering enables the pump to move automatically to the neutral position ($V_g$ = 0) (independent of swivel angle).

### Correlation of Direction of rotation, Control and Flow direction

| Direction of rotation (viewed on drive shaft) | | | | |
|---|---|---|---|---|
| | Pilot Pressure | Control Pressure | Flow Direction | Working Pressure |
| CW | a | $X_2$ | B to A | $M_A$ |
| | b | $X_1$ | A to B | $M_B$ |
| CCW | a | $X_2$ | A to B | $M_B$ |
| | b | $X_1$ | B to A | $M_A$ |




### Circuit diagram,HW



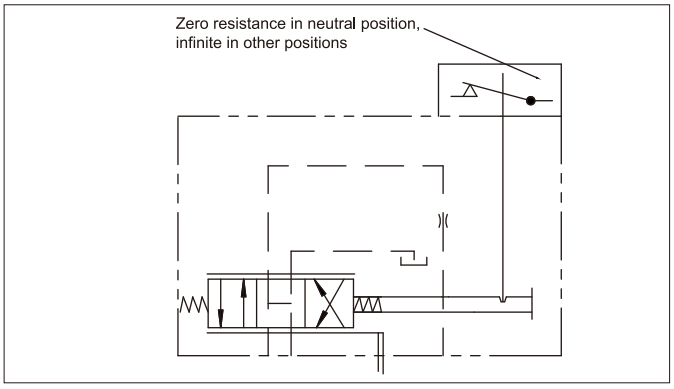
## HW - Mechanical Servo Control

### Variant I:With Neutral Position Switch, HWL

The neutral position switch is closed when the control lever on the HW control valve is in its neutral position. The switch opens when the control lever is moved out of the neutral position in either direction. The neutral position switch protects the systems that required zero flow under certain working conditions, such as starting the engine.

| Technical data, neutral position switch | |
|---|---|
| Switching capacity | 5A/12V&3A/24V |
| Type of connector | AMP DJ7021-1.8-20 |

Circuit diagram,HWL

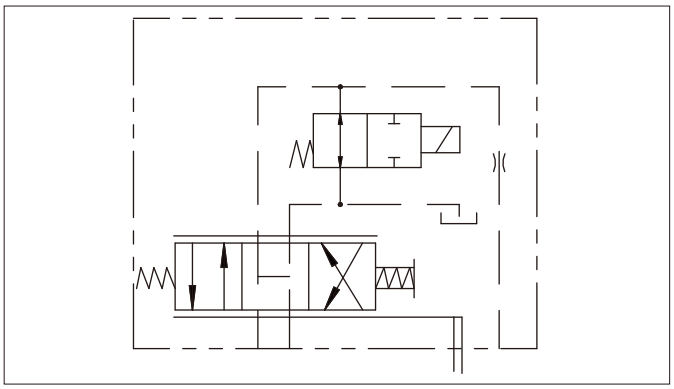



### Variant II:ith Brake Valve Switch,HWO/HWC

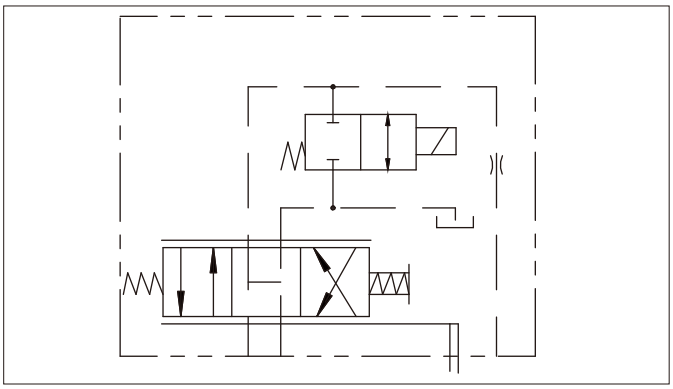
HWO：
with normally open brake valve; brake valve actuated when de-energized
HWC：
with normally closed brake valve; brake valve actuated when energized

| Technical data, solenoid | HWO(C)1 | HWO(C)2 |
|---|---|---|
| Voltage | 12V DC±1.8V | 24V DC±3.6V |
| Nominal resistance(20°C) | 9Ω | 36Ω |
| Rated power | 18W | 18W |
| Minimum required current | 1.5A | 0.75 |
| Type of connector | DEUTSCH DT04-2P | |
| Duty cycle | 100% | |
| Type of protection | IP67 | |

Circuit diagram,HWO
With NO Brake Valve

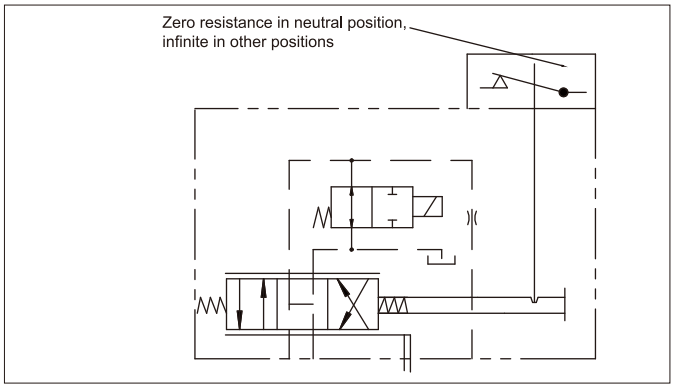


Circuit diagram,HWC
With NC Brake Valve

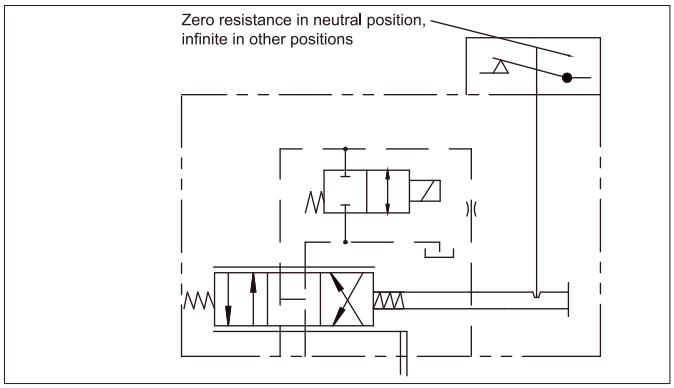


### Variant III:With Brake Valve & Neutral Position Switch, HWOL/HWCL

Circuit diagram,HWOL
With NO Brake Valve & Neutral Position Switch




Circuit diagram,HWCL
With NO Brake Valve & Neutral Position Switch

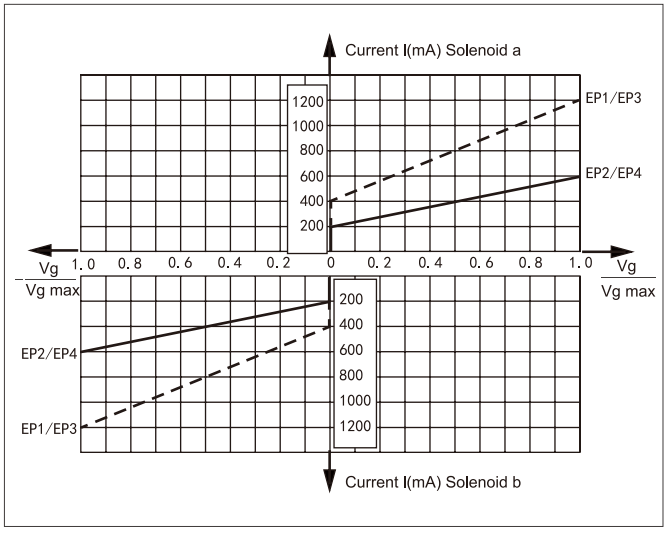


## EP - Electric Control with Proportional Solenoid

Dependent on the preset current I of the two proportional solenoids (a and b), the variable cylinder of the pump obtains control pressure via the EP controller so that the swashplate moves to infinitely adjust the displacement. Each proportional solenoid corresponds to one flow direction.

| Technical data, solenoid | EP1/EP3 | EP2/EP4 |
|---|---|---|
| Voltage | 12V DC±20% | 24V DC±20% |
| Start of control $V_{g0}$ | 400mA | 200mA |
| End of control $V_{g\,max}$ | 1200mA | 600mA |
| Current limit | 1.54A | 0.77A |
| Nominal resistance (20℃) | 5.5Ω | 22.7Ω |
| Dither frequency | 100Hz | |
| Type of connector | DEUTSCH DT04-2P | |
| Duty cycle | 100% | |
| Type of protection | IP67 | |

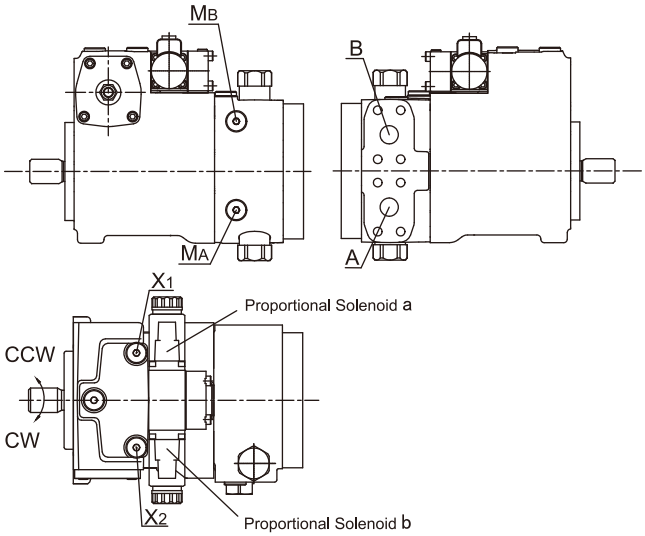
EP1\EP2：without inlet filter (Not for new projects!)
EP3\EP4：with inlet filter (standard)



