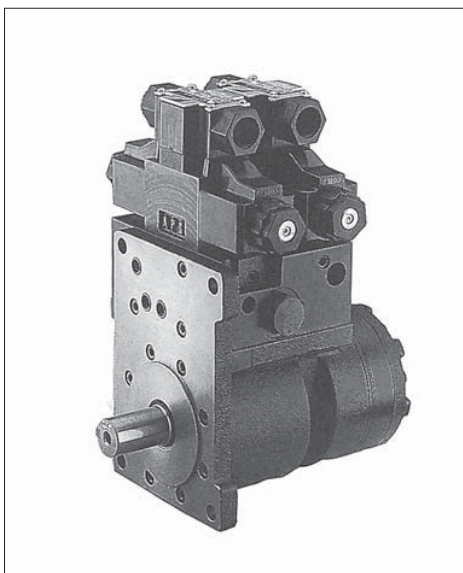


# M

## POSITIONING MOTORS

| [Model No.] | Rated pressure<br>MPa<br>{kgf/cm <sup>2</sup> } | Theoretical output torque<br>N·m {kgf·m} |             |  |  |  |  |     |  |  |  |  |     | Page |
|-------------|---|--|-------------|--|--|--|--|-----|--|--|--|--|-----|------|
|             |   |  | 50          |  |  |  |  | 100 |  |  |  |  | 150 |      |
| TM05        | 3.5 {35}  | 24 { 2.4}                                | <div></div> |  |  |  |  |     |  |  |  |  |     | M-2  |
|             | 5 {50}  | 34 { 3.4}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 7 {70}  | 48 { 4.8}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
| TM10        | 3.5 {35}  | 43 { 4.3}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 5 {50}  | 61 { 6.1}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 7 {70}  | 86 { 8.6}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
| TM13        | 3.5 {35}  | 58 { 5.8}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 5 {50}  | 82 { 8.2}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 7 {70}  | 115 {11.5}                               | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
| TM19        | 3.5 {35}  | 82 { 8.2}                                | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 5 {50}  | 117 {11.7}                               | <div></div> |  |  |  |  |     |  |  |  |  |     |      |
|             | 7 {70}  | 164 {16.4}                               | <div></div> |  |  |  |  |     |  |  |  |  |     |      |

## TM Series Positioning Motors



### <Applications>

Machining centers' ATC units, NC lathes' turrets, automatic loaders, pallet changers, constant feed devices, etc.

### Features

#### ● Hydromechanical positioning

These positioning motors integrate Daikin's original hydromechanical rotary positioning system developed based on orbit motors known for low noise and high-torque at the low-speed range.

#### ● Integrated compact unit

All the components for the required mechanisms of rotation, deceleration, and rotary positioning are joined with no piping and integrated into one compact unit.

#### ● Quick positioning

Adoption of a deceleration cam system and mechanical valves, in addition to quick response features, achieves appropriate speed reduction under the load conditions, enabling shockless stops in a short time without indexing errors.

#### ● High-accuracy positioning

The number of indexing positions can be selected from three options - 1 position, 2 positions or 3 positions over a full revolution - while the positioning cam groove can be selected from two options: highly accurate ( $\pm 0.1^\circ$ ) groove V and groove R with backlash for supplementary positioning.

#### ● Simple control & easy operation

Simple on/off control of solenoid valves achieves easy operation of the positioning motor.

#### ● Flexible feed pitch selection

The capability to set the feed pitch as required enables smooth multi-pitch feed.

### Nomenclature

TM    ✕ ✕   ✕ ✕   -   ✕ ✕ ✕ ✕   -   ✕ ✕ ✕ ✕   -   20

1    2    3    4    5    6    7    8    9    10    11    12

#### 1 Model No.

TM: TM series positioning motor

#### 2 Motor capacity

05: 54 cm<sup>2</sup>/rev  
10: 96 cm<sup>2</sup>/rev  
13: 129 cm<sup>2</sup>/rev  
19: 184 cm<sup>2</sup>/rev

#### 3 Flange

A: SAE A  
B: SAE B  
F: Flange piping

#### 4 Shaft diameter

S:  $\phi 20.0$  (key width: 6.00 mm) \*1  
M:  $\phi 25.0$  (key width: 7.00 mm)  
I:  $\phi 25.4$  (key width: 6.35 mm)

