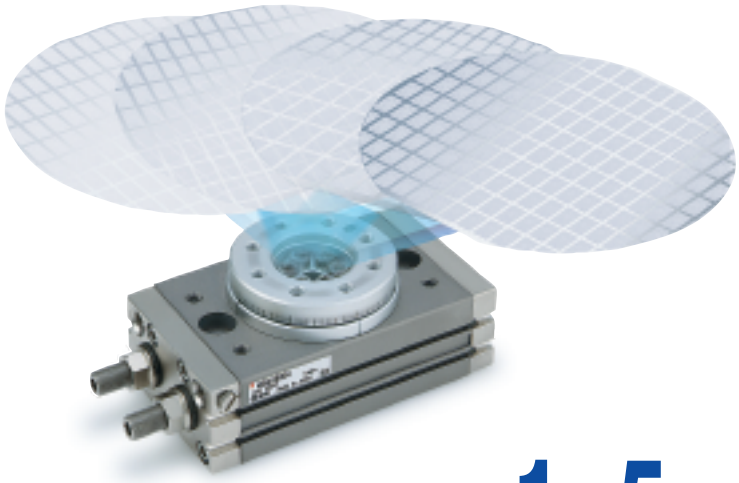
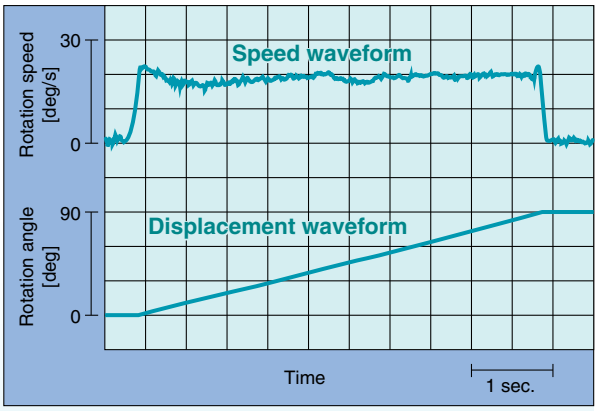
# Low-Speed Rotary Actuator

## Possible to transfer a workpiece at low-speed.



### ● Realized a stable motion at 5s/90°.

Smooth motion without stick-slip phenomemon




### ● Rotation time adjustment range: 1 to 5 (s/90°)

| Model | | Size | Rotation time adjustment range (s/90°) 1 2 3 4 5 |
|---|---|---|---|
| Low-speed | **CRQ2X** | 10, 15, 20, 30, 40 | **1 to 5** (0.7 to 5 for CRQ2X□10,15) |
| | **MSQX** | 10, 20, 30, 50 | |
| Stand-ard | CRQ2 | 10, 15, 20, 30, 40 | 0.2 to 1 (0.2 to 0.7 for CRQ2□10,15) |
| | MSQ | 10, 20, 30, 50 | |

Measurement conditions / Fluid: Air
Mounting orientation: Horizonal without load
Operating pressure: 0.5 MPa
Pneumatic circuit: Meter-out circuit
Ambient temperature: Room temperature

### ● Dimensions compatible with the CRQ2, MSQ series


## Series CRQ2X/MSQX

SMC

CAT.ES20-197A

# Series CRQ2X/MSQX
# Model Selection

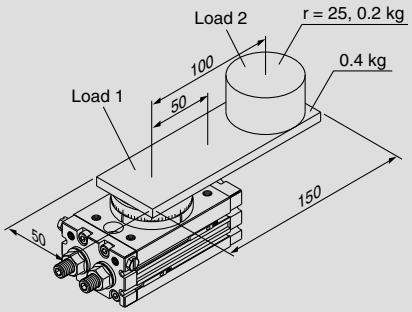
* **The selection procedure of the rotary for low-speed is the same as for an ordinary rotary. If the rotation time exceeds 2s per 90°, however, the necessary torque and the kinetic energy are calculated with rotation time of 2s per 90°.**

| Selection Procedure | Remarks | Selection Example |
|---|---|---|

## 0 Operating conditions

**Operating conditions are as follows:**
- **Provisionally selected model**
- **Operating pressure: MPa**
- **Mounting position**
- **Load type**
  - **Static load: N·m**
  - **Resistance load: N·m**
  - **Inertial load: N·m**
- **Load dimension: m**
- **Load mass: kg**
- **Rotation time: s**
- **Rotation angle: rad**

- **See P.3 for load type.**
- **The unit of the rotation angle is Radians.**
  **180° = πrad**
  **90° = π/2rad**




**Provisionally selected model: MSQXB10A**
**Operating pressure: 0.3 MPa**
**Mounting position: Vertical, Type of load: Inertial load**
**Rotation time: 6s  Rotation angle: πrad (180°)**

## 1 Calculation of moment of inertia

**Calculate the moment of inertia of the load.**

**⇒ P.2**

- **If the moment of inertia of the load is made up of multiple components, calculate the moment of inertia of each component and add them together.**