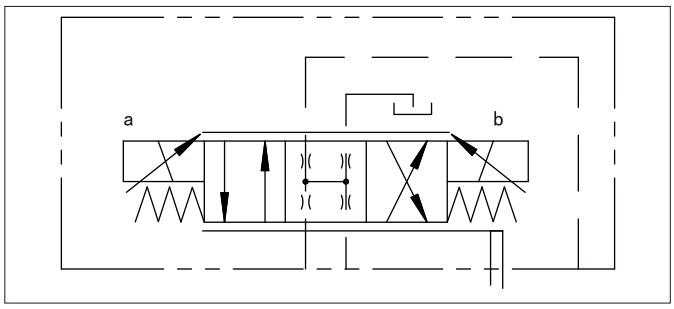

Note:
The spring at the center of the pilot control device is not a safety device. The spool may get stuck at any position due to contamination of the control device, such as hydraulic fluid pollutant, wear debris and foreign matters in the system, etc.
In this case, the pump flow no longer observes the operator's instructions.
- Make sure the driven device can promptly reach a safety state (e.g. stop) with the emergency stop module.
- Always observe the cleanliness level according to ISO 4406: 20/18/15 (< 90 ℃) or 19/17/14 (> 90 ℃)

### Correlation of Direction of rotation, Control and Flow direction

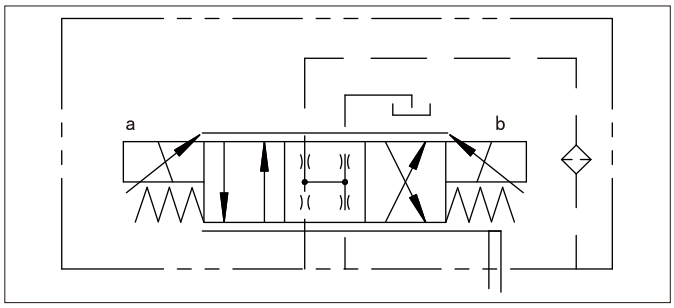
| Direction of rotation (viewed on drive shaft) | | | | |
|---|---|---|---|---|
| | Proportional Solenoid | Control Pressure | Flow Direction | Working Pressure |
| CW | a | $X_1$ | A to B | $M_B$ |
| | b | $X_2$ | B to A | $M_A$ |
| CCW | a | $X_1$ | B to A | $M_A$ |
| | b | $X_2$ | A to B | $M_B$ |




### Circuit diagram,EP1/2




### Circuit diagram,EP3/4



## EZ - Electric Control with Switching Solenoid

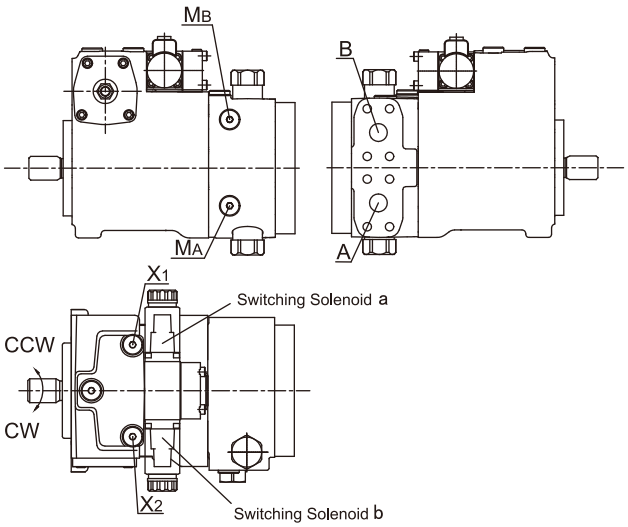
By switching on or off the switching solenoid a or b, the control cylinder of the pump obtains control pressure via the EZ controller so that the swashplate realizes adjustment between $V_g$=0 and $V_{g\ max}$.
Each solenoid corresponds to one flow direction.

| Technical data, solenoid | EZ1/3 | EZ2/4 |
|---|---|---|
| Voltage | 12V DC(±20%) | 24V DC(±20%) |
| Neutral position $V_g$=0 | De-energized | De-energized |
| Position $V_{g\ max}$ | Energized | Energized |
| Nominal resistance(20°C) | 5.5Ω | 21.7Ω |
| Rated power | 26.2W | 26.5W |
| Minimum required current | 1.32A | 0.67A |
| Type of connector | DEUTSCH DT04-2P | |
| Duty cycle | 100% | |
| Type of protection | IP67 | |

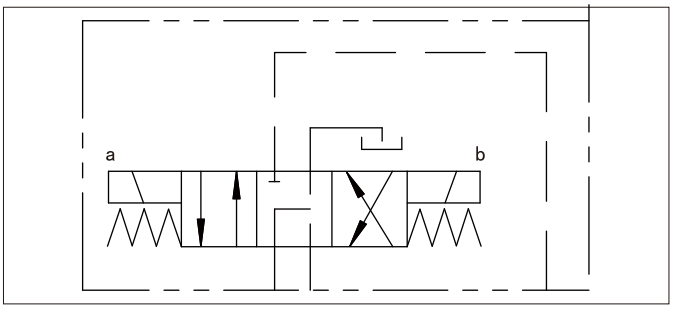
Standard: switching solenoid without manual emergency control.
The manual emergency control realized by returning spring may be provided as required.

Correlation of Direction of rotation, Control and Flow direction

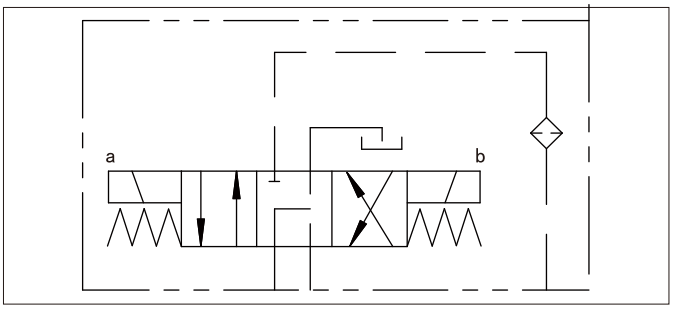
| Direction of rotation (viewed on drive shaft) | | | | |
|---|---|---|---|---|
| | Proportional Solenoid | Control Pressure | Flow Direction | Working Pressure |
| CW | a | $X_2$ | B to A | $M_A$ |
| | b | $X_1$ | A to B | $M_B$ |
| CCW | a | $X_2$ | A to B | $M_B$ |
| | b | $X_1$ | B to A | $M_A$ |




Circuit diagram,EZ1/2




Circuit diagram,EZ3/4



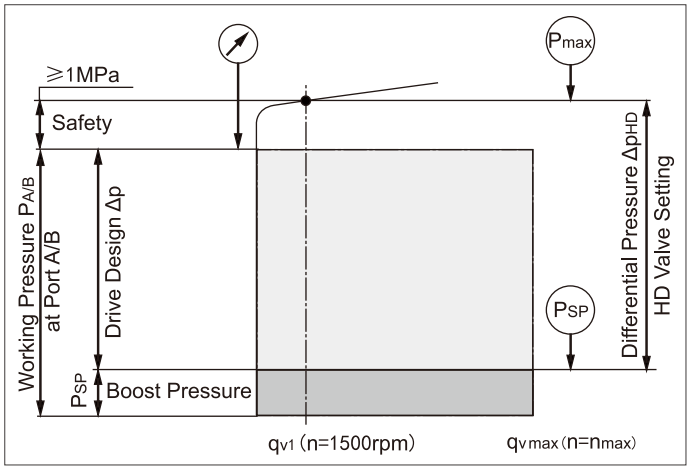
## High-pressure Relief Valve

### Setting range

| High-pressure relief valve, direct operated (size 28/45/53) | Differential pressure setting $\Delta p_{HP}$ |
|---|---|
| Setting range valve 2<br>$\Delta p$=35−45MPa | 36MPa |
| | 38MPa |
| | 40MPa |
| | 42MPa |
| | 44MPa |
| Setting range valve 3<br>$\Delta p$=25−35MPa | 26MPa |
| | 28MPa |
| | 30MPa |
| | 32MPa |
| | 34MPa |
| Setting range valve 4<br>$\Delta p$=10−25MPa | 10MPa |
| | 12MPa |
| | 14MPa |
| | 16MPa |
| | 18MPa |
| | 20MPa |
| | 22MPa |
| | 24MPa |
| Setting range valve 5<br>$\Delta p$=25−35MPa | 26MPa |
| | 28MPa |
| | 30MPa |
| | 32MPa |
| | 34MPa |
| Setting range valve 6<br>$\Delta p$=10−25MPa | 10MPa |
| | 12MPa |
| | 14MPa |
| | 16MPa |
| | 18MPa |
| | 20MPa |
| | 22MPa |
| | 24MPa |
| Setting range valve 7<br>$\Delta p$=35−45MPa | 36MPa |
| | 38MPa |
| | 40MPa |
| | 42MPa |
| | 44MPa |

Standard differential pressure setting.
Values when no special remarks are made when ordering.