#### 5 Number of indexing positions

1: One indexing position over a full revolution  
2: Two indexing positions over a full revolution  
3: Three indexing positions over a full revolution

#### 6 Cam groove

R: Groove R (Supplementary positioning, with backlash)  
V: Groove V (Sharp positioning with accuracy:  $\pm 0.1^\circ$ )

#### 7 Control port

0: None  
2: With UN, CL  
3: With UN, CL, CO

#### 8 Operating pressure

1: 3.5 MPa { 35 kgf/cm<sup>2</sup> } maximum  
2: 3.6 to 5 MPa { 36 to 50 kgf/cm<sup>2</sup> }  
3: 5.1 to 7 MPa { 51 to 70 kgf/cm<sup>2</sup> }

#### 9 Solenoid valve type \*2

| Code | For rotation      | For pin disengagement |
|------|-------------------|-----------------------|
| AT   | KSO-G02-2CA-30-EN | KSO-G02-9CA-30-EN     |
| AF   | KSO-G02-2CA-30-CE | KSO-G02-9CA-30-CE     |
| BT   | KSO-G02-2CB-30-N  | KSO-G02-9CB-30-N      |
| PT   | KSO-G02-2CP-30-EN | KSO-G02-9CP-30-EN     |
| XT   | LS-G02-2CA-30-EN  | LS-G02-9CA-30-EN      |
| XF   | LS-G02-2CA-30-CE  | LS-G02-9CA-30-CE      |

#### 10 CL port throttle code

0:  $\phi 1.0$  1:  $\phi 2.0$   
2:  $\phi 1.2$  3:  $\phi 2.2$   
4:  $\phi 1.4$  5:  $\phi 2.4$   
6:  $\phi 1.6$   
8:  $\phi 1.8$  N: Not featured

#### 11 Proximity switch

K: Equipped  
N: None  
S: None (with detection rod)

#### 12 Design No. (The design No. is subject to change.)

Note: \*1 Shaft diameter S is only applicable to TM05.

\*2 Refer to KSO-G02 on Page G-12 or LS-G02 on Page G-4 for the solenoid specifications.

## Specifications

| Model No.                        |  | TM05  |      |                | TM10             |      |                | TM13             |      |                | TM19             |      |               |
|----------------------------------|--|---|------|----------------|------------------|------|----------------|------------------|------|----------------|------------------|------|---------------|
| Motor capacity                   | cm <sup>2</sup> /rev   | 54  |      |                | 96               |      |                | 129              |      |                | 184              |      |               |
| Maximum load                     | kg·m <sup>2</sup><br>(GD2: N·m <sup>2</sup> {kgf·m <sup>2</sup> }) | 0.125<br>(5 {0.5})  |      |                | 0.50<br>(20 {2}) |      |                | 0.75<br>(30 {3}) |      |                | 1.25<br>(50 {5}) |      | 1<br>(40 {4}) |
| Number of indexing positions     | rev <sup>-1</sup>  | 1   | 2    | 3              | 1                | 2    | 3              | 1                | 2    | 3              | 1                | 2    | 3             |
| Maximum rotational speed         | min <sup>-1</sup>  | 200   |      | 150            | 200              |      | 150            | 150              |      |                | 100              |      |               |
| Required flow rate               | L/min  | 13  |      | 10             | 22               |      | 17             | 22               |      |                | 21               |      |               |
| Indexing time                    | s *3   | 0.50  | 0.35 | 0.30           | 0.70             | 0.50 | 0.40           | 0.80             | 0.60 | 0.50           | 1.00             | 0.70 | 0.60          |
| Deceleration signal output angle |  | 120° near side  |      | 100° near side | 120° near side   |      | 100° near side | 120° near side   |      | 100° near side | 90° near side    |      |               |
| Rated pressure                   | MPa {kgf/cm <sup>2</sup> }   | 1st pattern: 3.5 {35}, 2nd pattern: 5 {50}, 3rd pattern: 7 {70} |      |                |                  |      |                |                  |      |                |                  |      |               |
| Permissible back pressure        | MPa {kgf/cm <sup>2</sup> }   | 1 {10}  |      |                |                  |      |                |                  |      |                |                  |      |               |
| Indexing accuracy                |  | ±0.1  |      |                |                  |      |                |                  |      |                |                  |      |               |
| Backlash                         |  | Groove R: ±0.1°, Groove V: 0°                                   |      |                |                  |      |                |                  |      |                |                  |      |               |
| Radial load                      | kN {kgf}   | 2.25 {225}  |      |                | 4.5 {450}        |      |                |                  |      |                |                  |      |               |
| Thrust load                      | kN {kgf}   | 2.25 {225}  |      |                | 3.5 {350}        |      |                |                  |      |                |                  |      |               |
| Minimum operating pressure       | MPa {kgf/cm <sup>2</sup> }   | 1.5 {15}  |      |                |                  |      |                |                  |      |                |                  |      |               |
| Holding torque                   | N·m {kgf·m}  | 160 {16}  |      |                |                  |      |                |                  |      |                |                  |      |               |
| Paint color                      |  | Black (Munsell code N1.5, semigloss)                            |      |                |                  |      |                |                  |      |                |                  |      |               |