**Load 1 moment of inertia: $I_1$**

$$I_1 = 0.4 \times \frac{0.15^2 + 0.05^2}{12} + 0.4 \times 0.05^2 = 0.001833$$

**Load 2 moment of inertia: $I_2$**

$$I_2 = 0.2 \times \frac{0.025^2}{2} + 0.2 \times 0.1^2 = 0.002063$$

**Total moment of inertia: $I$**

$$I = I_1 + I_2 = 0.003896\ [kg \cdot m^2]$$

## 2 Calculation of necessary torque

**Calculate necessary torque corresponding to the load type, and ensure it is within effective torque range.**

- **Static load (Ts)**
  **Necessary torque T = Ts**
- **Resistance load (Tf)**
  **Necessary torque T = Tf x (3 to 5)**
- **Inertial load (Ta)**
  **Necessary torque T = Ta x 10**

**⇒ P.3**

- **When calculating the inertial load, if the rotation time exceeds 2s per 90°, inertial load is calculated with rotation time of 2s per 90°.**
- **Even for resistance load, when the load is rotated, necessary torque calculated from inertial load shall be added.**

  **Necessary torque T = Tf x (3 to 5) + Ta x 10**

**Inertial load: Ta**

$$Ta = I \cdot \dot{\omega}$$

$$\dot{\omega} = \frac{2\theta}{t^2}\ [rad/s^2]$$

**Necessary torque: T**

$$T = Ta \times 10$$

$$= 0.003896 \times \frac{2 \times \pi}{4^2} \times 10 = 0.015\ [N \cdot m]$$

**(t is calculated with 2s per 90°.)**

**0.109 N·m < Effective torque  OK**

## 3 Checking rotation time

**Confirm that it is within the adjustable range of rotation time.**

**⇒ P.4**

- **Converted to the time per 90° for comparison. (For comparison, 6s/180° is converted to 3s/90°.)**

$$1.0 \leq t \leq 5$$

**t = 3s/90° OK**

## 4 Calculation of kinetic energy

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

**Can be confirmed by the graph of the moment of inertia and the rotation time.**

**⇒ P.4**

- **If the rotation time exceeds 2s per 90°, kinetic energy is calculated with rotation time of 2s per 90°.**
- **If the allowable value is exceeded, an external cushioning mechanism such as an absorber needs to be installed.**

$$E = \frac{1}{2} \cdot I \cdot \omega^2$$

$$\omega = \frac{2 \cdot \theta}{t}$$

**Kinetic energy**

$$\frac{1}{2} \times 0.003896 \times \left(\frac{2 \times \pi}{4}\right)^2 = 0.0048\ [J]$$

**(t is calculated with 2s per 90°.)**

**0.0048 [J] < Allowable energy  OK**

## 5 Checking allowable load

**Check if the load applied to the product is within the allowable range.**

**⇒ P.5**

- **If the allowable value is exceeded, an external bearing needs to be installed.**

**M = 0.4 x 9.8 x 0.05 + 0.2 x 9.8 x 0.1**
**= 0.392 [N·m]**

**0.392 [N·m] < Allowable moment load  OK**

## 6 Calculation of air consumption and necessary air quantity

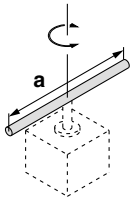
**Calculate air consumption and necessary air quantity as required.** **⇒ P.6**

## Equation Table of Moment of Inertia (Calculation of moment of inertia I)

I: Moment of inertia (kg·m²) **m**: Load mass (kg)

### 1. Thin shaft

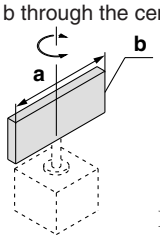
Position of rotational axis:
Perpendicular to the shaft through the center of gravity




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

### 2. Thin rectangular plate

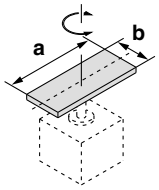
Position of rotational axis:
Parallel to side b through the center of gravity




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

### 3. Thin rectangular plate (Including rectangular parallelepiped)

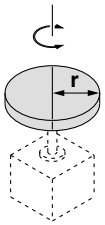
Position of rotational axis:
Perpendicular to the plate through the center of gravity




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

### 4. Round plate (Including column)

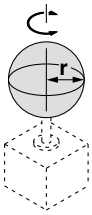
Position of rotational axis:
Passing through the center axis




$$I = \mathbf{m} \cdot \frac{\mathbf{r}^2}{2}$$

### 5. Solid sphere

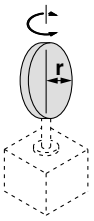
Position of rotational axis:
Passing through the diameter




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

### 6. Thin round plate

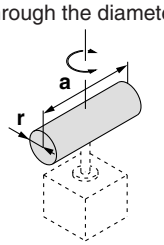
Position of rotational axis:
Passing through the diameter