### Pressure setting diagram




Note: The high-pressure relief valve is set at n =1500rpm and $V_{g\,max}$ ($q_{v1}$).
Hint: boost pressure 2MPa, working pressure 29MPa
Working pressure $P_{A/B}$ - Pressure $P_{SD}$
= differential pressure $\triangle p_{HP}$ (29-2=27MPa)

### Bypass function

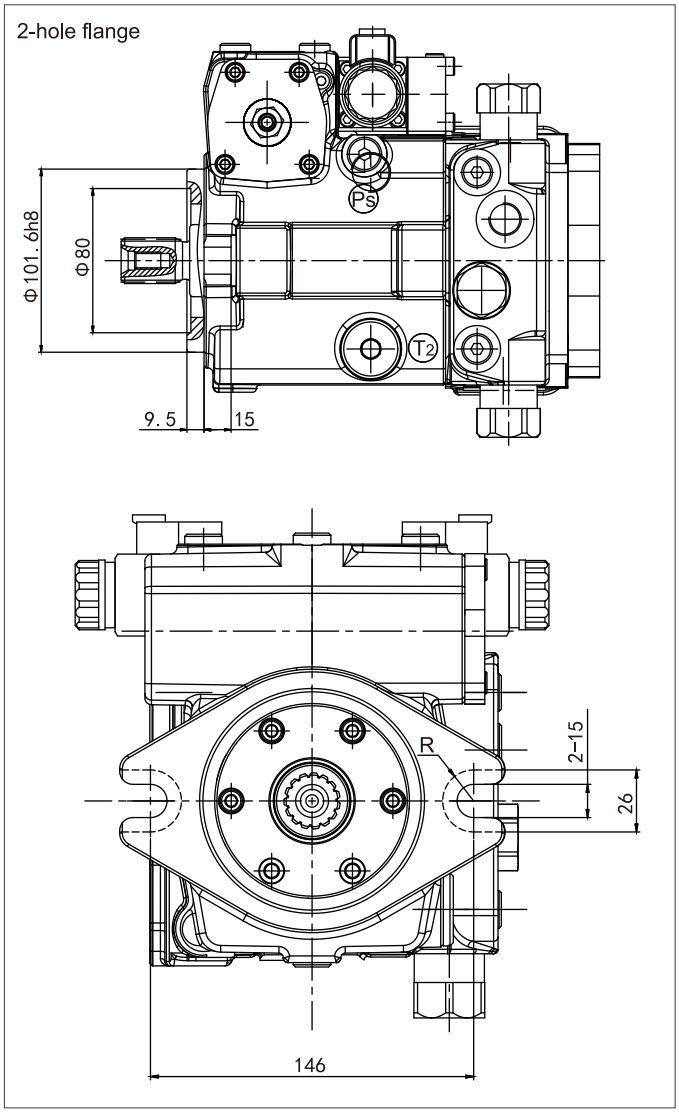
Valves 5/6/7 have the bypass function,The bypass function is only intended for short-term operation at reduced displacement, for example to tow a vehicle out of a danger zone.

## Pressure Cut-off Valve，D

The pressure cut-off is a pressure control which adjusts the displacement of the pump to $V_{g\,min}$ after the set pressure is reached.
The pressure cut-off valve prevents the operation of the high-pressure relief valve during acceleration or deceleration.
The high-pressure relief valve protects against pressures occurring during fast swiveling of the swashplate and maximum pressure in the system.
The setting range of the pressure cut-off valve may be anywhere within the entire working pressure range.
However, the range must be set 3 MPa lower than the setting of the high-pressure relief valve.

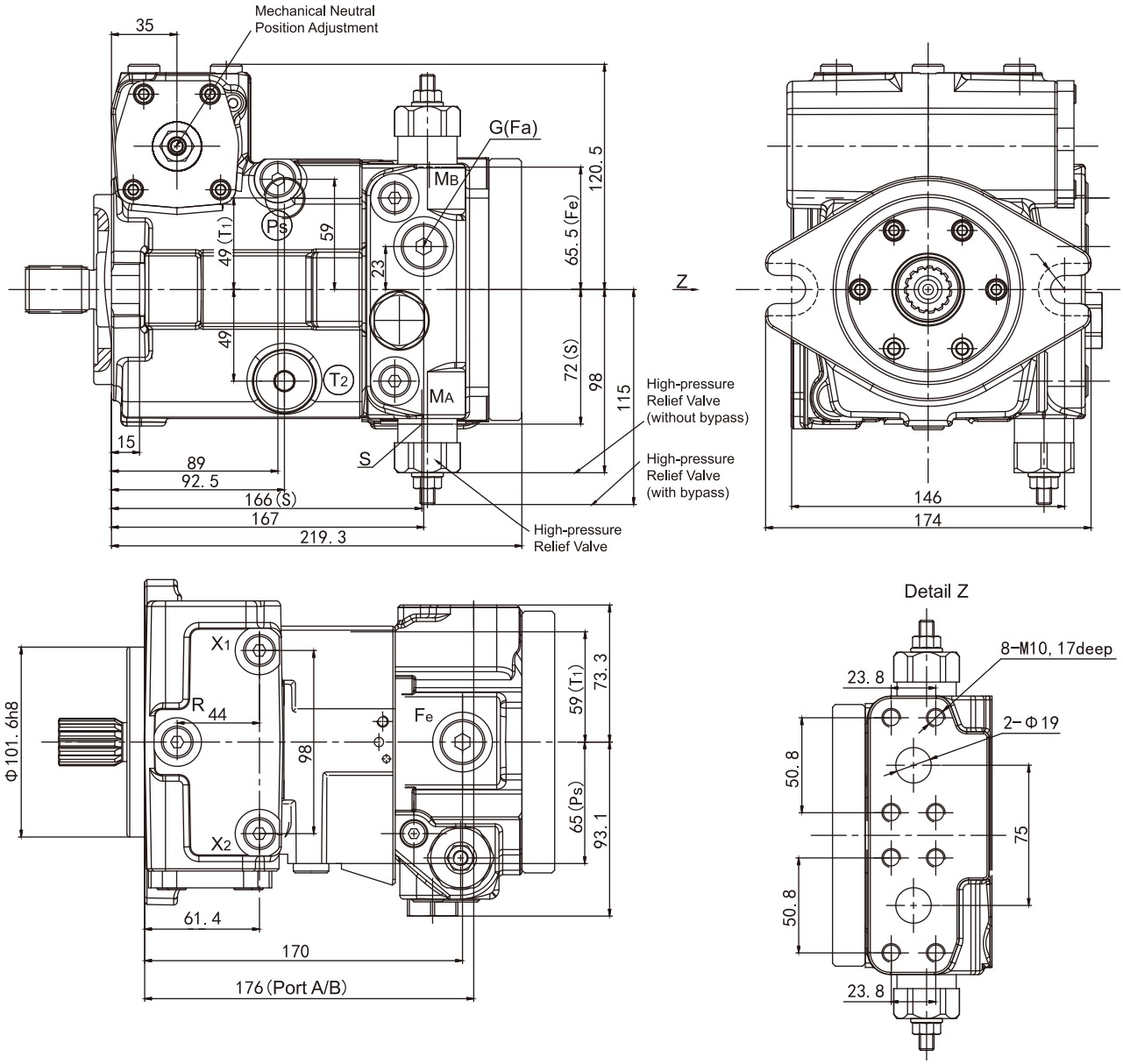
## Mechanical Stroke Limite，M

The mechanical stroke limiter is an auxiliary function for continual reduction of the maximum displacement of the pump, regardless of the control device used.
Two adjusting screws are used to limit the stroke of the stroking cylinder and thus the maximum swivel angle of the pump.



## Installation Dimensions

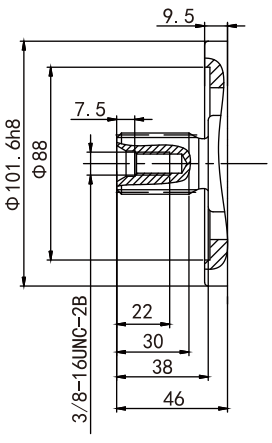
Size 28
Without control valve



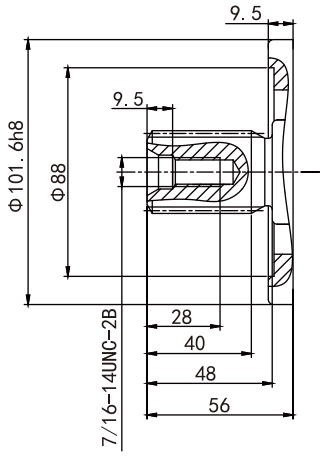

### Ports

| | | |
|---|---|---|
| A/B | Working port (high pressure series) | SAE J518 3/4" |
| | Fastening thread | DIN13 M10x1.5, 18deep |
| $T_1$ | Case drain port or filling port | DIN3852 M22x1.5, 17deep |
| $T_2$ | Case drain port | DIN3852 M22x1.5, 17deep |
| $M_A/M_B$ | Measuring port pressure | DIN3852 M12x1.5, 14deep |
| R | Air bleed port | DIN3852 M12x1.5, 15deep |
| S | Boost suction port | DIN3852 M33x2, 20deep |
| $X_1/X_2$ | Control pressure port | DIN3852 M12x1.5, 15deep |
| G(Fa) | Pressure port, auxiliary circuit | DIN3852 M18x1.5, 14deep |
| $P_S$ | Control pressure inlet port | DIN3852 M14x1.5, 14deep |
| $F_e$ | Filter outlet | DIN3852 M18x1.5, 15deep |

