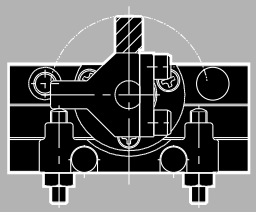
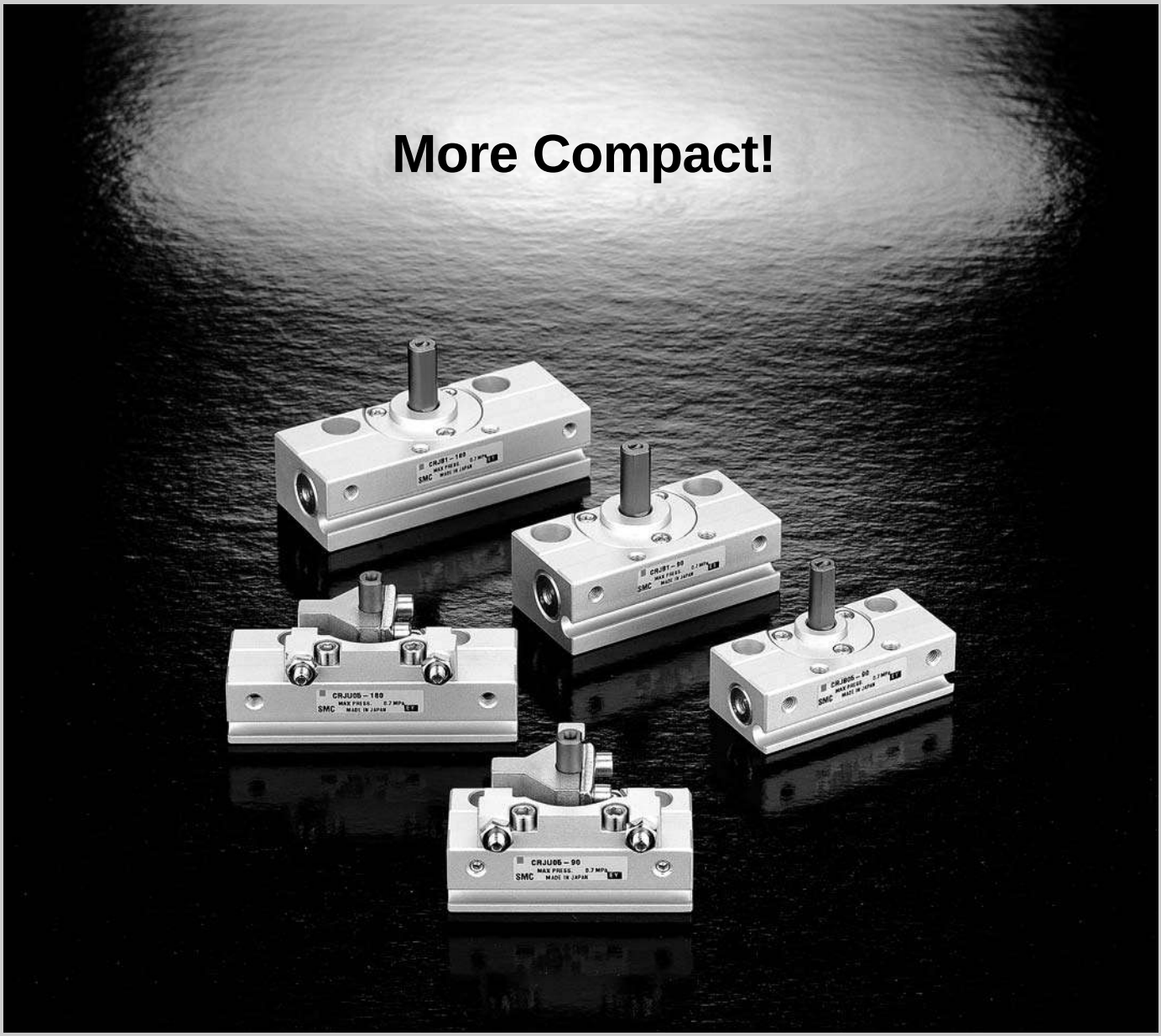


# Mini-Rotary Actuator
## Rack-and-Pinion Type/Size: 05, 1
# Series CRJ



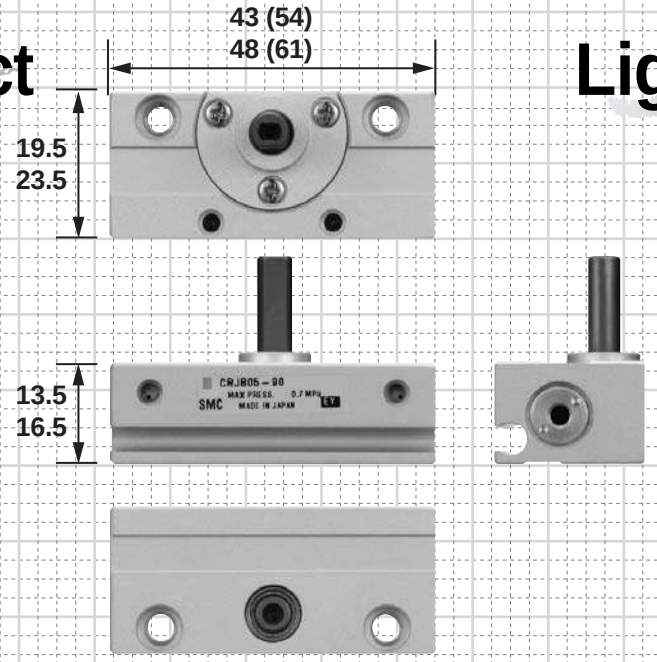



In our pursuit of excellence in size and weight reduction, we proudly announce the release of the Series CRJ **Mini**-Rotary Actuator!

# Mini-Rotary Actuator *Series CRJ*

**Rack-and-Pinion Type/Size: 05, 1**

## Compact




Actual size (CRJB05-90)

## Light weight

**CRJ05: 32g (39g)**
**CRJ 1: 54g (67g)**

Dimensions
Weights

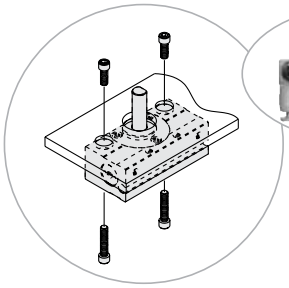
**Top CRJ05**
**Bottom CRJ 1**

**Numbers in ( ) are for 180°.**

# Flexible mounting

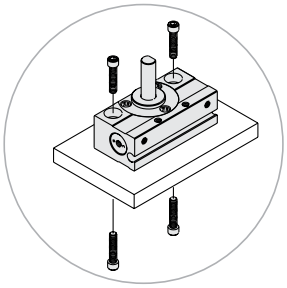
A new compact body design not only reduces overall space requirements, but also achieves space savings in wiring and piping.
Ease in mounting is maximized thanks to the merits of the new compact body.

## Free mount

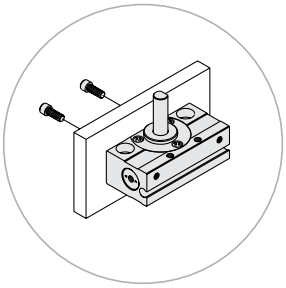


Speed controllers do not protrude from the top of the body.