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

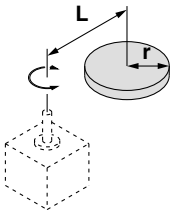
### 7. Cylindrical

Position of rotational axis:
Passing through the diameter and the center of gravity




$$I = \mathbf{m} \cdot \frac{3\mathbf{r}^2 + \mathbf{a}^2}{12}$$

### 8. When rotational axis and the center of the load are not concentric.

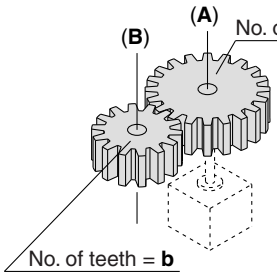



$$I = \mathbf{K} + \mathbf{m} \cdot \mathbf{L}^2$$

**K**: The moment of inertia around the center of gravity of the load

In case of 4. Round plate $\mathbf{K} = \mathbf{m} \cdot \frac{\mathbf{r}^2}{2}$

### 9. Gear transmission



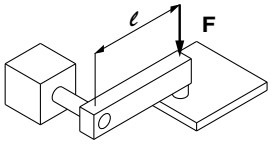
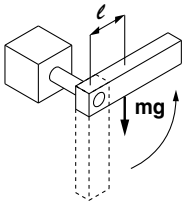
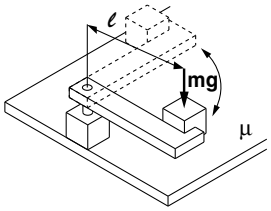
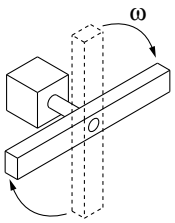
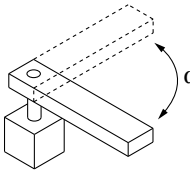

1. Find the moment of inertia $I_B$ for the rotation of shaft (**B**).
2. Next, $I_B$ is entered to find $I_A$ the moment of inertia for the rotation of shaft (**A**) as

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

# Model Selection

## Load Type

**Calculation method of necessary torque depends on the load type. Refer the below table.**

| Load type | | |
|---|---|---|
| **Static load: Ts** | **Resistance load: Tf** | **Inertial load: Ta** |
| Only pressing force is necessary. (e.g. for clamping) | Weight or friction force is applied to rotating direction. | Rotate the load with inertia. |
|  | Gravity is applied.<br>  <br>  <br>Friction force is applied. | Center of rotation and center of gravity of the load are concentric.<br>  <br>  <br>Rotation shaft is vertical (up and down). |
| **Ts** = **F**·ℓ<br><br>**Ts**: Static load (N·m)<br>**F** : Clamping force (N)<br>ℓ : Distance from the rotation center to the clamping position (m) | Gravity is applied in rotating direction.<br><br>**Tf** = **m**·**g**·ℓ<br><br>Friction force is applied in rotating direction.<br><br>**Tf** = μ·**m**·**g**·ℓ<br><br>**Tf** : Resistance load (N·m)<br>**m** : Load mass (kg)<br>**g** : Gravitational acceleration 9.8 (m/s$^2$)<br>ℓ : Distance from the rotation center to the point of application of the weight or friction force (m)<br>μ : Friction coefficient | $\mathbf{Ta} = I \cdot \omega = I \cdot \frac{2\theta}{\mathbf{t}^2}$<br><br>**Ta**: Inertial load (N·m)<br>I : Moment of inertia (kg·m$^2$)<br>ω : Angular acceleration (rad/s$^2$)<br>θ : Rotation angle (rad)<br>**t** : Rotation time (s)<br><br>For low speed rotary, if the rotation time exceeds 2s per 90°, inertial load is calculated with rotation time of 2s per 90°. |
| Necessary torque: **T** = **Ts** | Necessary torque: **T** = **Tf** x (3 to 5) Note) | Necessary torque: **T** = **Ta** x 10 Note) |

• Resistance load: Gravity or friction force is applied to rotating direction.
  Ex. 1) Rotation shaft is horizontal (lateral), and the rotation center and the center of gravity of the load are not concentric.
  Ex. 2) Load moves by sliding on the floor

  ∗ The total of resistance load and inertial load is the necessary torque. **T** = **Tf** x (3 to 5) + **Ta** x 10

• Not resistance load: Neither weight or friction force is applied in rotating direction.
  Ex. 1) Rotation shaft is vertical (up and down).
  Ex. 2) Rotation shaft is horizontal (lateral), and rotation center and the center of gravity of the load are not concentric.

  ∗ Necessary torque is inertial load only. **T** = **Ta** x 10

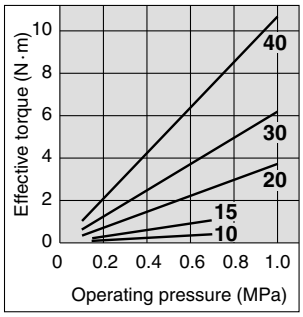
Note) To adjust the speed, margin is necessary for Tf and Ta.