Drive shaft S
SAE J744-25-4(B-B)
Φ1" 15T 16/32DP

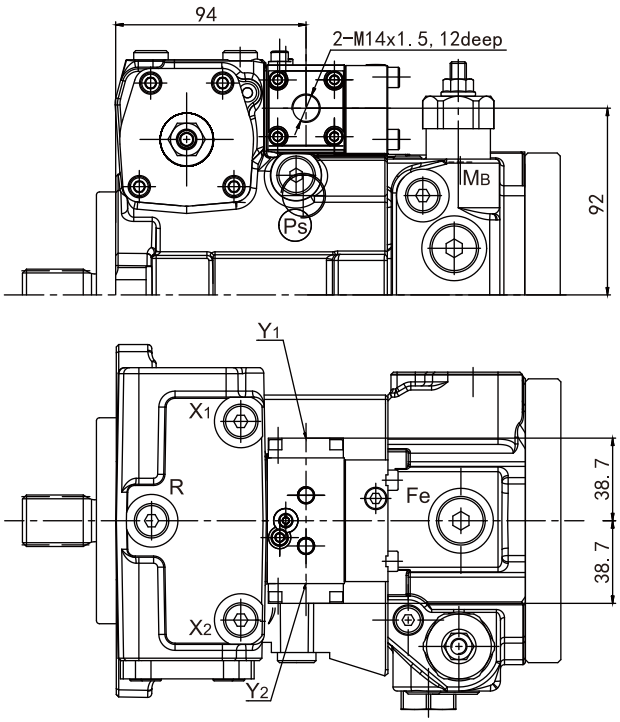



Drive shaft T
SAE J744-32-4(C)
Φ1 1/4" 14T 12/24DP

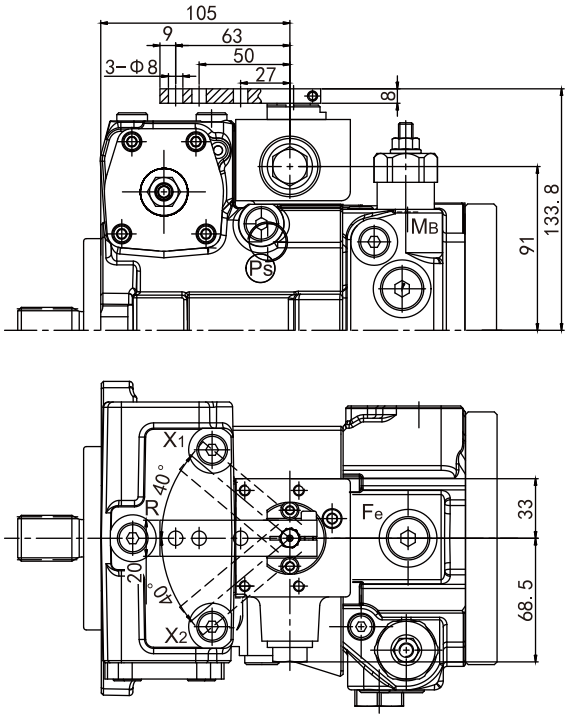


## Installation Dimensions

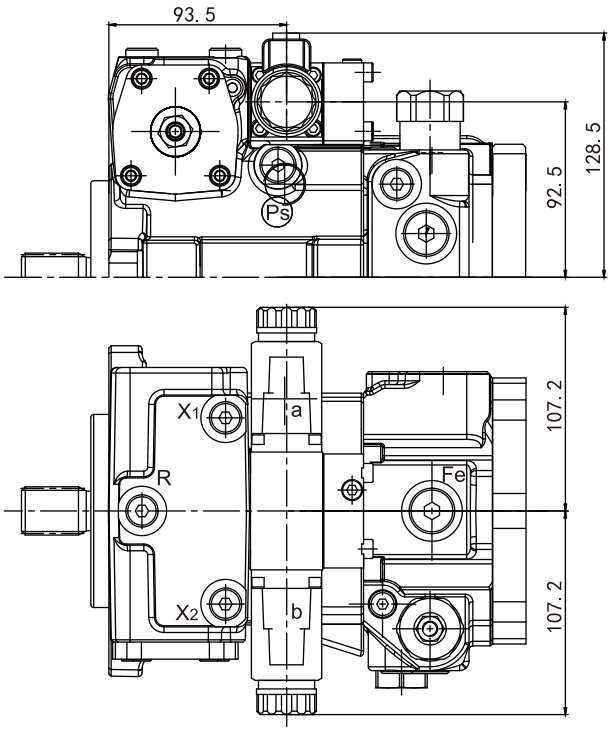
HD hydraulic control, pilot pressure related