**Top mount**



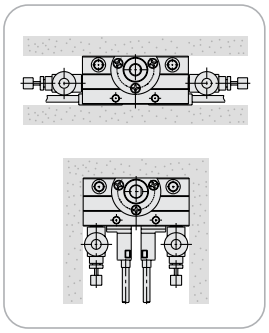
**Bottom mount**

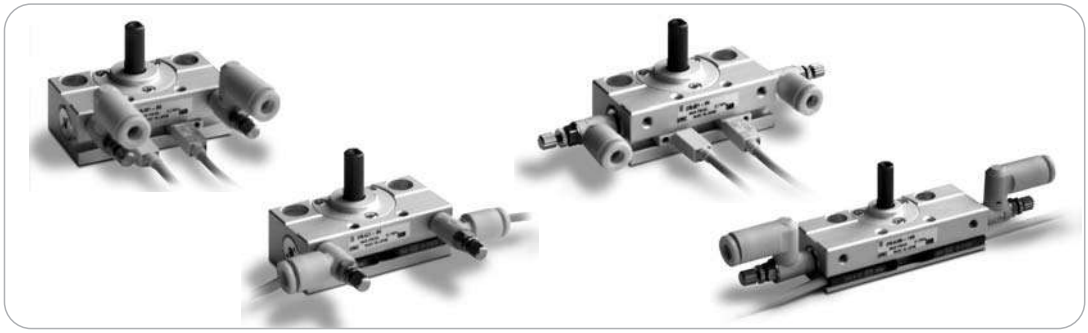


**Side mount**

## Wiring and piping direction can be selected depending on mounting conditions.

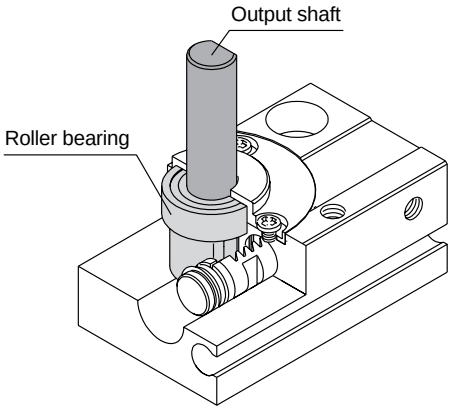
Mounting examples for auto switch and speed controller

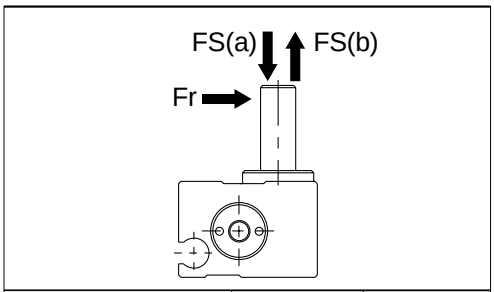




# Improved allowable load

**Large roller bearing** and **large diameter output shaft** add to overall compactness while ensuring high rigidity.

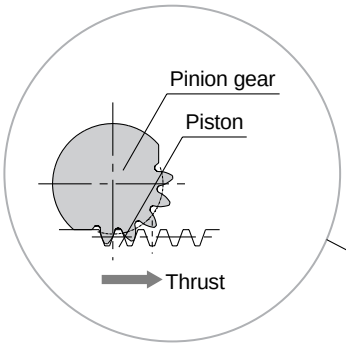


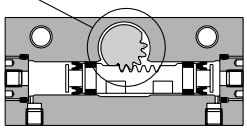

| Model | | CRJ05 | CRJ1 |
|---|---|---|---|
| Allowable load (N) | Fr | 25 | 30 |
| | FS(a) | 20 | 25 |
| | FS(b) | 20 | 25 |
| Output shaft size (mm) | | ø5 | ø6 |

# Reduced backlash

Even with a single rack design, the use of a special construction minimizes backlash.

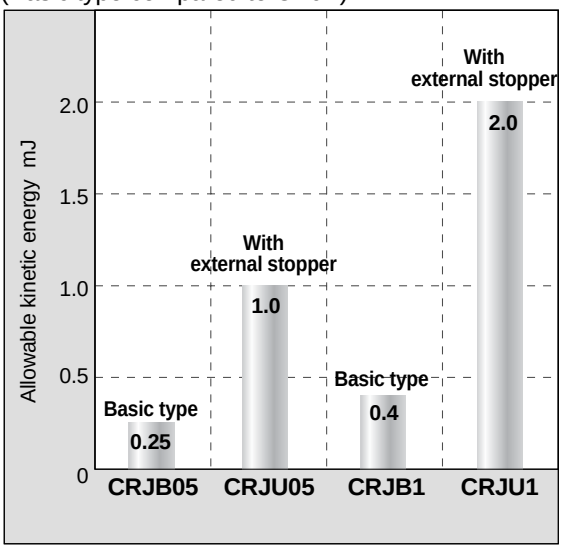



Stopping the pinion gear by having it strike against the flat surface of the piston eliminates backlash.

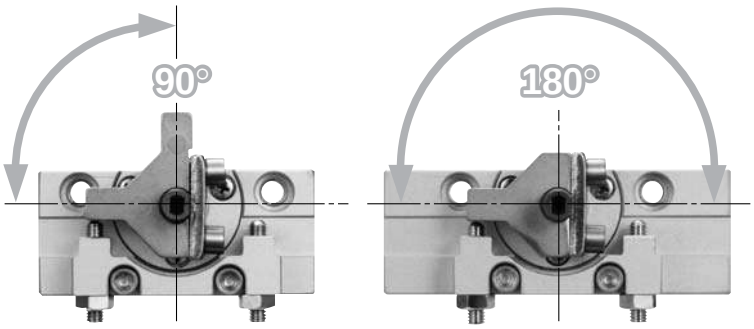


## With external stopper/*Series CRJU*

4 to 5 times allowable kinetic energy
(Basic type compared to CRJB)




Angle is adjustable: ±5° at each rotation end




# Variations

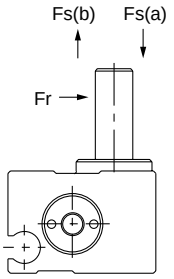
| Series | | Rotation angle | | | | Port location | Auto switch |
|---|---|---|---|---|---|---|---|
| | | 90° | 100° | 180° | 190° | | |
| Basic type | CRJB05 | ● | ● | ● | ● | Front port<br>Side port | D-F8<br>D-F9 |
| | CRJB 1 | ● | ● | ● | ● | | |
| With external stopper | CRJU05 | ● | — | ● | — | | |
| | CRJU 1 | ● | — | ● | — | | |

# Model Selection

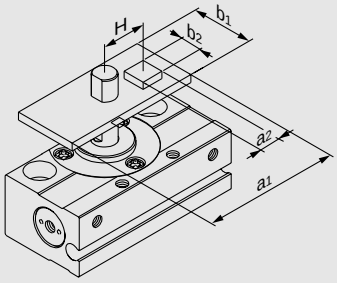
| Procedure | Calculation | Example |
|---|---|---|

## 1 Operating conditions

**List all possible operating conditions according to the mounting position.**




- Model used
- Operating pressure
- Mounting position
- Load type
  - Ts (N·m)
  - Tf (N·m)
  - Ta (N·m)
- Load configuration
- Rotation time t (s)
- Rotation angle
- Load mass m (kg)
- Distance between central axis and center of gravity H (mm)




**Rotary actuator:** CRJB05-90 **Pressure:** 0.4MPa
**Mounting orientaion:** Vertical **Type of load:** Inertial load Ta
**Load 1 configuration:** 20mm x 10mm (rectangular plate)
**Load 2 configuration:** 5mm x 5mm (square plate)
**Rotation time t:** 0.2s **Rotation angle:** 90°
**Load 1 mass m1:** 0.03kg **Load 2 mass m2:** 0.006kg
**Distance between central axis and center of gravity H:** 7mm

## 2 Required torque

**Confirm the type of load as shown below, and select an actuator that satisfies the required torque.**

- **Static load: Ts**
- **Resistance load: Tf** **Load types**
- **Inertial load: Ta**

Effective torque ≥ Ts
Effective torque ≥ (3 to 5) x Tf
Effective torque ≥ 10 x Ta

**Effective torque**

**Inertial load**

$10 \times Ta = 10 \times I \times \dot{\omega}$

$= 10 \times 1.57 \times 10^{-6} \times (2 \times (\pi / 2) / 0.2^2)$

$= 0.0012 N \cdot m <$ Effective torque OK

Note) $I$ substitutes for ⑤, the value for inertial moment.