Note:  $^{*3}$  The indexing time indicates the value at a pressure of 3.5 MPa {35 kgf/cm $^2$ }.

### ● Specifications of proximity switch

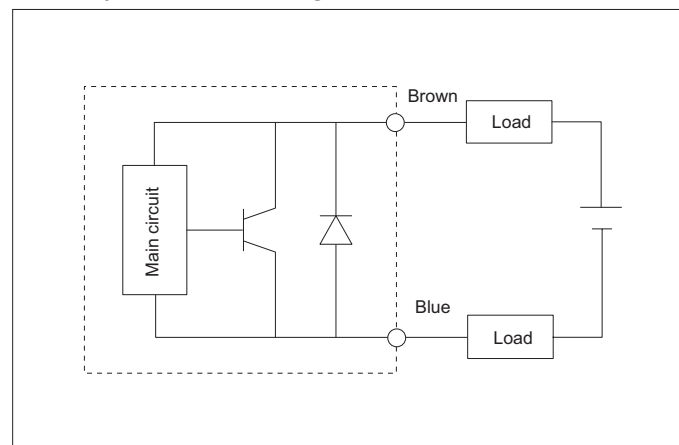
Manufacturer: Azbil Corporation

Model: FL2R-4J6SD

| Item                          | Specifications   |
|-------------------------------|--|
| Detection method              | High-frequency oscillation   |
| Rated operation distance      | 4 $\pm$ 0.4 mm   |
| Rated power supply voltage    | Common to DC 12 V and DC 24 V  |
| Operating voltage range       | DC 10 to 30 V  |
| Leak current                  | 1 mA maximum   |
| Operation configuration       | Normally open<br>Loaded (operating) at positioning                   |
| Output configuration          | DC 2-line type<br>Transistor output                                  |
| Control output                | Switching current: 4 to 100 mA<br>Residual voltage:<br>3.3 V maximum |
| Withstand voltage             | AC 500 V, 1 minute   |
| Insulation resistance         | 50 M $\Omega$ minimum (DC 500 VM)                                    |
| Response frequency            | 1.5 kHz minimum  |
| Operating ambient temperature | -25 to 70°C  |
| Dust-/water-proof property    | IEC 529 IP67   |

### Output section circuit diagram

Proximity switch circuit diagram



Note: The load shown in the output section circuit diagram can be connected in either the positive or negative polarity of the power supply.

## Handling

### ● Electric wiring and operation

| Solenoid valve                       |                                       | SOL No. | Operation at solenoid excitation  |
|--------------------------------------|---------------------------------------|---------|---|
| For pin engagement/<br>disengagement | KSO-G02-9CA-30-EN<br>LS-G02-9CA-30-EN | SOL.1b  | Positioning cancelation, preparing for rotation                         |
|                                      |                                       | SOL.1a  | Deceleration start → positioning complete                               |
| For rotation                         | KSO-G02-2CA-30-EN<br>LS-G02-2CA-30-EN | SOL.2a  | Counterclockwise rotation (viewed from the end of motor's output shaft) |
|                                      |                                       | SOL.2b  | Clockwise rotation (viewed from the end of motor's output shaft)        |

## Operation description

- The table below shows on/off timing of solenoid valve and status of rotation and of main machine.