## Effective Torque

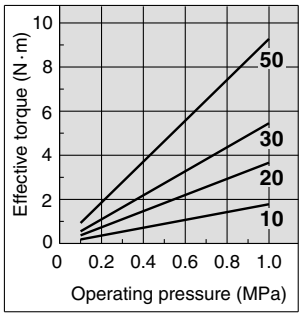
Unit: N·m

| Model | Size | Operating pressure (MPa) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.1 | 0.15 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| CRQ2X | 10 | — | 0.09 | 0.12 | 0.18 | 0.24 | 0.30 | 0.36 | 0.42 | — | — | — |
| | 15 | — | 0.22 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.04 | — | — | — |
| | 20 | 0.37 | 0.55 | 0.73 | 1.10 | 1.47 | 1.84 | 2.20 | 2.57 | 2.93 | 3.29 | 3.66 |
| | 30 | 0.62 | 0.94 | 1.25 | 1.87 | 2.49 | 3.11 | 3.74 | 4.37 | 4.99 | 5.60 | 6.24 |
| | 40 | 1.06 | 1.59 | 2.11 | 3.18 | 4.24 | 5.30 | 6.36 | 7.43 | 8.48 | 9.54 | 10.6 |
| MSQX | 10 | 0.18 | — | 0.36 | 0.53 | 0.71 | 0.89 | 1.07 | 1.25 | 1.42 | 1.60 | 1.78 |
| | 20 | 0.37 | — | 0.73 | 1.10 | 1.47 | 1.84 | 2.20 | 2.57 | 2.93 | 3.29 | 3.66 |
| | 30 | 0.55 | — | 1.09 | 1.64 | 2.18 | 2.73 | 3.19 | 3.82 | 4.37 | 4.91 | 5.45 |
| | 50 | 0.93 | — | 1.85 | 2.78 | 3.71 | 4.64 | 5.57 | 6.50 | 7.43 | 8.35 | 9.28 |

**CRQ2X**




**MSQX**




Note 1) Values of operating torque in the above table are representative values, and not guaranteed. Make use of the values as a reference when ordering.
Note 2) Except for cases when an external stopper is used, the holding torque at the operation end is half of the table value.

## Kinetic Energy/Rotating Time

**In a rotational movement, the kinetic energy of a load may damage the internal parts, even if the required torque for a load is small. Consider the moment of inertia and rotation time before selecting a model.**
**(For model selection, refer to the moment of inertia and rotation time graph as shown on the below table.)**

### Allowable kinetic energy and rotation time adjustment range

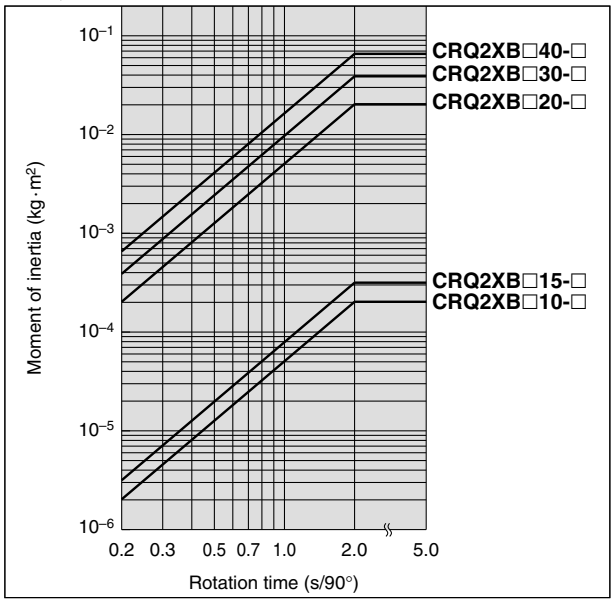
Set the rotation time, within stable operational guidelines, using the adjustment range specification table as detailed below. When operating at low-speeds which exceed the rotation time adjustment range, use caution as it may result in sticking or malfunction.

| Model | Size | Allowable kinetic energy (J) | Stable operational rotation time adjustment range (s/90°) |
|---|---|---|---|
| CRQ2X | 10 | 0.00025 | 0.7 to 5 |
| | 15 | 0.00039 | |
| | 20 | 0.025 | 1 to 5 |
| | 30 | 0.048 | |
| | 40 | 0.081 | |
| MSQX | 10 | 0.007 | |
| | 20 | 0.025 | |
| | 30 | 0.048 | |
| | 50 | 0.081 | |

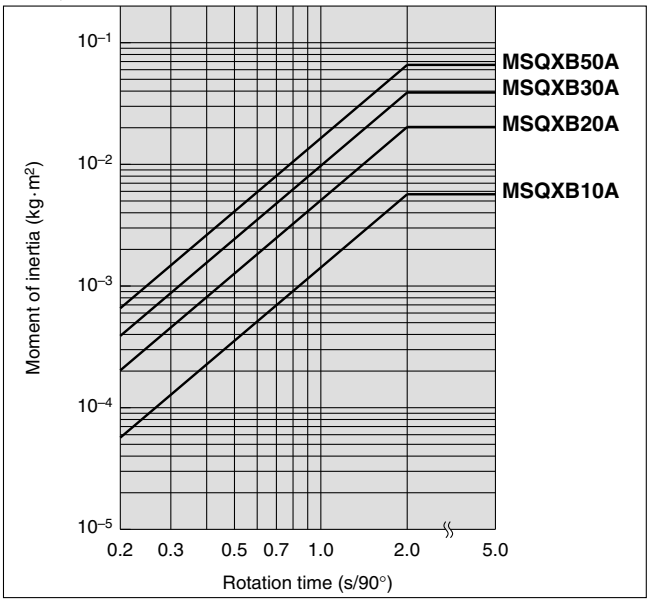
## Model Selection

Select a model based on the moment of inertia and rotation time as shown graph below.