## 3 Rotation time

**Confirm that it is within the rotation adjustment time range.**

0.1 to 0.5s/90°

0.2s/90° OK

## 4 Allowable load

**Confirm that the radial load, thrust load and moment are within the allowable ranges.**

Thrust load: m x 9.8 ≤ Allowable load

**Allowable load**

(0.03 + 0.006) x 9.8 = 0.35N < Allowable load OK

## 5 Inertial moment

**Find the load's inertial moment "I" for the energy calculation.**

$I_1 = m \times (a^2 + b^2)/12$

$I_2 = m \times (a^2 + b^2)/12 + m \times H^2$

$I = I_1 + I_2$

**Inertial moment**

$I_1 = 0.03 \times (0.02^2 + 0.01^2)/12 = 1.25 \times 10^{-6} kg \cdot m^2$

$I_2 = 0.006 \times (0.005^2 + 0.005^2)/12 + 0.006 \times 0.007^2$

$= 0.32 \times 10^{-6} kg \cdot m^2$

$I = 1.25 \times 10^{-6} + 0.32 \times 10^{-6}$

$= 1.57 \times 10^{-6} kg \cdot m^2$

## 6 Kinetic energy

**Confirm that the load's kinetic energy is within the allowable value.**

$1/2 \times I \times \omega^2 \leq$ Allowable energy

$\omega = 2\theta / t$ ($\omega$: Terminal angular velocity)

$\theta$: Rotation angle (rad)

t: Rotation time (s)

**Allowable kinetic energy/Rotation time**

$1/2 \times 1.57 \times 10^{-6} \times (2 \times (\pi/2)/0.2)^2$

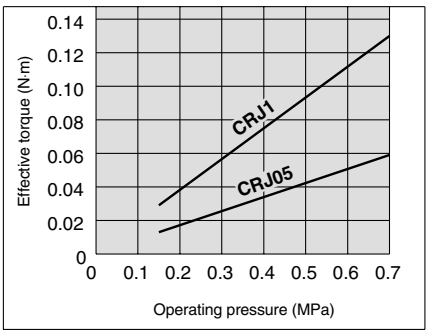
$= 0.00019J = 0.19mJ <$ Allowable energy OK

## Effective Torque

Unit: N·m

| Size | Operating pressure (MPa) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0.15 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 |
| **05** | 0.013 | 0.017 | 0.026 | 0.034 | 0.042 | 0.050 | 0.059 |
| **1** | 0.029 | 0.038 | 0.057 | 0.076 | 0.095 | 0.11 | 0.13 |

Note) Effective torque values are representative values. They are not guaranteed values. Use them only as a guide.






## Load Types

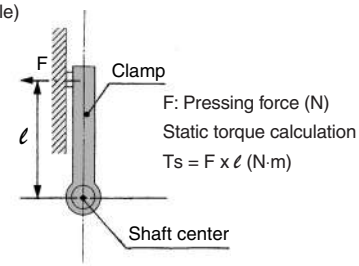
### • Static load: Ts

**Definition for our purposes:**

A load that requires pressing force only, as represented by the clamp.

(If the mass of the clamp itself in the drawing below is considered in the calculations, it should be regarded as an inertial load.)

(Example)




F: Pressing force (N)

Static torque calculation

Ts = F x ℓ (N·m)

### • Resistance load: Tf

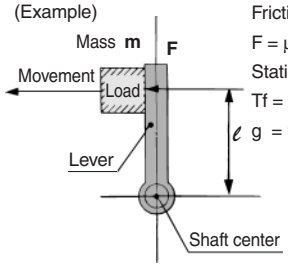
**Definition for our purposes:**

A load that is affected by external forces such as friction or gravity. Since the purpose is to move the load, and speed adjustment is necessary, allow an extra margin of 3 to 5 times in the effective torque.

∗ Actuator effective torque ≥ (3 to 5) x Tf

(If the mass of the lever itself in the drawing below is considered in the calculations, it should be regarded as an inertial load.)

(Example)




Friction coefficient μ

F = μmg

Static torque calculation

Tf = F x ℓ (N·m)

g = 9.8m/s²

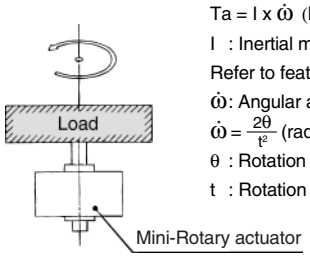
### • Inertial load:

**Definition for our purposes:**

The load that is actually rotated by the actuator. Since the purpose is to rotate the load, and speed adjustment is necessary, allow an extra margin of 10 times or more in the effective torque.

∗ Actuator effective torque ≥ S x Ta
(S is 10 times or more)

**Accelerating torque calculation**




Ta = I x $\dot{\omega}$ (N·m)

I : Inertial moment

Refer to features page 5.

$\dot{\omega}$: Angular acceleration

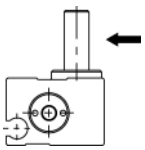
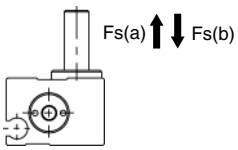
$\dot{\omega} = \frac{2\theta}{t^2}$ (rad/s²)

θ : Rotation angle (rad)

t : Rotation time (S)

## Allowable Load

**Set the load and moment applied to the shaft within the allowable values provided in the table below.**
**(Operation above the allowable values can cause adverse effects on service life, such as play in the shaft and loss of accuracy.)**

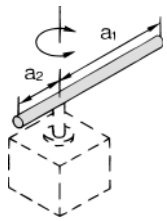
| |  |  Fs(a) Fs(b) | |
|---|---|---|---|
| Size | Allowable radial load Fr (N) | Allowable thrust load (N) | |
| | | Fs(a) | Fs(b) |
| **05** | 25 | 20 | 20 |
| **1** | 30 | 25 | 25 |

## Inertial Moment Formulas

I: Inertial moment kg·m², m: Load mass kg

### 1. Thin shaft

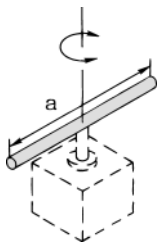
Position of rotational axis: Perpendicular to the shaft anywhere along its length




$$I = m_1 \times \frac{a_1^2}{3} + m_2 \times \frac{a_2^2}{3}$$

### 2. Thin shaft

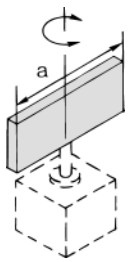
Position of rotational axis: Through the shaft's centre of gravity




$$I = m \times \frac{a^2}{12}$$

### 3. Thin rectangular plate (rectangular parallelopiped)

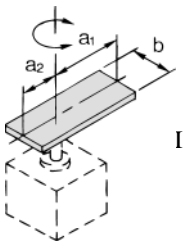
Position of rotational axis: Through the plate's centre of gravity




$$I = m \times \frac{a^2}{12}$$

### 4. Thin rectangular plate (rectangular parallelopiped)

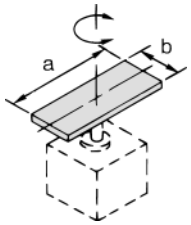
Position of rotational axis: Perpendicular to the plate through one end (also the same in the case of a thicker plate)




$$I = m_1 \times \frac{4a_1^2 + b^2}{12} + m_2 \times \frac{4a_2^2 + b^2}{12}$$

### 5. Thin rectangular plate (rectangular parallelopiped)

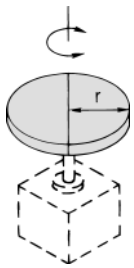
Position of rotational axis: Through the centre of gravity and perpendicular to the plate (also the same in the case of a thicker plate)




$$I = m \times \frac{a^2 + b^2}{12}$$

### 6. Cylinder (including thin round plate)

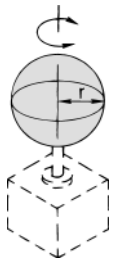
Position of rotational axis: Through the plate's central axis




$$I = m \times \frac{r^2}{2}$$

### 7. Solid sphere

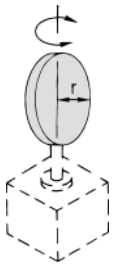
Position of rotational axis: Through the sphere's diameter




$$I = m \times \frac{2r^2}{5}$$

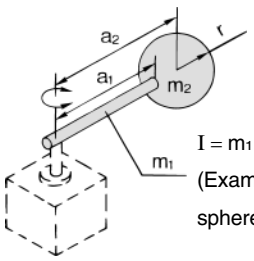
### 8. Thin round plate

Position of rotational axis: Through the plate's diameter




$$I = m \times \frac{r^2}{4}$$

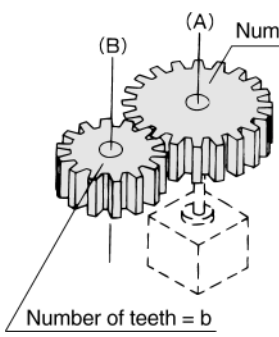
### 9. Load at the end of lever




$$I = m_1 \times \frac{a_1^2}{3} + m_2 \times a_2^2 + K$$

(Example) When the shape of $m_2$ is a sphere, refer to 7 above. $K = m_2 \times \frac{2r^2}{5}$