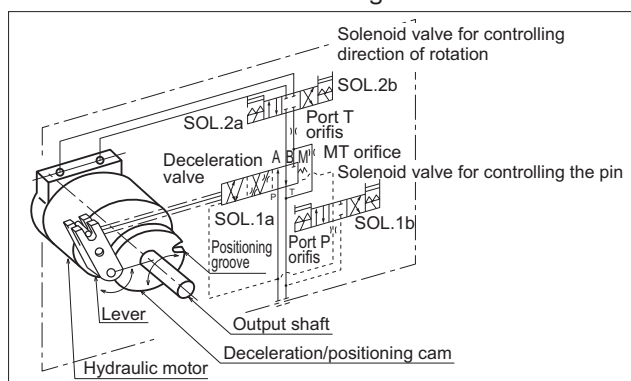
### ● Operation sequence (0 → 1 → 2 → 3 → 4 → 0) <Example: When using ports UN and CL for a lathe>

| Solenoid valve<br>Operation sequence | For pin operation |     | For rotation<br>2a or 2b | Turret  | For rotation | Positional relationship between cam and pin  | Mechanical valve symbol  |
|--------------------------------------|-------------------|-----|--------------------------|---------|--------------|--|--|
|                                      | 1a                | 1b  |                          |         |              |  |  |
| 0                                    | OFF               | OFF | OFF                      | Clamp   | Stop         | Within the positioning groove  | P → A B → T M block  |
| 1                                    | ↑                 | ON  | ↑                        | Unclamp | Preparing    | Leaving the positioning groove   | P → B M → T A → T  |
| 2                                    | ↑                 | ↑   | ON                       | ↑       | Start        | ↑  | ↑  |
| 3                                    | ON                | OFF | ↑                        | ↑       | Deceleration | Pin coming onto the cam and decelerating<br>Approaching the positioning groove (target position) along cam shape | P → B M → T A → T<br>Area of opening being reduced in proportion to the decelerating curve (meter-out) |
| 4                                    | OFF               | ↑   | ↑                        | Clamp   | Stop         | Entering the positioning groove  | P → A B → T M block  |
| 0                                    | ↑                 | ↑   | OFF                      | ↑       | ↑            | Within the positioning groove  | ↑  |

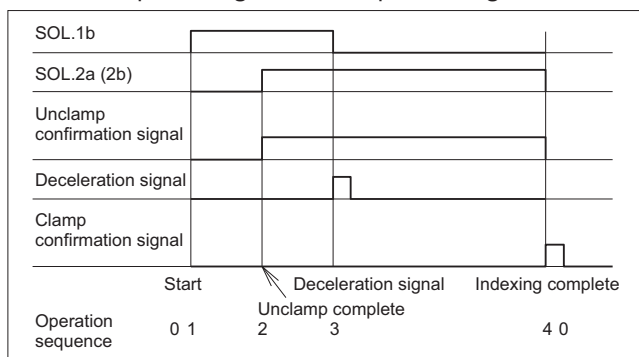
- The on/off operation of the solenoid valve for pin operation provides the pilot pressure to move the mechanical valve's spool. At deceleration, the spool is returned by the lever following the profile of the cam mechanism.

- The spool of the mechanical valve is connected to the pin by the lever, so once the pin comes onto the cam the spool moves along the cam geometry and reduces the opening area.

Structure diagram



Example timing chart for 2-port configuration



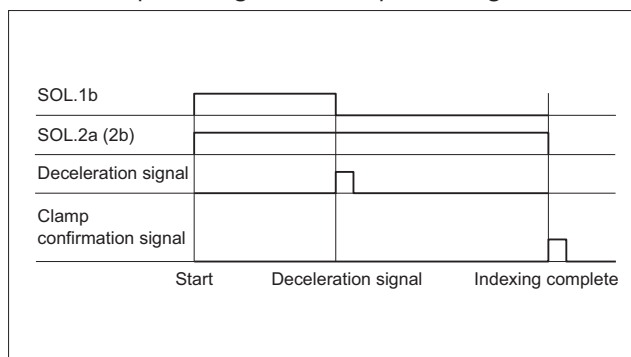
Deceleration signal:

Signal emitted at reduction signal output angle from an encoder or another device on the main machine (SOL.1b: OFF, SOL.1a: ON)

Clamp confirmation signal:

Clamp signal from the proximity switch of a curvic coupling or another device on the main machine (This signal is not from the optional proximity switch.)