HW hydraulic control, mechanical servo

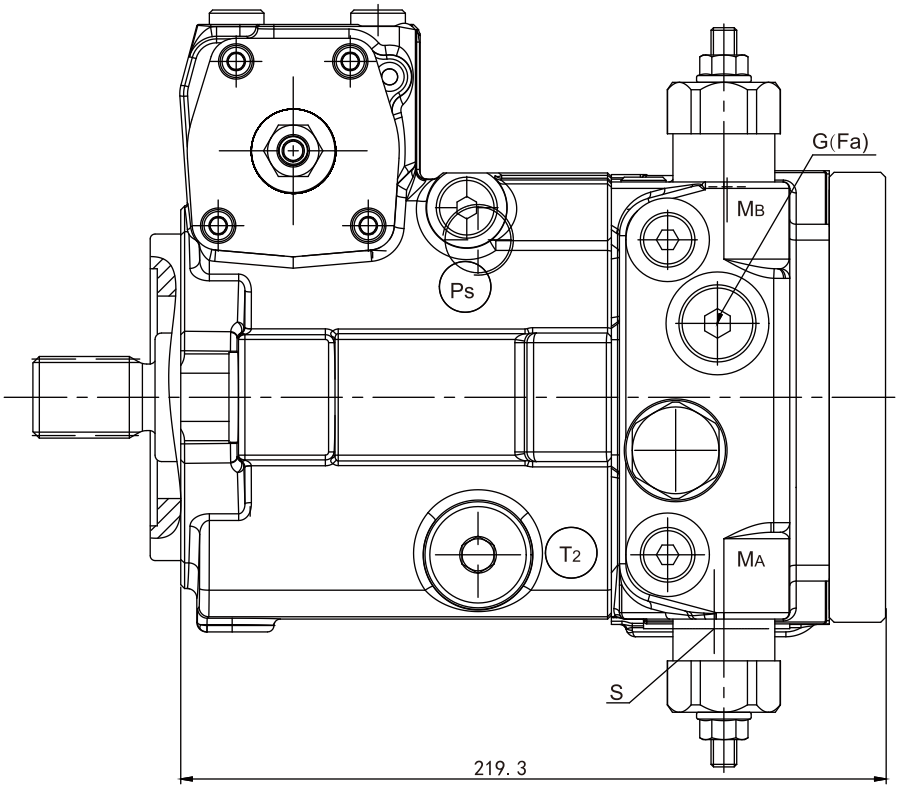



EP electric control, with proportional solenoid

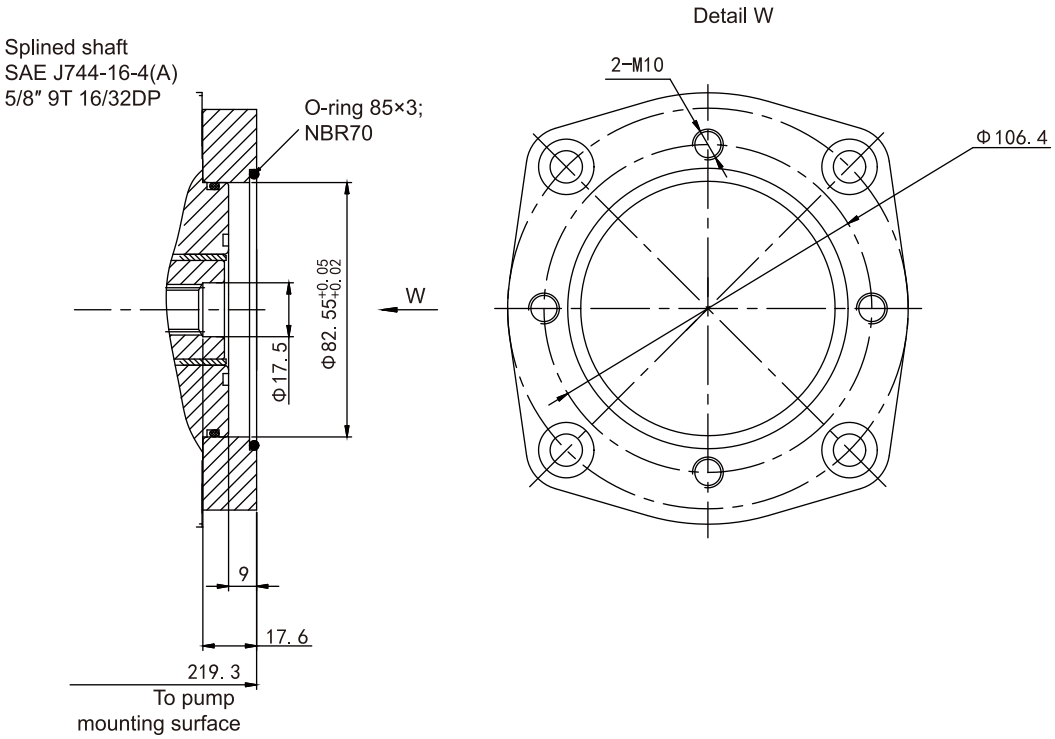


## Installation Dimensions

Without through drive F00/N00

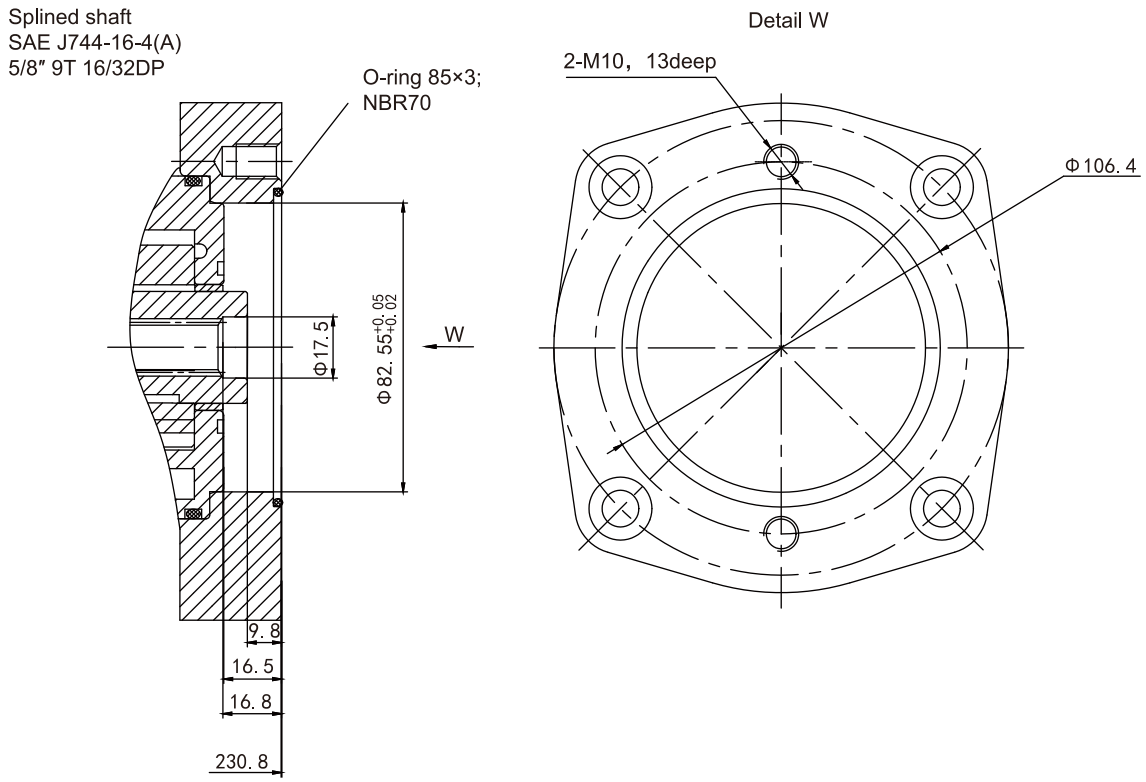



With through drive F01/K01(5.8mL/r boost pump )
Flange SAE J744-82-2(A)

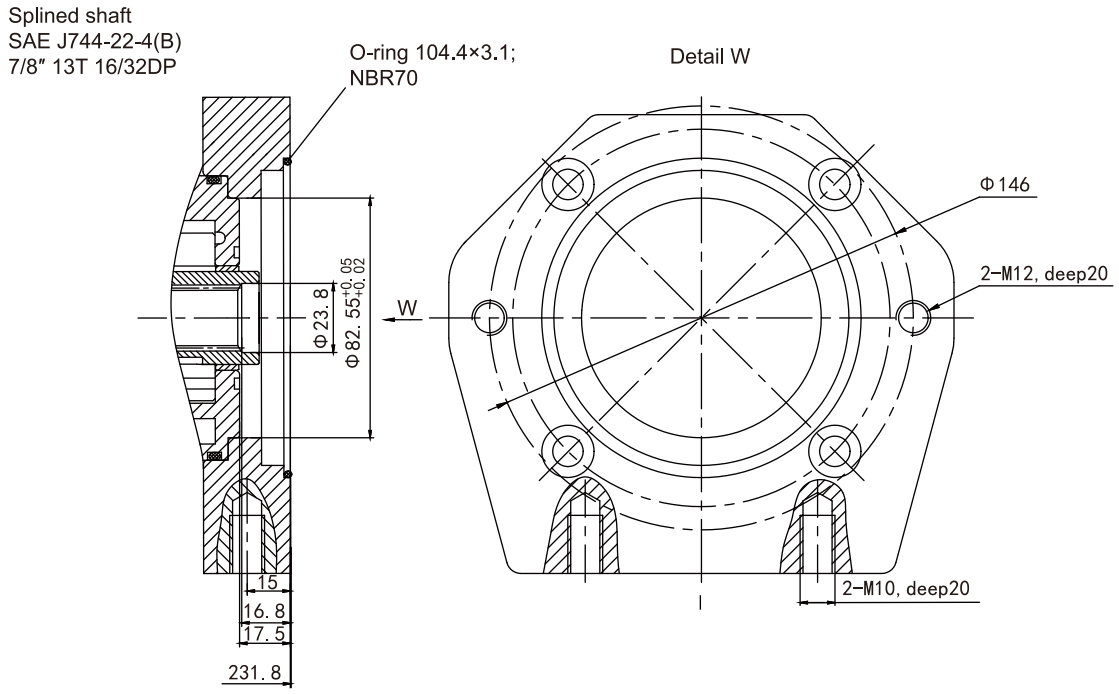


## Installation Dimensions

With through drive F01/K01(13.8mL/r boost pump )
Flange SAE J744-82-2(A)

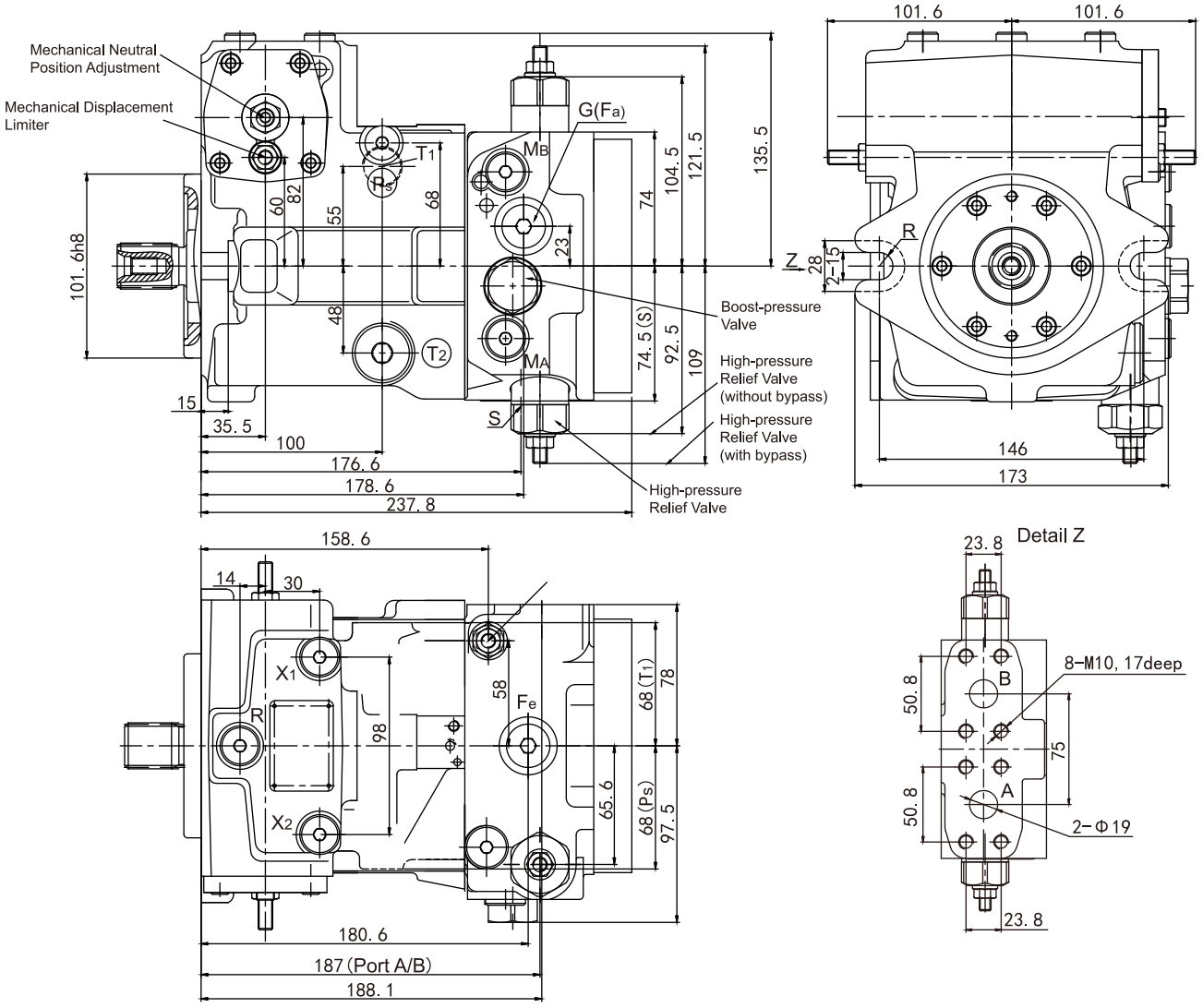



With through drive F02/K02(13.8mL/r boost pump )
Flange SAE J744-101-2(B)