### 10. Gear transmission




1. Find the inertial moment $I_B$ for the rotation of shaft (B).
2. Next, $I_B$ is entered to find the inertial moment $I_A$ for the rotation of shaft (A) as

$$I_A = (\frac{a}{b})^2 \times I_B$$

## Kinetic Energy/Rotation Time

**Even in cases where the torque required for rotation of the load is small, damage to internal parts may result from the inertial force of the load.**
**Take into account the load's inertial moment and rotation time during operation when making your model selection.**
**(The inertial moment and rotation time charts can be used for your convenience in making model selections.)**

### 1. Allowable kinetic energy and rotation time adjustment range

From the table below, set the rotation time within the proper adjustment range for stable operation. Note that slow speed operation exceeding the rotation time adjustment range, may lead to sticking or stopping of operation.

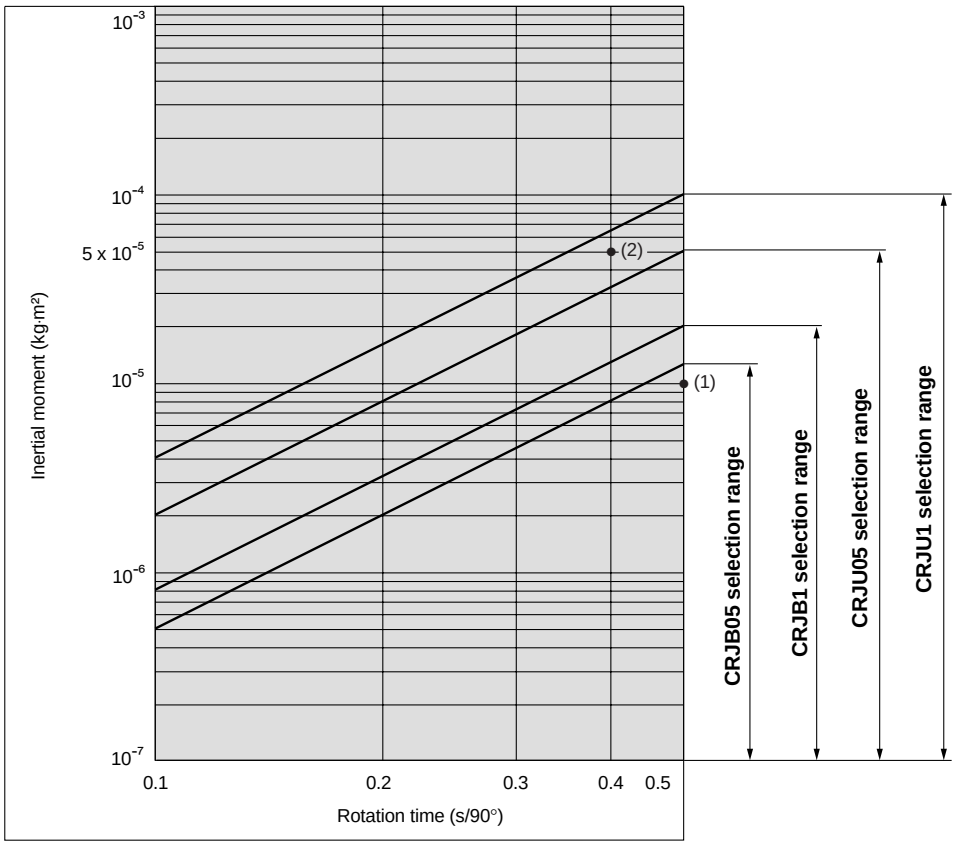
| Size | | | Allowable kinetic energy mJ | Rotation time adjustment range for stable operation s/90° |
|---|---|---|---|---|
| **05** | Basic type | **CRJB05** | 0.25 | 0.1 to 0.5 |
| | With external stopper | **CRJU05** | 1.0 | |
| **1** | Basic type | **CRJB 1** | 0.40 | |
| | With external stopper | **CRJU 1** | 2.0 | |

### 2. Inertial moment calculation

Since the formulas for inertial moment differ depending on the configuration of the load, refer to the inertial moment calculation formulas on the preceding page.

### 3. Model selection

Select models by applying the inertial moment and rotation time that you have calculated to the chart below.




**1. <How to read the chart>**

- Inertial moment …… 1 x $10^{-5}$kg·m²
- Rotation time …..…… 0.5s/90°

CRJB05 is selected in this case.

**2. <Calculation example>**

Load configuration: A cylinder of radius 0.05m and mass 0.04kg

Rotation time: 0.4s/90°

I = 0.04 x 0.05²/2 = 5 x $10^{-5}$kg·m²

In the inertial moment and rotation time chart, find the intersection of the lines extended from the points corresponding to 5 x $10^{-5}$ kg·m² on the vertical axis (inertial moment) and 0.4s/90° on the horizontal axis (rotation time). Since the resulting intersection point falls within the CRJU1 selection range, CRJU1 may be selected.

# Mini-Rotary Actuator
# Air Consumption

Air consumption is the volume of air that is expended by the Mini-Rrotary Actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve. It is required for selection of a compressor and for calculation of its running cost.

* The air consumption ($Q_{CR}$) required for one reciprocation of a single Mini-Rotary Actuator alone is shown in the table below, and can be used to simplify the calculation.

Formulas

$$Q_{CR} = 2V \times \left(\frac{P + 0.1}{0.1}\right) \times 10^{-3}$$

$$Q_{CP} = 2 \times a \times \ell \times \frac{P}{0.1} \times 10^{-6}$$

$$Q_C = Q_{CR} + Q_{CP}$$

$Q_{CR}$ = Air consumption of Mini-Rotary Actuator [ℓ (ANR)]

$Q_{CP}$ = Air consumption of tubing or piping [ℓ (ANR)]

V = Internal volume of Mini-Rotary Actuator [$cm^3$]

P = Operating pressure [MPa]

$\ell$ = Length of piping [mm]

a = Internal cross section of piping [$mm^2$]

$Q_C$ = Air consumption required for one reciprocation of Mini-Rotary Actuator [ℓ (ANR)]

When selecting a compressor, it is necessary to choose one that has sufficient reserve for the total downstream air consumption of all pneumatic actuators. This is affected by factors such as leakage in piping, consumption by drain valves and pilot valves, and reduction of air volume due to temperature drops.