**CRQ2X**




**MSQX**



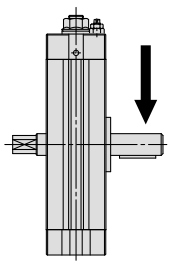
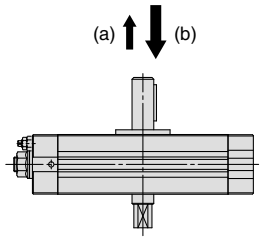

∗ If the rotation time exceeds 2s per 90°, kinetic energy is calculated with rotation time of 2s per 90°.

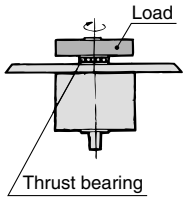
# Model Selection

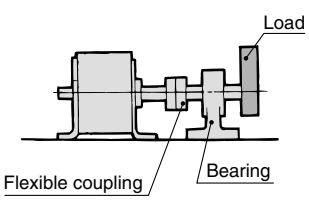
## Allowable Load

### CRQ2X

A load up to the allowable radial/thrust load can be applied provided that a dynamic load is not generated. However, applications which apply a load directly to the shaft should be avoided whenever possible. In order to further improve the operating conditions, a method such as that shown in the drawing on the right side is recommended so that a direct load is not applied to the shaft.

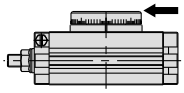
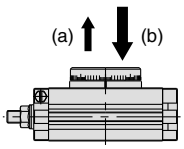
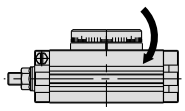
| Size |  |  |
|---|---|---|
| | Allowable radial load (N) | Allowable thrust load (N) |
| | | (a) / (b) |
| **10** | 14.7 | 7.8 / 15.7 |
| **15** | 19.6 | 9.8 / 19.6 |
| **20** | 49 | 29.4 / 49 |
| **30** | 78 | 49 / 98 |
| **40** | 98 | 59 / 108 |




### MSQX

Do not allow the load and moment applied to the table to exceed the allowable values shown in the below table.
(Operation beyond the allowable values can cause adverse effects on service life, such as play in the table and loss of accuracy.)

| Size |  |  |  |
|---|---|---|---|
| | Allowable radial load (N) | Allowable thrust load (N) | Allowable moment (N·m) |
| | | (a) / (b) | |
| **10** | 78 | 74 / 78 | 2.4 |
| **20** | 147 | 137 / 137 | 4.0 |
| **30** | 196 | 197 / 363 | 5.3 |
| **50** | 314 | 296 / 451 | 9.7 |

# Rotary Actuator Technical Data
# Air Consumption

Air consumption is the volume of air which is expended by the rotary actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve, etc. This is necessary for selection of a compressor and for calculation of its running cost.

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

**Formulas**

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

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

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

**$Q_{CR}$** = Air consumption of rotary actuator [ℓ (ANR)]
**$Q_{CP}$** = Air consumption of tubing or piping [ℓ (ANR)]
**V** = Internal volume of rotary actuator [$cm^3$]
**P** = Operating pressure [MPa]
**ℓ** = Length of piping [mm]
**a** = Internal cross section of piping [$mm^2$]
**$Q_C$** = Air consumption required for one reciprocation of rotary actuator [ℓ (ANR)]

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

**Formulas**

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

**$Q_{C2}$** = Compressor discharge flow rate [ℓ/min (ANR)]
**n** = Actuator reciprocations per minute
**Reserve factor**: 1.5 or greater

### 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 |
| **TU0805** | 8 | 5 | 19.6 |
| **T□0806** | 8 | 6 | 28.3 |
| **1/8B** | — | 6.5 | 33.2 |
| **T□1075** | 10 | 7.5 | 44.2 |
| **TU1208** | 12 | 8 | 50.3 |
| **T□1209** | 12 | 9 | 63.6 |
| **1/4B** | — | 9.2 | 66.5 |
| **TS1612** | 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: **$Q_{CR}$** ℓ (ANR)