## Installation Dimensions

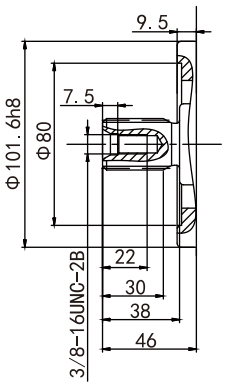
Size 45/53
Without control valve



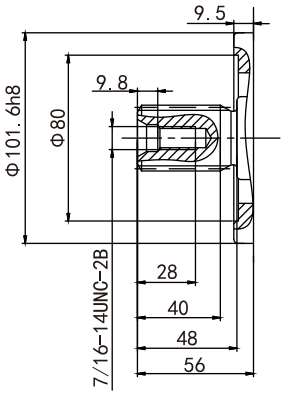

### Ports

| | | |
|---|---|---|
| A/B | Working port (high pressure series) | SAE J518 3/4″ |
| | Fastening thread | DIN13 M10x1. 5, 17deep |
| $T_1$ | Case drain port or filling port | DIN3852 M22x1. 5, 17deep |
| $T_2$ | Case drain port | DIN3852 M22x1. 5, 17deep |
| $M_A/M_B$ | Measuring port pressure | DIN3852 M12x1. 5, 14deep |
| R | Air bleed port | DIN3852 M12x1. 5, 15deep |
| S | Boost suction port | DIN3852 M33x2, 19deep |
| $X_1/X_2$ | Control pressure port | DIN3852 M12x1. 5, 14deep |
| G(Fa) | Pressure port, auxiliary circuit | DIN3852 M18x1. 5, 14deep |
| $P_s$ | Control pressure inlet port | DIN3852 M14x1. 5, 14deep |
| $F_e$ | Filter outlet | DIN3852 M18x1. 5, 14deep |

Drive shaft S
SAE J744-25-4(B-B)
Φ1″ 15T 16/32DP

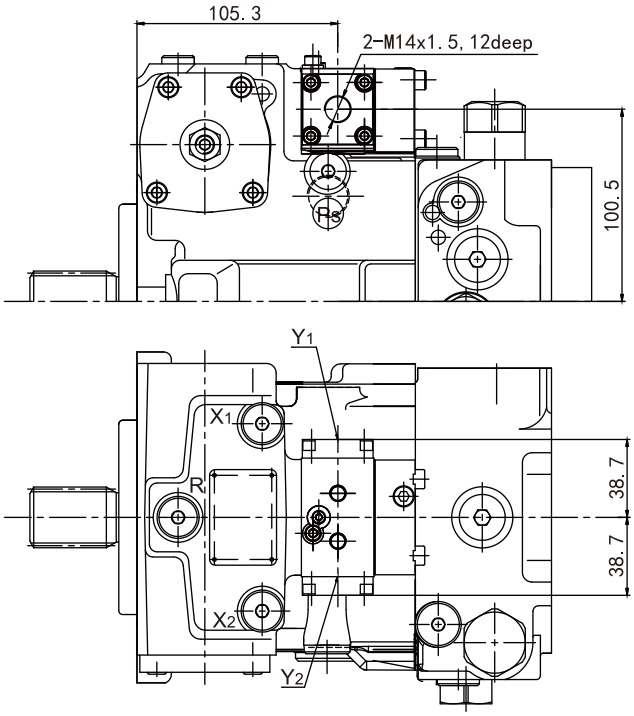



Drive shaft T
SAE J744-32-4(C)
Φ1 1/4″ 14T 12/24DP

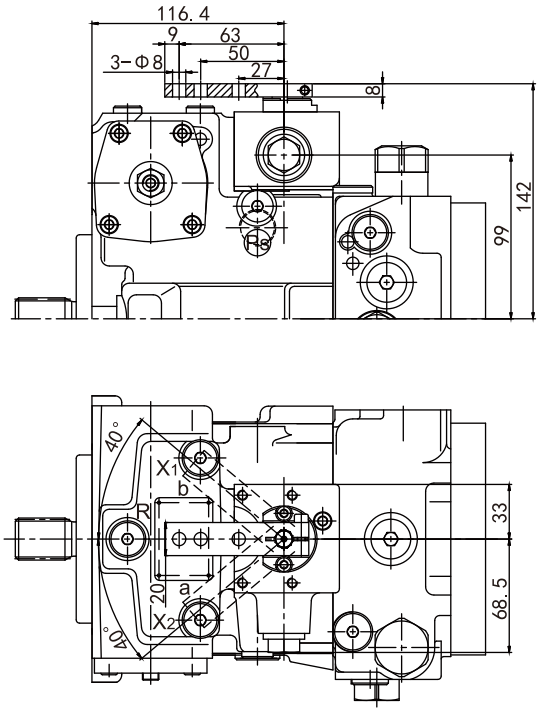


## Installation Dimensions

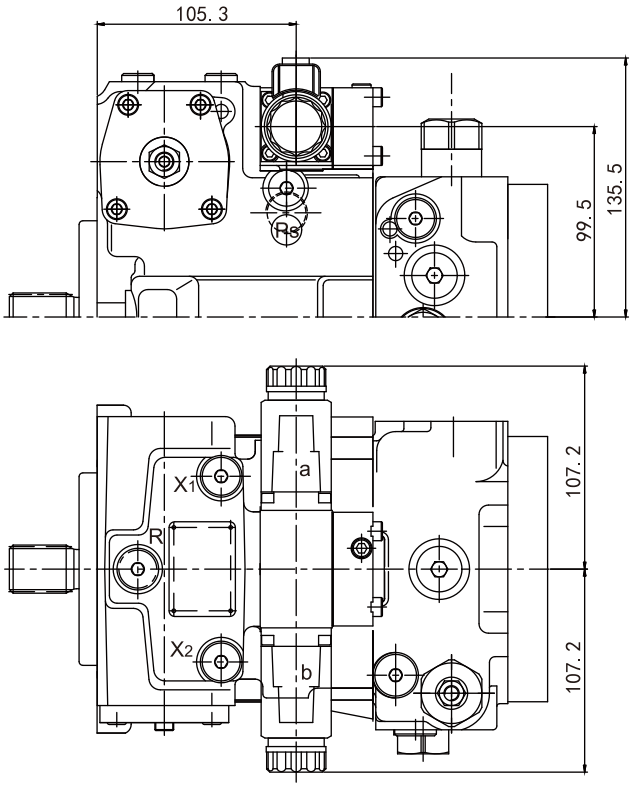
HD hydraulic control, pilot pressure related