Formula

$$Q_{C2} = Q_C \times n \times \text{Number of actuators} \times \text{Reserve factor}$$

$Q_{C2}$ = Compressor discharge flow rate

n = Actuator reciprocations per minute

### Internal cross section of tubing and steel piping

| Nominal size | O.D. (mm) | I.D. (mm) | Internal cross section a ($mm^2$) |
|---|---|---|---|
| **T□ 0425** | 4 | 2.5 | 4.9 |
| **T□ 0604** | 6 | 4 | 12.6 |
| **TU 0805** | 8 | 5 | 19.6 |
| **T□ 0806** | 8 | 6 | 28.3 |
| **1/8B** | — | 6.5 | 33.2 |
| **T□ 1075** | 10 | 7.5 | 44.2 |
| **TU 1208** | 12 | 8 | 50.3 |
| **T□ 1209** | 12 | 9 | 63.6 |
| **1/4B** | — | 9.2 | 66.5 |
| **TS 1612** | 16 | 12 | 113 |
| **3/8B** | — | 12.7 | 127 |
| **T□ 1613** | 16 | 13 | 133 |
| **1/2B** | — | 16.1 | 204 |
| **3/4B** | — | 21.6 | 366 |
| **1B** | — | 27.6 | 598 |

## Air Consumption

Air consumption of rotary actuator: $Q_{CR}$ ℓ (ANR)

| Size | Rotation | Internal volume ($cm^3$) | Operating pressure (MPa) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 0.15 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 |
| **05** | 90° | 0.15 | 0.00074 | 0.00089 | 0.0012 | 0.0015 | 0.0018 | 0.0021 | 0.0024 |
| | 180° | 0.31 | 0.0015 | 0.0018 | 0.0025 | 0.0031 | 0.0037 | 0.0043 | 0.0049 |
| **1** | 90° | 0.33 | 0.0016 | 0.0020 | 0.0026 | 0.0033 | 0.0039 | 0.0046 | 0.0052 |
| | 180° | 0.66 | 0.0033 | 0.0039 | 0.0052 | 0.0065 | 0.0078 | 0.0091 | 0.010 |

# Mini-Rotary Actuator

# *Series CRJ*



## How to Order

**Basic type** CRJ B **05** – **90** **E** – **F9B** **S**

**With external stopper** CRJ U **05** – **90** **E** – **F9B** **S**

**Rotation angle**

| | |
|---|---|
| **90** | 90° |
| **100** | 100° |
| **180** | 180° |
| **190** | 190° |

**Size**

| |
|---|
| **05** |
| **1** |

**Number of auto switches**

| | |
|---|---|
| **Nil** | 2 pcs. |
| **S** | 1 pc. |

**Auto switch type**

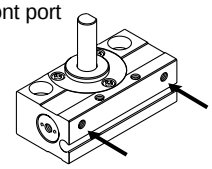
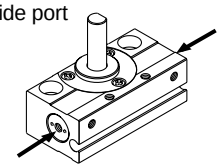
| | |
|---|---|
| **Nil** | Without auto switch (built-in magnet) |

∗ Select applicable auto switches from the table below.

**Rotation angle**

| | |
|---|---|
| **90** | 90° |
| **180** | 180° |

**Connecting port position**

| | |
|---|---|
| **Nil** | Front port  |
| **E** | Side port  |

These auto switches have been changed
Contact SMC or view www.smcworld.com

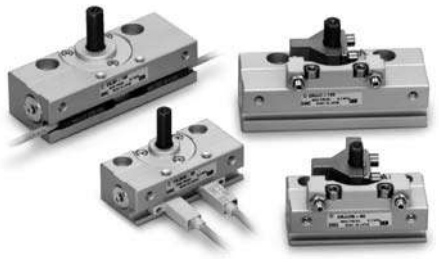
F9N➡**M9N**
F9P➡**M9P**
F9B➡**M9B**

### Applicable auto switches

| Type | Special function | Electrical entry | Indicator light | Wiring (output) | Load voltage | | | Auto switch part no. | | Lead wire length (m)∗ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DC | | AC | Electrical entry direction | | 0.5 (Nil) | 3 (L) | 5 (Z) |
| | | | | | | | | Perpendicular | In-line | | | |
| Solid state switch | — | Grommet | Yes | 3-wire (NPN) | 24V | 12V | — | — | **F9N** | ● | ● | — |
| | | | | | | | | **F8N** | — | ● | ● | ○ |
| | | | | 3-wire (PNP) | | | | — | **F9P** | ● | ● | — |
| | | | | | | | | **F8P** | — | ● | ● | ○ |
| | | | | 2-wire | | | | — | **F9B** | ● | ● | — |
| | | | | | | | | **F8B** | — | ● | ● | ○ |
| | Diagnostic indication (2-colour indication) | | | 3-wire (NPN) | | | | — | **F9NW** | ● | ● | ○ |
| | | | | 3-wire (PNP) | | | | — | **F9PW** | ● | ● | ○ |
| | | | | 2-wire | | | | — | **F9BW** | ● | ● | ○ |

∗ Lead wire length symbols: 0.5m ..... Nil (Example) F9N
3m ..... L (Example) F9NL
5m ..... Z (Example) F9NWZ

∗ Auto switches marked "○" are produced upon receipt of order.



## Specifications

| Size/Type | 05 | | 1 | |
|---|---|---|---|---|
| | Basic type | With external stopper | Basic type | With external stopper |
| **Fluid** | Air (non-lube) | | | |
| **Max. operating pressure** | 0.7MPa | | | |
| **Min. operating pressure** | 0.15MPa | | | |
| **Ambient and fluid temperature** | 0° to 60°C (with no freezing) | | | |
| **Rotation angle** Note) | $90^{+8°}_{0}$, $100^{+10°}_{0}$ $180^{+8°}_{0}$, $190^{+10°}_{0}$ | 90, 180 | $90^{+8°}_{0}$, $100^{+10°}_{0}$ $180^{+8°}_{0}$, $190^{+10°}_{0}$ | 90, 180 |
| **Angle adjustment range** | — | ±5° at each rotation end | — | ±5° at each rotation end |
| **Cylinder bore size** | ø6 | | ø8 | |
| **Port size** | M3 | | | |

Note) If optimum accuracy of the rotation angle is required, select an actuator with external stopper.

## Allowable Kinetic Energy and Rotation Time Adjustment Range

| Size/Type | | | Allowable kinetic energy (mJ) | Rotation time adjustment range for stable operation (s/90°) |
|---|---|---|---|---|
| **05** | Basic type | **CRJB05** | 0.25 | 0.1 to 0.5 |
| | With external stopper | **CRJU05** | 1.0 | |
| **1** | Basic type | **CRJB 1** | 0.40 | |
| | With external stopper | **CRJU 1** | 2.0 | |

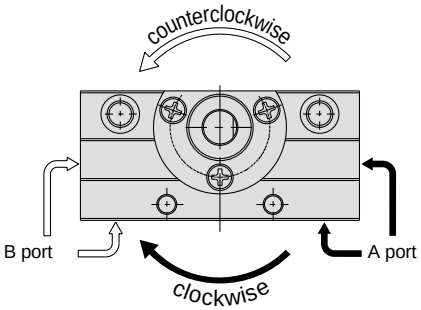
## Weights

| Type/Size | | Model | Weight (g) Note) |
|---|---|---|---|
| Basic type | **05** | **CRJB05-90** | 32 |
| | | **CRJB05-100** | |
| | | **CRJB05-180** | 39 |
| | | **CRJB05-190** | |
| | **1** | **CRJB 1-90** | 54 |
| | | **CRJB 1-100** | |
| | | **CRJB 1-180** | 67 |
| | | **CRJB 1-190** | |
| With external stopper | **05** | **CRJU05-90** | 47 |
| | | **CRJU05-180** | 53 |
| | **1** | **CRJU 1-90** | 70 |
| | | **CRJU 1-180** | 81 |

Note) Above values do not include auto switch weights.

## Rotating Direction and Rotation Angle

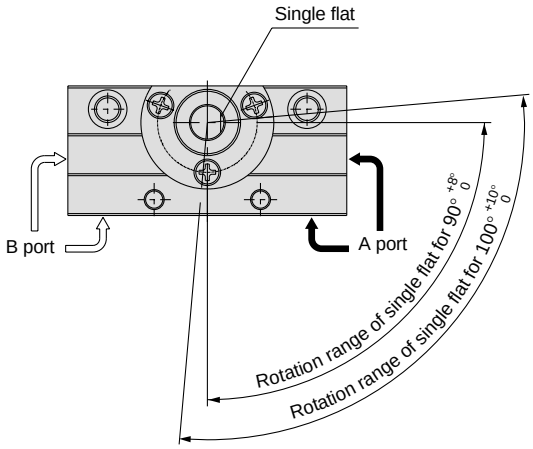
- The shaft turns clockwise when the A port is pressurized, and counterclockwise when the B port is pressurized.
- For actuators with external stopper, the rotation end can be set within the ranges shown in the drawing by adjusting the stopper bolt.