Example timing chart for 3-port configuration



## ● Handling of the control ports

The positioning motor is provided with control ports to operate a hydraulic cylinder (for operating curvic couplings, magazine indexing, etc.). The port configuration can be selected from two options: 2-port (CL, UN) and 3-port (CL, UN, CO). The following figures show an example application of each type.

### ○ 2-port (CL, UN)

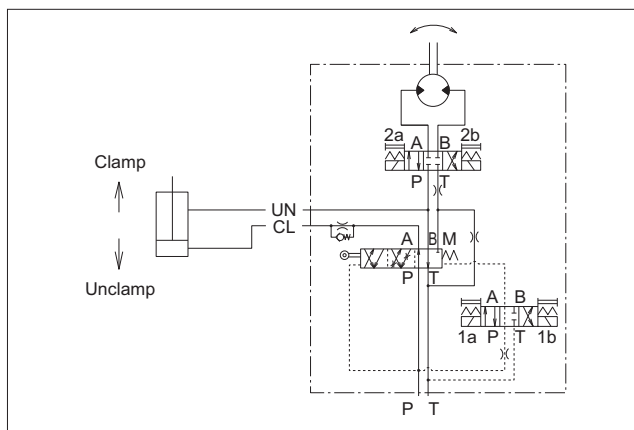
Used to control the cylinder for magazine indexing, for example.

[Connection] Port CL: Clamp side  
Port UN: Unclamp side

SOL.1b and SOL.2a: Simultaneous excitation not possible

Be sure to excite SOL.2a (2b) after confirming completion of the unclamping operation, otherwise the motor starts to rotate while carrying out the unclamping.

### 2-port (CL, UN)



### ○ 3-port (CL, UN, CO)

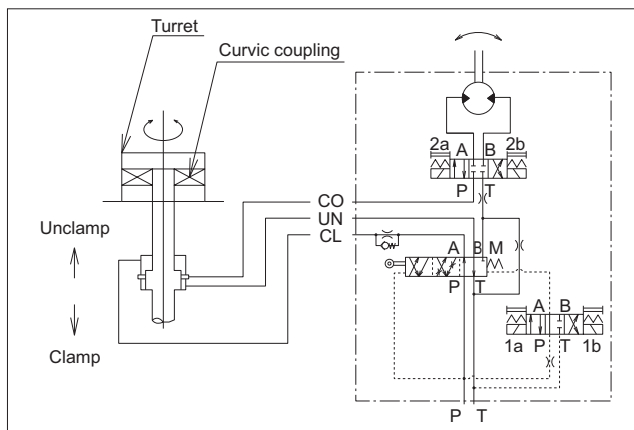
Used for interlocked cylinders such as for curvic couplings.

[Connection] Port CL: Clamp side  
Port UN: Unclamp side  
Port CO: Common side

SOL.1b and SOL.2a: Simultaneous excitation possible

Simultaneous excitation will not cause a problem because the motor does not rotate (fluid is not supplied at port CO) unless the unclamping operation is completed.

### 3-port (CL, UN, CO)



## If operation fails

**More than 90% of operation failures are caused by the fixed throttle becoming clogged with contamination. (See the sectional structural diagram for the location of orifice.)**

### ● Motor not rotating or rotating slowly

- Clean each orifice with clean oil and blow it with compressed air. (Do not wrap orifices with sealing tape when reassembling.)
- Replace the solenoid valve for rotation (spool type/operation type: 2C).

### ● Indexing error

- Clean each orifice with clean oil and blow it with compressed air. (Do not wrap orifices with sealing tape when reassembling.)
- Replace the solenoid valve for pin engagement/disengagement (spool type/operation type: 9C).