| Model | Size | Rotation angle (°) | Internal volume **V** ($cm^3$) | Operating pressure (MPa) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.1 | 0.15 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| **CRQ2X** | **10** | 90 | 1.2 | — | 0.006 | 0.007 | 0.009 | 0.012 | 0.014 | 0.016 | 0.018 | — | — | — |
| | | 180 | 2.2 | — | 0.011 | 0.013 | 0.018 | 0.022 | 0.026 | 0.031 | 0.035 | — | — | — |
| | **15** | 90 | 2.9 | — | 0.015 | 0.017 | 0.023 | 0.029 | 0.035 | 0.041 | 0.046 | — | — | — |
| | | 180 | 5.5 | — | 0.028 | 0.033 | 0.044 | 0.055 | 0.066 | 0.077 | 0.088 | — | — | — |
| | **20** | 90 | 7.1 | 0.028 | 0.036 | 0.043 | 0.057 | 0.071 | 0.085 | 0.099 | 0.114 | 0.128 | 0.142 | 0.156 |
| | | 180 | 13.5 | 0.054 | 0.068 | 0.081 | 0.108 | 0.135 | 0.162 | 0.189 | 0.216 | 0.243 | 0.270 | 0.297 |
| | **30** | 90 | 12.1 | 0.048 | 0.060 | 0.073 | 0.097 | 0.121 | 0.145 | 0.169 | 0.193 | 0.218 | 0.242 | 0.266 |
| | | 180 | 23.0 | 0.092 | 0.115 | 0.138 | 0.184 | 0.230 | 0.276 | 0.322 | 0.368 | 0.413 | 0.459 | 0.505 |
| | **40** | 90 | 20.6 | 0.082 | 0.103 | 0.123 | 0.164 | 0.206 | 0.247 | 0.288 | 0.329 | 0.370 | 0.411 | 0.452 |
| | | 180 | 39.1 | 0.156 | 0.195 | 0.234 | 0.313 | 0.391 | 0.469 | 0.547 | 0.625 | 0.703 | 0.781 | 0.859 |
| **MSQX** | **10** | 190 | 6.6 | 0.026 | 0.033 | 0.040 | 0.053 | 0.066 | 0.079 | 0.092 | 0.106 | 0.119 | 0.132 | 0.145 |
| | **20** | | 13.5 | 0.054 | 0.068 | 0.081 | 0.108 | 0.135 | 0.162 | 0.189 | 0.216 | 0.243 | 0.270 | 0.297 |
| | **30** | | 20.1 | 0.080 | 0.101 | 0.121 | 0.161 | 0.201 | 0.241 | 0.281 | 0.322 | 0.362 | 0.402 | 0.442 |
| | **50** | | 34.1 | 0.136 | 0.171 | 0.205 | 0.273 | 0.341 | 0.409 | 0.477 | 0.546 | 0.614 | 0.682 | 0.750 |

# Low-Speed Compact Rotary Actuator
## Rack & Pinion Type
# *Series CRQ2X*
## Size: 10, 15, 20, 30, 40

### How to Order

**Standard** CRQ2 X B S 20 ☐ – 90

**With auto switch** CDRQ2 X B S 20 ☐ – 90 – M9BW ☐

- Built-in magnet
- Low-speed specification

**Shaft type**

| | |
|---|---|
| **S** | Single shaft |
| **W** | Double shaft |

**Size**

| |
|---|
| **10** |
| **15** |
| **20** |
| **30** |
| **40** |

**Thread type**

| Port type | | Size |
|---|---|---|
| **Nil** | M5 | 10, 15 |
| | Rc 1/8 | 20, 30, 40 |
| **TF** | G 1/8 | |
| **TN** | NPT 1/8 | |
| **TT** | NPTF 1/8 | |

**Rotation angle**

| | |
|---|---|
| **90** | 80° to 100° |
| **180** | 170° to 190° |

**Number of auto switches**

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

**Auto switch**

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

∗ For applicable auto switch models, refer to the below table.

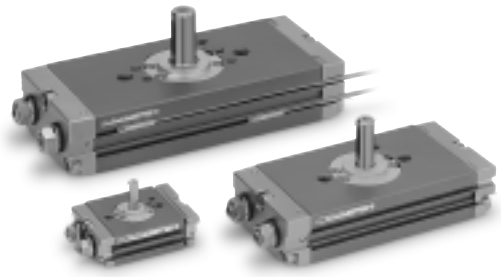
### Applicable Auto Switches/Refer to pages 24 through to 27 for further information on auto switches.

| Type | Special function | Electrical entry | Indicator light | Wiring (Output) | Load voltage | | | Auto switch model | | Lead wire length (m)∗ | | | | Applicable load | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DC | | AC | Perpendicular | In-line | 0.5 (Nil) | 1 (M) | 3 (L) | 5 (Z) | | |
| Solid state switch | —— | Grommet | Yes | 3-wire (NPN) | 24 V | 5 V,12 V | — | **M9NV** | **M9N** | ● | — | ● | ○ | IC circuit | Relay, PLC |
| | | | | 3-wire (PNP) | | | | **M9PV** | **M9P** | ● | — | ● | ○ | | |
| | | | | 2-wire | | 12 V | | **M9BV** | **M9B** | ● | — | ● | ○ | — | |
| | Diagnostic indication (2-color) | | | 3-wire (NPN) | | 5 V,12 V | | **M9NWV** | **M9NW** | ● | ● | ● | ○ | IC circuit | |
| | | | | 3-wire (PNP) | | | | **M9PWV** | **M9PW** | ● | ● | ● | ○ | | |
| | | | | 2-wire | | 12 V | | **M9BWV** | **M9BW** | ● | ● | ● | ○ | — | |
| | Water resistant ∗∗ (2-color) | | | 3-wire (NPN) | | 5 V,12 V | | **M9NAV** | **M9NA** | ○ | ○ | ● | ○ | IC circuit | |
| | | | | 3-wire (PNP) | | | | **M9PAV** | **M9PA** | ○ | ○ | ● | ○ | | |
| | | | | 2-wire | | 12 V | | **M9BAV** | **M9BA** | ○ | ○ | ● | ○ | — | |
| Reed switch | —— | Grommet | No | 2-wire | 24 V | 12 V | 100 V or less | **A90V** | **A90** | ● | — | ● | — | IC circuit | Relay, PLC |
| | | | Yes | 3-wire (NPN equiv.) | — | 5 V | — | **A96V** | **A96** | ● | — | ● | — | | — |
| | | | | 2-wire | 24 V | 12 V | 100 V | **A93V** | **A93** | ● | — | ● | — | — | Relay, PLC |

∗∗ Although it is possible to mount water resistant type auto switches, note that the rotary actuator itself is not of water resistant construction.