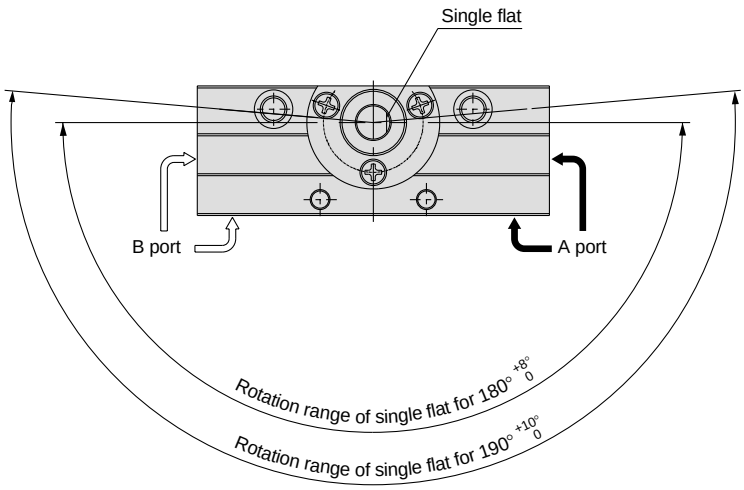



### Basic type

**For 90° and 100°**

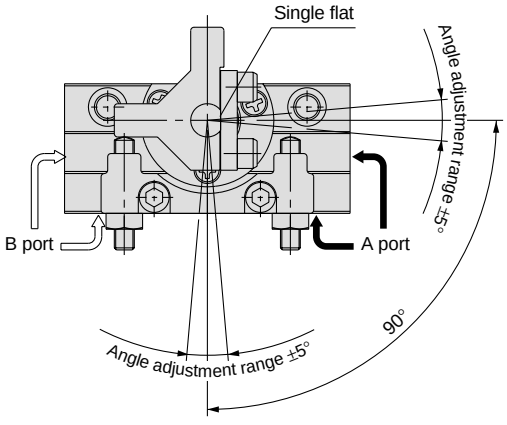



**For 180° and 190°**

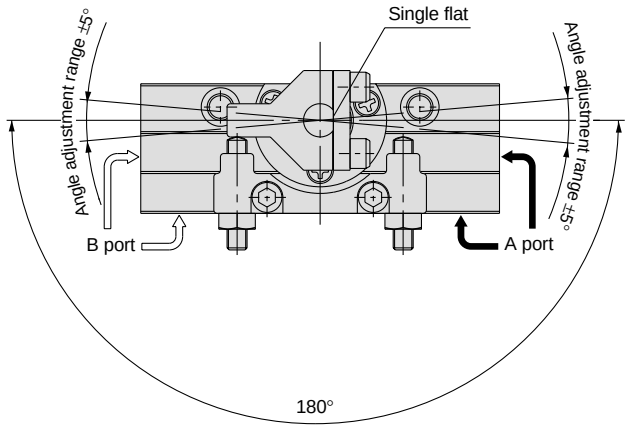



### With external stopper

**For 90°**



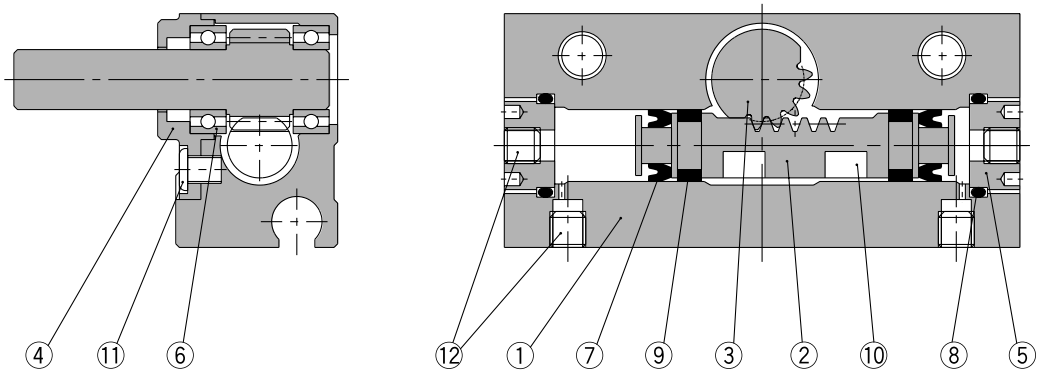

**For 180°**



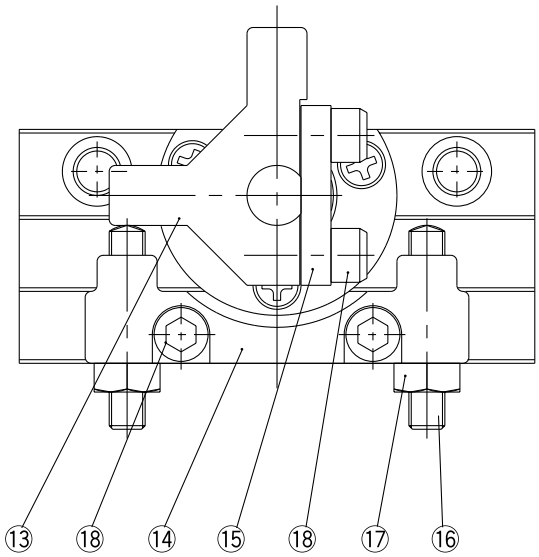

Note) • The drawings show the rotation range for the shaft's single flat.
• The single flat position in the drawings shows the counterclockwise rotation end when the rotation angle is adjusted to 90° and 180°.