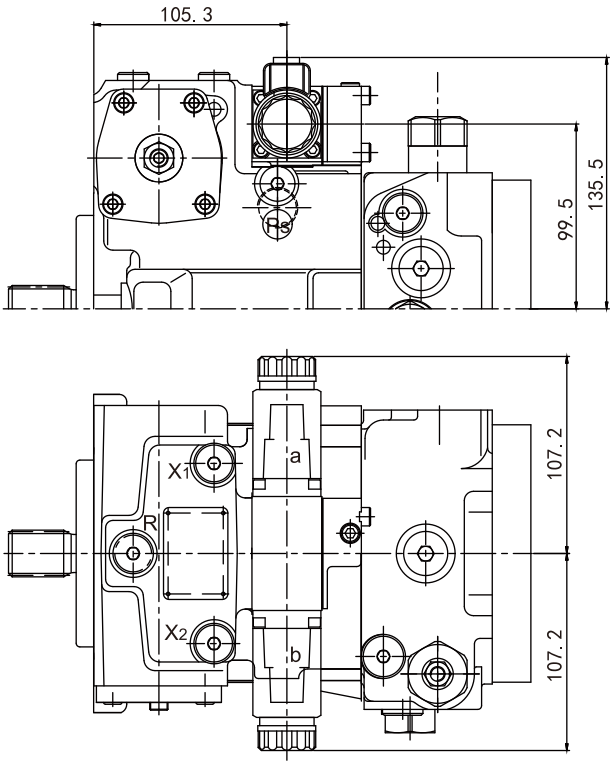

HW hydraulic control, mechanical servo




EP electric control, with proportional solenoid

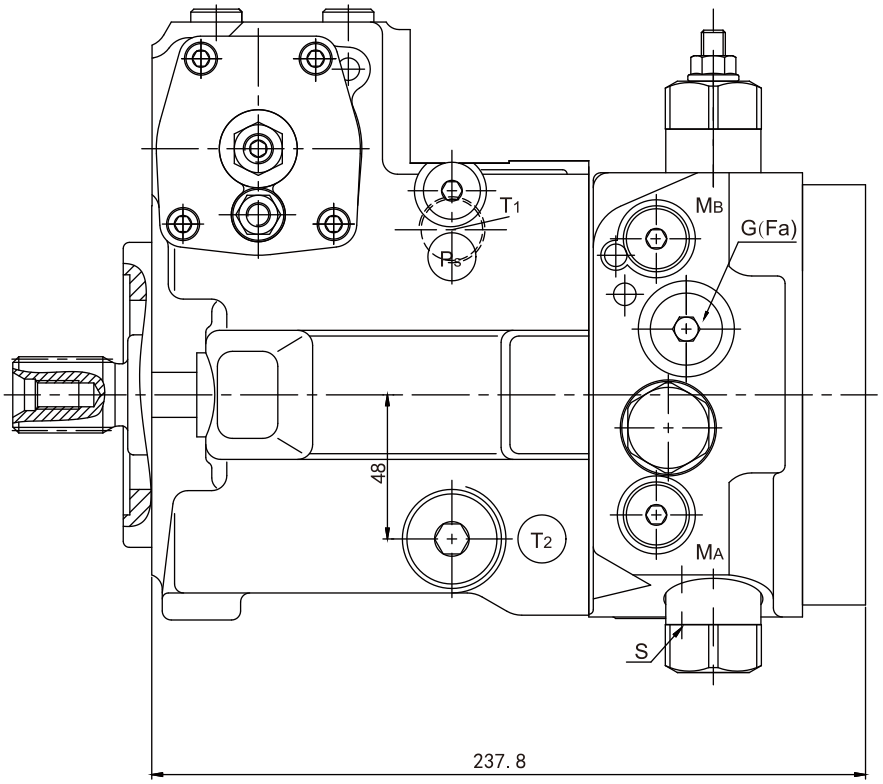



EZ electric control, with switching solenoid

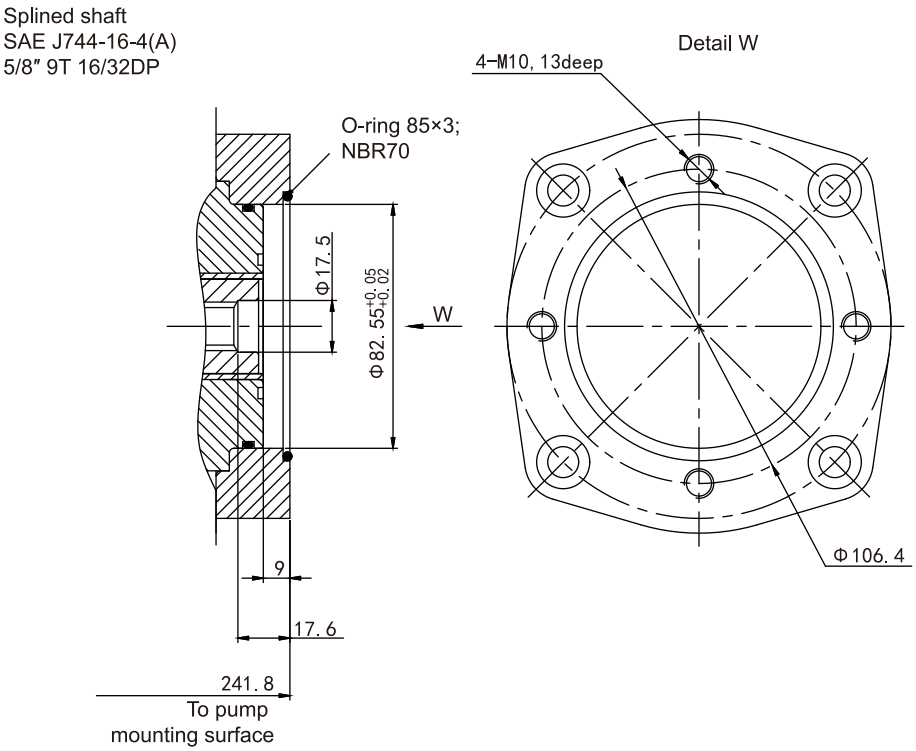


## Installation Dimensions

Without through drive F00/N00



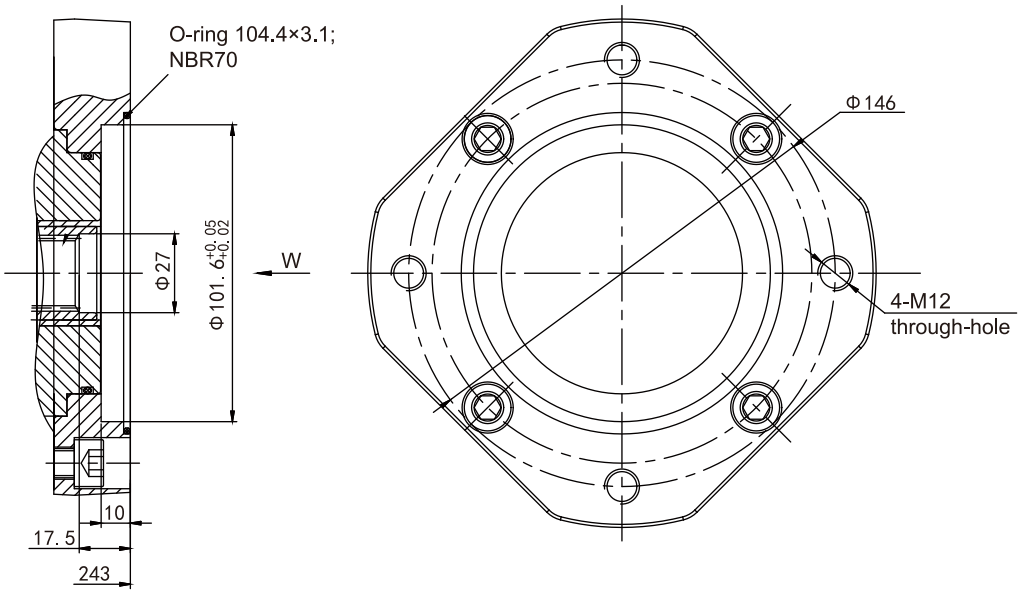

With through drive F01/KO1
Flange SAE J744-82-2(A)



## Installation Dimensions

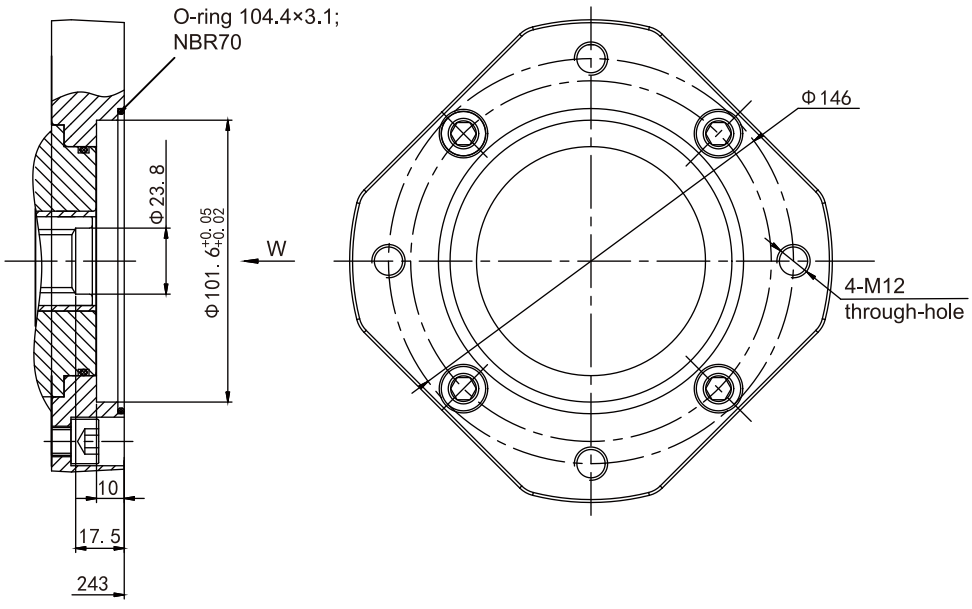
With through drive F04/K04
Flange SAE J744-101-2(B)

Splined shaft
SAE J744-25-4(B-B)
1″ 15T 16/32DP




With through drive F02/K02
Flange SAE J744-101-2(B)

Splined shaft
SAE J744-101-2(B)
7/8″ 13T 16/32DP



## Filtration

Standard: Filtration in Boost Pump Suction Line,S

Standard type (preferred)

Type of filter： filter without bypass

Recommendation： with contamination indicator

Flow resistance at filter element：

V=30mm²/s时，n=nmax _____ Δp≤0.1bar

V=1000mm²/s时，n=nmax _____ Δp≤0.3bar

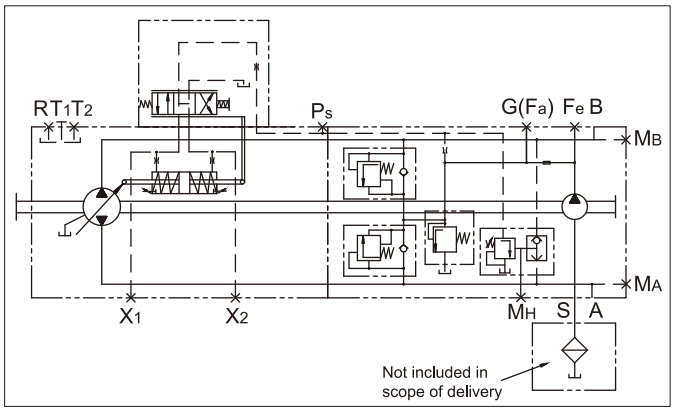
Pressure at suction port S：

V=30mm²/s时，n=nmax _____ Δp≥0.8bar

Cold start (V=1600mm²/s时，n≤1000rpm _____ Δp≥0.5bar

The filter is not included in the scope of delivery.

Circuit diagram-Standard, S



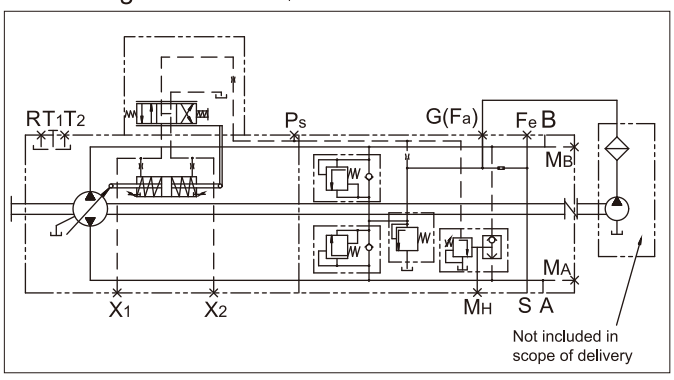

### Variant I:External Fluid Supply,E

This version is used for models without integrated boost pump, N00 or K...

Port S plugged, fluid supply from port Fa or Fa1.

Filter arrangement: separately installed to ensure stable functioning and fluid cleanliness level at port Fa or Fa1 (see “Technical Data - Filter”).

Circuit diagram-Variant I, E




### Variant II:Filtration in Boost Pump Pressure Line, with Ports for External Boost Circuit Filtration, D

Filter inlet: port Fe

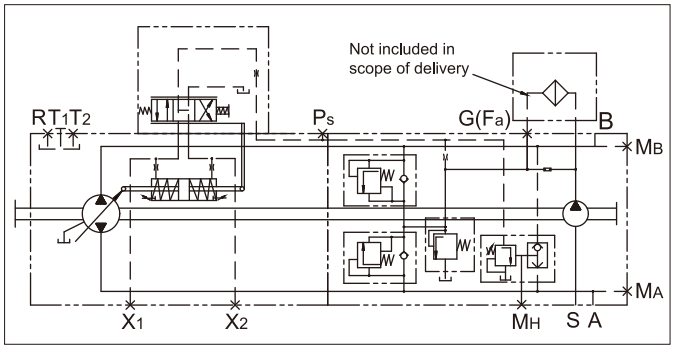
Filter outlet: port Fa

Type of filter：

- Filters with bypass are not recommended
- Filters with contamination indicator are recommended

The filter is not included in our scope of delivery.