## Handling

### ● Installation

- Avoid crosswise drive of a belt, chain, etc. because it will cause large radial loads. Always drive the load via bearing support by using pillow blocks, for example.
- When driving a motor with a spur gear fitted at the end of the shaft, keep the load within 4.5 kN {450 kgf} (2.25 kN {225 kgf} for TM05) including the radial load.  
If the load exceeds this limit, drive it via bearing support by using pillow blocks, for example.
- Ensure that the eccentricity of the drive shaft and motor shaft is no greater than 0.05 mm (TIR).
- Tighten the screw in the M8 tapped hole (depth of 20 mm) at the shaft end within a tightening torque of 2.5 to 3 N·m {250 to 300 kgf·cm}.
- Before replacing the motor, be sure to stop the hydraulic supply and check that there is no remaining pressure within the hydraulic circuit.  
Never disassemble the motor.
- Never use damaged hoses or old hoses for piping. Use hoses with sufficient pressure endurance range.
- When mounting the motor, securely fix it to the flange or base while being careful not to drop it and avoiding subjecting it to any impact with a hammer, etc.  
In addition, do not use the motor as a step.
- When connecting fittings on the motor, tighten them with an appropriate torque. Tightening them with an excessive torque may cause breakage of the block or other parts.
- Set the key on the motor shaft without any looseness. Ensure that the clearance between the key and the side wall of the key groove is no greater than 0.03 mm and securely fix the top part of the key using a screw or other means.
- Do not apply any load exceeding the permissible radial load (4.5 kN {450 kgf}) or the permissible thrust load (3.5 kN {350 kgf}) on the motor shaft. Do not hit the motor with a hammer, especially on the motor shaft. It will cause fluid leakage from the shaft sealing or damage to other parts.
- When using the front mount type, take care not to trap the O-ring.
- During piping work, take necessary measures to prevent dust or cutting chips getting inside the piping or motor.  
Flush pipes before using them in piping work.
- When connecting the motor directly to a load part, accurate centering is required.
- Do not expose valves and sensors to water or impacts.
- Do not pull the detection rod or proximity plate with excessive force, or bend them.
- Be careful to connect motor pipes correctly.
- Do not use the products in an environment susceptible to rust.

### ● Hydraulic oil

- Use a petroleum-based hydraulic fluid. Do not use other types of hydraulic fluid or mix different types of hydraulic fluid.  
Use hydraulic fluid within parameters where all of its specification conditions are satisfied at the same time.
- Positioning motors are not designed to handle combustible fluids or hazardous fluids.  
If such fluids are used and leak, the potential hazards include fire, disease, and environmental contamination.
  - Recommended hydraulic fluid: Fluid equivalent to ISO VG32 to 56
  - Recommended viscosity range: 15 to 400 mm<sup>2</sup>/s {cSt}
  - Permissible fluid temperature range: 0 to 60°C
  - Contamination: Within NAS class 12 (Use a line filter with a filtration accuracy of 25 μ or better.)