∗ Lead wire length symbols: 0.5 m ····· Nil (Example) M9NW
1 m ····· M M9NWM
3 m ····· L M9NWL
5 m ····· Z M9NWZ

- Auto switches marked with "○" are manufactured upon a receipt of order.
- For details about auto switches with pre-wired connector, refer to "SMC Best Pneumatics 2004" Vol. 11 catalog.
- Auto switches are shipped together, (but not assembled).



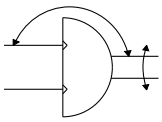
## Specifications

| Size | 10 | 15 | 20 | 30 | 40 |
|---|---|---|---|---|---|
| **Fluid** | Air (Non-lube) | | | | |
| **Max. operating pressure** | 0.7 MPa | | 1 MPa | | |
| **Min. operating pressure** | 0.15 MPa | | 0.1 MPa | | |
| **Ambient and fluid temperature** | 0° to 60°C (No freezing) | | | | |
| **Cushion** | Not attached | | | | |
| **Angle adjustment range** | Rotation end ±5° | | | | |
| **Rotation angle** | 80° to 100°, 170° to 190° | | | | |
| **Port size** | M5 x 0.8 | | Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8 | | |
| **Output (N·m)**∗ | 0.30 | 0.75 | 1.8 | 3.1 | 5.3 |

∗ Output under the operating pressure at 0.5 MPa. Refer to page 4 for further information.

## Allowable Kinetic Energy and Rotation Time Adjustment Range

**JIS Symbol**



| Size | Allowable kinetic energy (J) | Stable operational rotation time adjustment range (s/90°) |
|---|---|---|
| **10** | 0.00025 | 0.7 to 5 |
| **15** | 0.00039 | |
| **20** | 0.025 | 1 to 5 |
| **30** | 0.048 | |
| **40** | 0.081 | |

Note) If operated where the kinetic energy exceeds the allowable value, this may cause damage to the internal parts and result in product failure. Please pay special attention to the kinetic energy levels when designing, adjusting and during operation to avoid exceeding the allowable limit.

## Weight

(g)

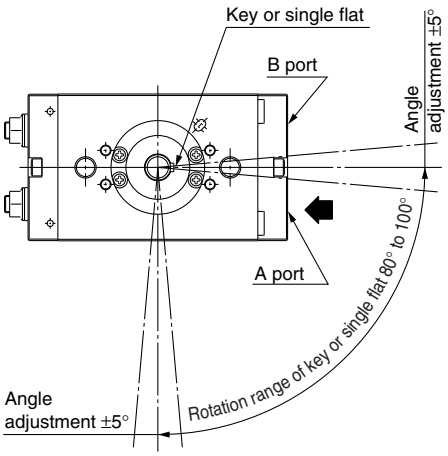
| Size | Standard weight∗ | |
|---|---|---|
| | 90° | 180° |
| **10** | 120 | 150 |
| **15** | 220 | 270 |
| **20** | 600 | 700 |
| **30** | 900 | 1100 |
| **40** | 1400 | 1600 |

∗ Not including the weight of auto switch.

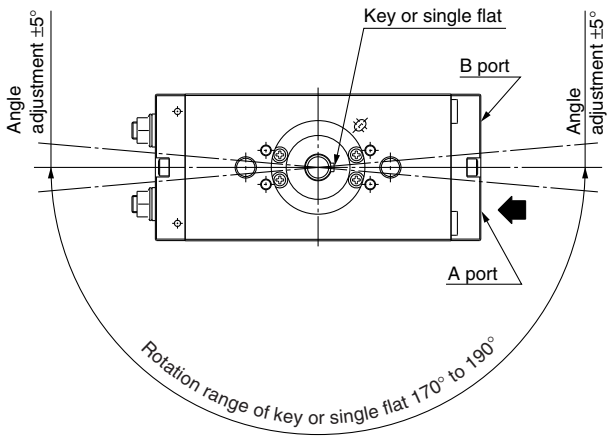
## Rotation Range

When pressurized from the port indicated by the arrow, the shaft will rotate in a clockwise direction.