## Construction

### Basic type/CRJB




### With external stopper/CRJU




### Parts list

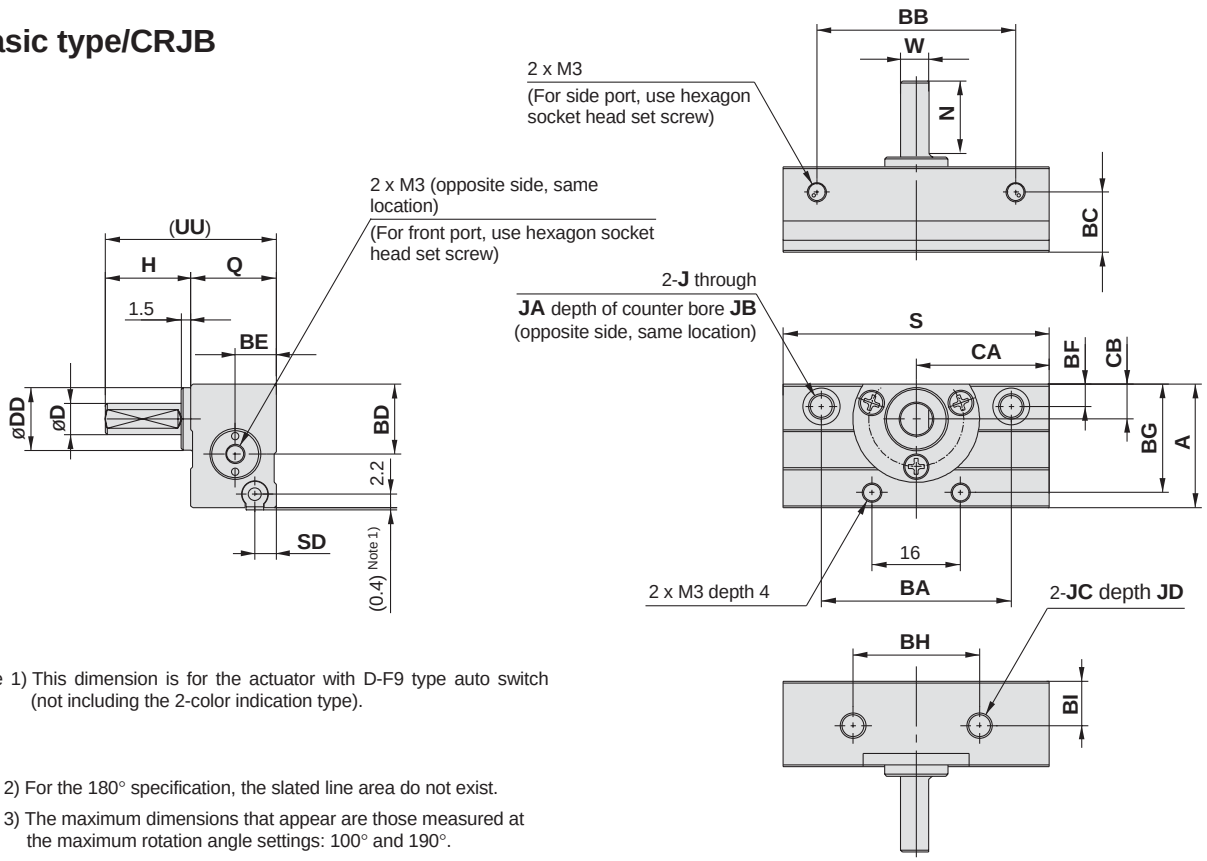
| No. | Description | Material |
|---|---|---|
| 1 | **Body** | Aluminum alloy |
| 2 | **Piston** | Stainless steel |
| 3 | **Shaft** | Stainless steel |
| 4 | **Bearing retainer** | Aluminum alloy |
| 5 | **Cover** | Aluminum alloy |
| 6 | **Bearing** | Bearing steel |
| 7 | **Piston seal** | NBR |
| 8 | **O-ring** | NBR |
| 9 | **Wear ring** | Resin |

| No. | Description | Material |
|---|---|---|
| 10 | **Magnet** | Magnetic material |
| 11 | **Round head no. 0 Phillips screw** | Steel wire |
| 12 | **Hexagon socket head set screw** | Stainless steel |
| 13 | **Stopper** | Chrome molybdenum steel |
| 14 | **Holder** | Aluminum alloy |
| 15 | **Stopper retainer** | Steel |
| 16 | **Hexagon socket head set screw** | Steel wire |
| 17 | **Hexagon nut** | Steel wire |
| 18 | **Hexagon socket head cap screw** | Stainless steel |

∗ The mounting position of hexagon socket head set screws (no. 12) varies depending on the connecting port position.

## Dimensions/Size 0.5, 1

### Basic type/CRJB

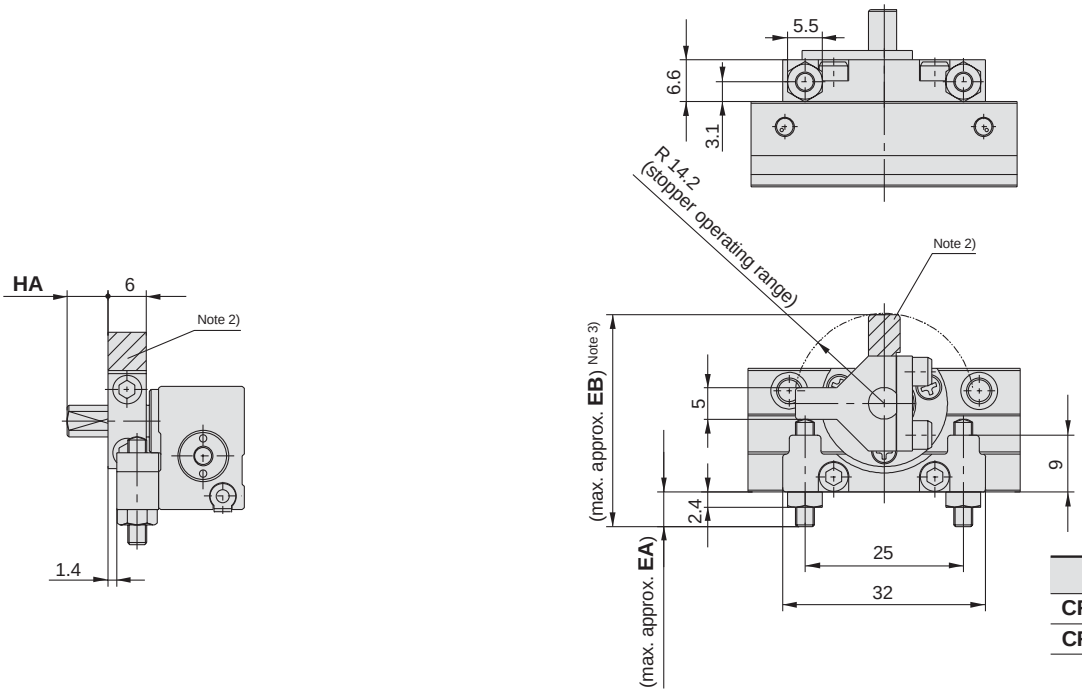



Note 1) This dimension is for the actuator with D-F9 type auto switch (not including the 2-color indication type).

Note 2) For the 180° specification, the slated line area do not exist.

Note 3) The maximum dimensions that appear are those measured at the maximum rotation angle settings: 100° and 190°.

### With external stopper/CRJU



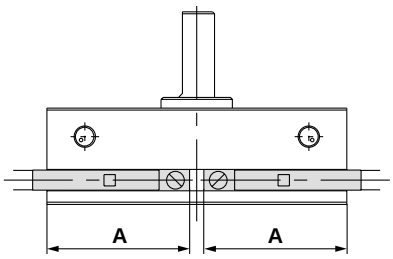

(mm)

| Size | EA | EB | HA |
|---|---|---|---|
| **CRJU05** | 5.6 | 33.8 | 6.5 |
| **CRJU 1** | 5.6 | 35.8 | 7.5 |

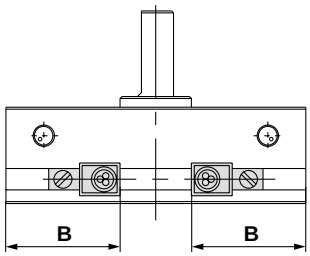
(mm)

| Size | Rotation angle | A | BA | BB | BC | BD | BE | BF | BG | BH | BI | CA | CB | D | DD | J | JA | JB | JC | JD | H | N | Q | S | SD | UU | W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CRJB05** | 90° | 19.5 | 30 | 32.4 | 9.5 | 11 | 6.5 | 3.5 | 17.1 | 20 | 7 | 21.5 | 5.5 | 5g6 | 10h9 | M4 | 5.8 | 3.5 | M4 | 5 | 14.5 | 12.5 | 13.5 | 43 | 3.4 | 28 | 4.5 |
| | 180° | | | 43.4 | | | | | | | | 27 | | | | | | | | | | | | 54 | | | |
| **CRJB 1** | 90° | 23.5 | 35 | 37.4 | 12.5 | 14 | 9 | 4.5 | 21.1 | 22 | 8.5 | 24 | 7.5 | 6g6 | 14h9 | M5 | 7.5 | 4.5 | M5 | 6 | 15.5 | 13.5 | 16.5 | 48 | 5.9 | 32 | 5.5 |
| | 180° | | | 50.4 | | | | | | | | 30.5 | | | | | | | | | | | | 61 | | | |

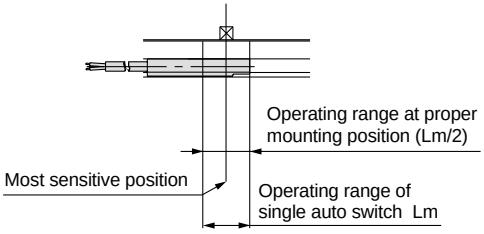
## Auto Switch/Proper Mounting Position at Rotation End




**For D-F9**




**For D-F8**




| Size | Rotation | D-F9 auto switch | | | D-F8 auto switch | | |
|---|---|---|---|---|---|---|---|
| | | A | Rotation range θm | Actuation range | B | Rotation range θm | Actuation range |
| **05** | 90° | 20.5 | 40° | 10° | 16.5 | 20° | 10° |
| | 180° | 23.2 | | | 19.2 | | |
| **1** | 90° | 22.4 | 30° | 10° | 18.4 | 15° | 10° |
| | 180° | 25.6 | | | 21.6 | | |

Rotation range θm: Value of the operating range Lm of a single auto switch converted to an axial rotation range.