Circuit diagram-Variant II,D

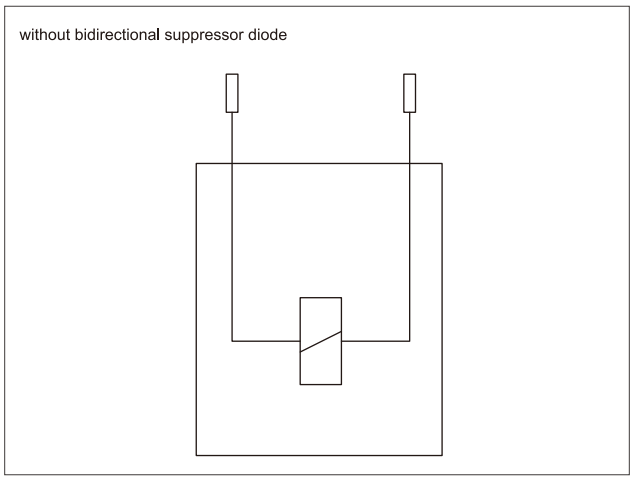


## Connector for Solenoids

DEUTSCH DT04-2P-EP04，2-pin
Molded，without bidirectional suppressor diode_____P

The following type of protection ensues with the installed mating connector:
IP67(DIN EN 60520)
IP69K(DIN 60050-9)

### Switching symbol

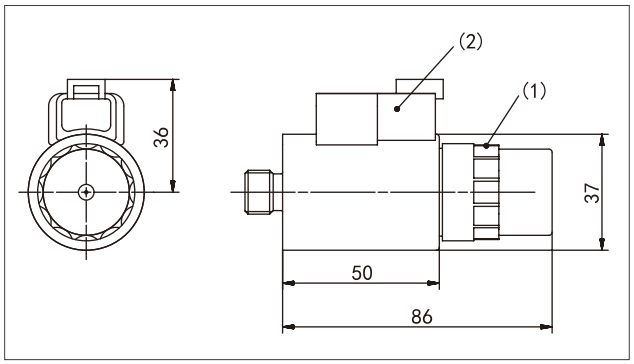



**Mating connector**
DEUTSCH DT06-2S-EP04

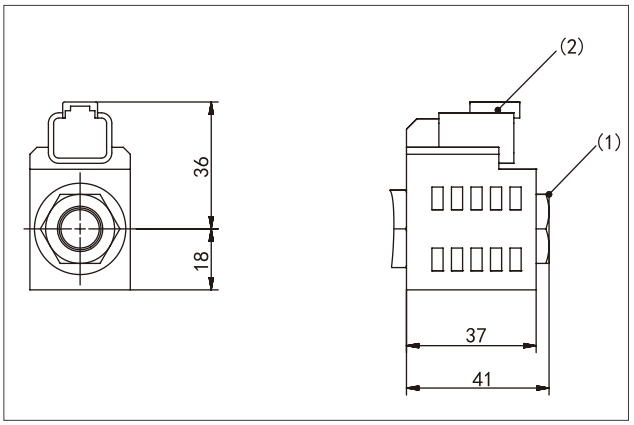
| Consisting of | DT |
|---|---|
| 1 housing | DT06-2S-EP04 |
| 1 wedge | W2S |
| 2 sockets | 0462-201-16141 |

The mating connector is not included in the scope of delivery.

### With emergency start and spring reset for Solenoid(EP/EZ)




### Brake Valve Solenoid (HWC/O)




### Notice

Manual emergency operation (emergency start) can be used in case of electrical system failure.
If necessary, you can change the position of the connector by turning the solenoid.
The position of the connectors varies  of delivery.

## Installation Instructions

### General

The axial piston unit must be always be filled with hydraulic fluid and air bled during commissioning and operation.
This must also be observed following a longer standstill as the system may empty via the hydraulic lines.
The leakage in the housing must be directed to the reservoir via the highest drain port.
The minimum suction pressure at port S must not fall below 0.08 MPa absolute pressure (or 0.05 MPa absolute pressure at cold start).
Under all operating conditions, the suction line and case drain line must flow into the reservoir below the minimum fluid level.

### Installation positions

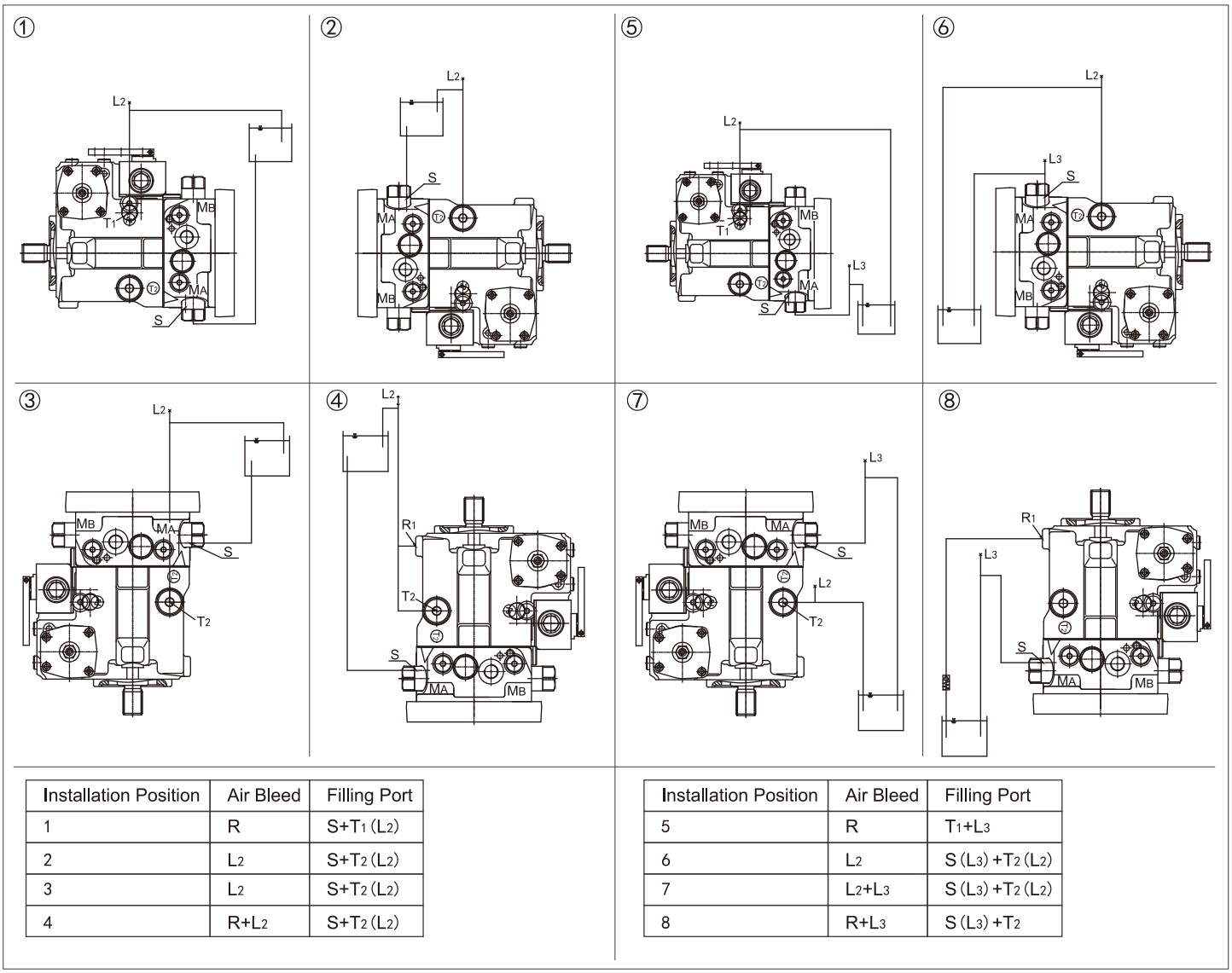
See the examples below. Other installation positions may be provided as required.

### Below-reservoir installation (standard)

Pump below the minimum fluid level of the reservoir. Recommended installation positions: 1 and 2.

### Above-reservoir installation

Pump above the minimum fluid level of the reservoir. Do not exceed the maximum permissible suction height $h_{max}$=800mm。
Recommendation for installation position 8 (shaft upwards):
Draining inside the housing may be prevented by installing a check valve (cracking pressure 0.05 MPa) in the drain line.




| Installation Position | Air Bleed | Filling Port |
|---|---|---|
| 1 | R | S+T1 (L2) |
| 2 | L2 | S+T2 (L2) |
| 3 | L2 | S+T2 (L2) |
| 4 | R+L2 | S+T2 (L2) |

| Installation Position | Air Bleed | Filling Port |
|---|---|---|
| 5 | R | T1+L3 |
| 6 | L2 | S (L3) +T2 (L2) |
| 7 | L2+L3 | S (L3) +T2 (L2) |
| 8 | R+L3 | S (L3) +T2 |

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**HYTEK POWER CO.,LTD.**

No.156,West Yuele Street,Lucheng District,Wenzhoucity 325029,Zhejiang,CHINA
Email: globalsales@hytek.cn

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