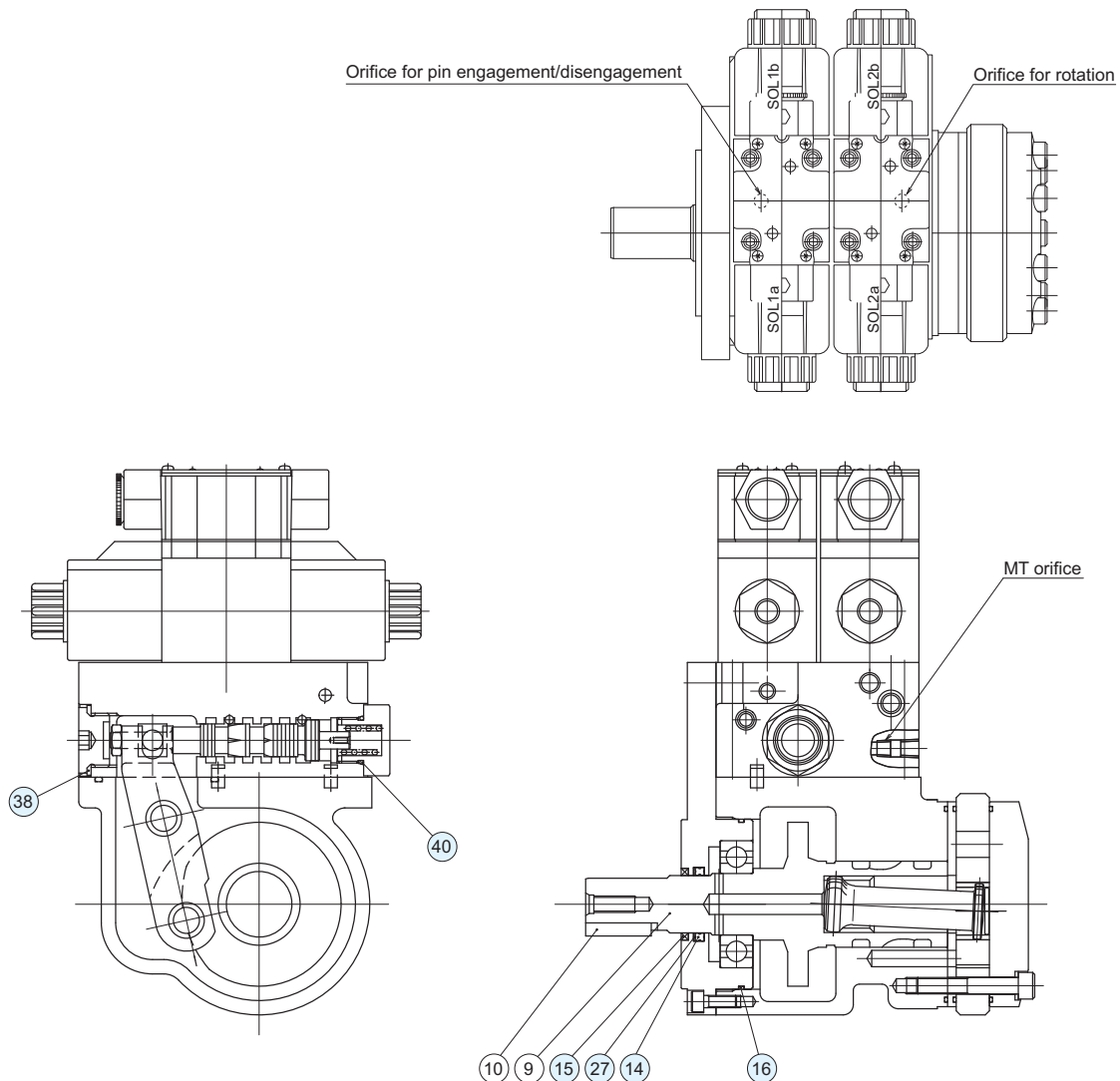
### ● Running

- Do not touch the rotating part while the motor is rotating because it is very dangerous. Be sure to provide a guard for the rotating part.
- If an abnormal pressure that exceeds the maximum operating pressure of the motor can be expected, install a safety valve together with the motor and set it to lower than the maximum operating pressure. Otherwise, the seal may be damaged and fluid may leak.
- Do not touch surface of the motor while it is running. You may sustain burns.
- If an abnormality such as fluid leakage, lowered torque, increased noise, or lowered speed is observed, stop operation immediately and take the necessary steps to prevent secondary accidents.
- Do not operate the motor only with a key attached. Otherwise the key may fly out.
- Maintain the back pressure at no greater than 1 MPa {10 kgf/cm<sup>2</sup>}.

### ● Others

- Use the motor in compliance with the specification conditions stated in the brochure or drawings.
- Products modified by the customer are not covered by the warranty and Daikin will accept no responsibility for them.

## Sectional structural diagram



Sealing part table

| Part No. | Name           | Quantity | Part specifications   |
|----------|----------------|----------|-----------------------|
| 14       | X-ring         | 1        | Seal kit (PP01632-01) |
| 15       | Dust seal      | 1        |                       |
| 16       | O-ring         | 1        |                       |
| 27       | Backup ring    | 1        |                       |
| 38       | Sealing washer | 1        | LBF060345E            |
| 40       | O-ring         | 1        | AS568-910             |

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