Actuation range: Value of auto switch hysteresis converted to an angle.

# Auto Switch Common Specifications

## Auto Switch Common Specifications

| Type | Solid state switch |
|---|---|
| Operating time | 1ms or less |
| Impact resistance | 1000m/s² |
| Insulation resistance | 50MΩ or more at 500VDC (between lead wire and case) |
| Withstand voltage | 1000VAC for 1min.<br>(between lead wire and case) |
| Ambient temperature | –10° to 60°C |
| Enclosure | IEC529 standard IP67<br>JISC0920 watertight construction |



## Lead Wire Lengths

**Indication of lead wire length**

**(Example)**

D-F9P[L]

**Lead wire length**

| | |
|---|---|
| **Nil** | 0.5m |
| **L** | 3m |
| **Z** | 5m |

Note 1) Lead wire length Z: Auto switch applicable to 5m length
Solid state switches: All models are produced upon receipt of order.

Note 2) The standard lead wire length is 3m for water resistant 2-color indication solid state switches. (0.5m is not available.)

Note 3) For solid state with flexible wire specification, enter "–61" after the lead wire length.

**(Example)**

D-F9PL-[61]

**Flexible specification**

## Lead Wire Colour Changes

Lead wire colours of SMC auto switches have been changed in order to meet standard IEC947-5-2 for production beginning September, 1996 and thereafter, as shown in the tables below.
Take special care regarding wire polarity during the time that the old colours still coexist with the new colours.

**2-wire**

| | Old | New |
|---|---|---|
| (+) Output | Red | Brown |
| (–) Output | Black | Blue |

**3-wire**

| | Old | New |
|---|---|---|
| (+) Power supply | Red | Brown |
| GND Power supply | Black | Blue |
| Output | White | Black |

**Solid state with diagnostic output**

| | Old | New |
|---|---|---|
| (+) Power supply | Red | Brown |
| GND Power supply | Black | Blue |
| Output | White | Black |
| Diagnostic output | Yellow | Orange |

**Solid state with latch type diagnostic output**

| | Old | New |
|---|---|---|
| (+) Power supply | Red | Brown |
| GND Power supply | Black | Blue |
| Output | White | Black |
| Latch type diagnostic output | Yellow | Orange |

# *Series CRJ*/Specific Product Precautions

**Be sure to read before handling.**

## Rotation Angle Adjustment

### ⚠Caution

As a standard feature, the actuator with external stopper is equipped with a rotation angle adjustment screw that can be used to adjust the angle of rotation.

| Size | Angle adjustment per single rotation of angle adjustment screw |
|---|---|
| **05** | 2.3° |
| **1** | 2.3° |

The rotation adjustment range for the actuator with external stopper is ±5° at each rotation end. Please note that adjusting beyond this range, may cause product malfunction.

## Mounting of Speed Controller and Fittings

### ⚠Caution

**The M3 piping port is used. In case the speed controller or fittings are directly connected, use the series listed below.**

- Speed controller
  AS12□1F/Elbow type
  AS13□1F/Universal type
- One-touch fitting
  One-touch mini Series KJ
- Reducer bushing Series M3

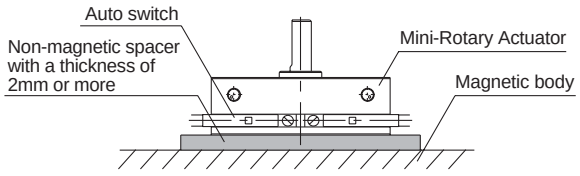
## Auto Switch Mounting

### ⚠Caution

**If a size 05 actuator with auto switch is being used, keep the magnetic body away at least 2mm or more from the bottom of the actuator.**

If the magnetic body comes closer than 2mm, malfunction of the auto switch may occur due to the magnetic force drop.

∗ When using the bottom face for mounting, a non-magnetic spacer (such as aluminum) is required as shown below.




## Maintenance

### ⚠Caution

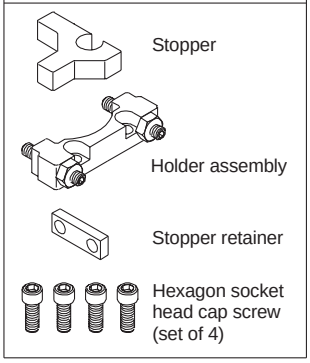
**This product requires special tools; therefore, it cannot be disassembled for maintenance.**

## External Stopper Unit

### ⚠Caution

**Order external stopper unit with the unit part numbers shown below.**

**Component parts**




| Model | Unit part no. |
|---|---|
| **CRJU05- 90** | P531010-1 |
| **CRJU05-180** | P531010-2 |
| **CRJU 1- 90** | P531020-1 |
| **CRJU 1- 180** | P531020-2 |

Note 1) External stopper units for 180° cannot be applied to the 90° Mini-Rotary Actuators.

Note 2) When using external stoppers for 90°, use Mini-Rotary Actuators with a rotation range of 100°, and for 180°, use actuators with a rotation range of 190°.

## External Stopper Assembly Procedure

∗ Actuators with external stopper (Model CRJU) come already assembled; therefore, the following procedure is not required.

### ⚠Caution

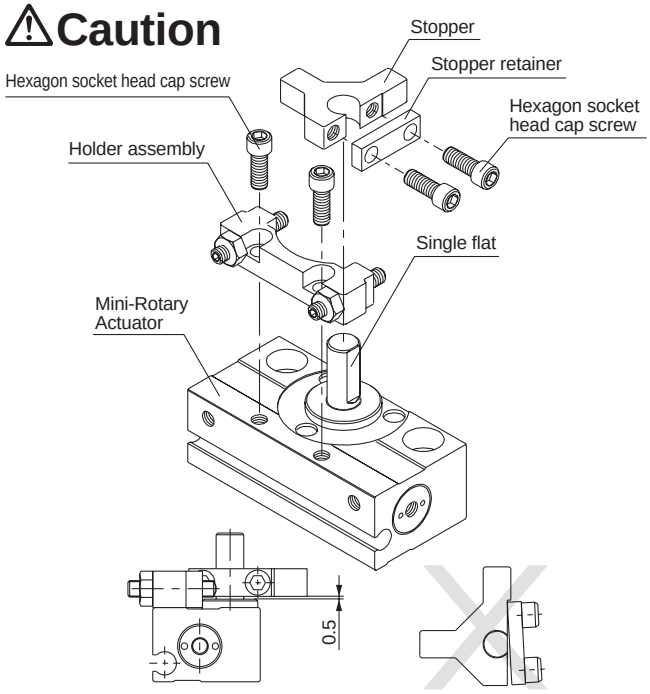



**Figure 1** **Figure 2**

1 Assemble the stopper retainer to the stopper temporarily. Then place the stopper retainer in the single flat position and tighten with hexagon socket head cap screws.

Leave a space of approximately 0.5mm between the stopper and the Mini-Rotary Actuator, as shown in Figure 1.

Tighten the hexagon socket head cap screws evenly so that the stopper retainer is not unevenly tightened as in Figure 2.

Furthermore, take precautions to avoid applying excessive force to the shaft when tightening.

2 Tighten the holder assembly with hexagon socket head cap screws.

| | Tightening torque N·m |
|---|---|
| Hexagon socket head cap screws | 0.8 to 1.2 |