**Rotation angle: 90°**

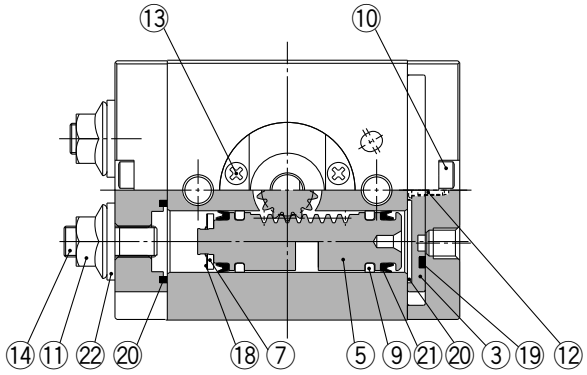


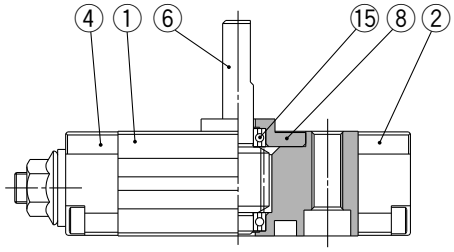

**Rotation angle: 180°**



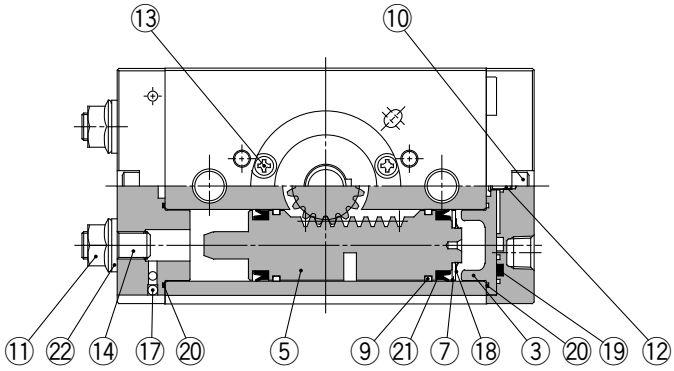
## Construction

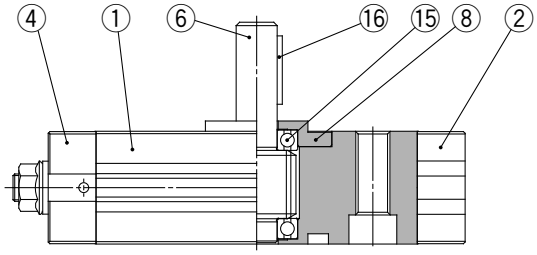
**Standard**
**Size 10/15**




**Standard**
**Size 20/30/40**




### Component Parts

| No. | Description | | Material |
|---|---|---|---|
| 1 | **Body** | | Aluminum alloy |
| 2 | **Cover** | | Aluminum alloy |
| 3 | **Plate** | | Aluminum alloy |
| 4 | **End cover** | | Aluminum alloy |
| 5 | **Piston** | | Stainless steel |
| 6 | **Size: 10, 15** | **Shaft** | Stainless steel |
| | **Size: 20, 30, 40** | | Chrome molybdenum steel |
| 7 | **Seal retainer** | | Aluminum alloy |
| 8 | **Bearing retainer** | | Aluminum alloy |
| 9 | **Wear ring** | | Resin |
| 10 | **Hexagon socket head cap screw** | | Stainless steel |
| 11 | **Hexagon nut with flange** | | Steel wire |
| 12 | **Cross recessed screw No. 0** | | Steel wire |

### Component Parts

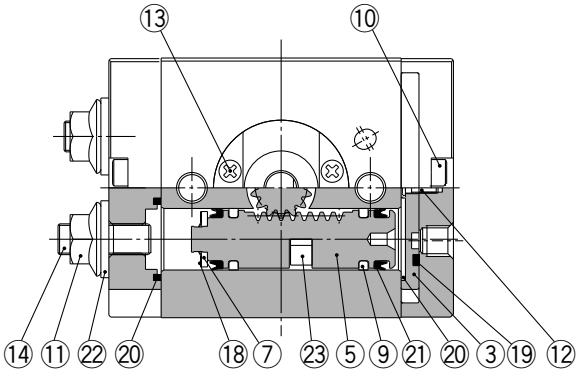
| No. | Description | | Material |
|---|---|---|---|
| 13 | **Size: 10, 15** | **Cross recessed screw No. 0** | Steel wire |
| | **Size: 20, 30, 40** | **Cross recessed screw** | |
| 14 | **Hexagon socket head set screw** | | Chrome molybdenum steel |
| 15 | **Bearing** | | Bearing steel |
| 16 | **Size: 20, 30, 40 only** | **Parallel key** | Carbon steel |
| 17 | **Size: 20, 30, 40 only** | **Steel ball** | Stainless steel |
| 18 | **CS-type retaining ring** | | Stainless steel |
| 19 | **Seal** | | NBR |
| 20 | **Gasket** | | NBR |
| 21 | **Piston seal** | | NBR |
| 22 | **Seal washer** | | NBR |
| 23 | **With auto switch only** | **Magnet** | — |

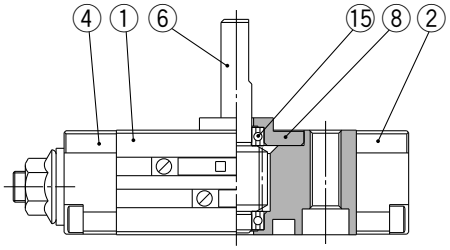
### Replacement Parts

| Description | Part no. | | | | | Note |
|---|---|---|---|---|---|---|
| | **10** | **15** | **20** | **30** | **40** | |
| **Seal kit** | P473010-23 | P473020-23 | P473030-23 | P473040-23 | P473050-23 | A set of above numbers ⑨, ⑲, ⑳, ㉑ and ㉒ |

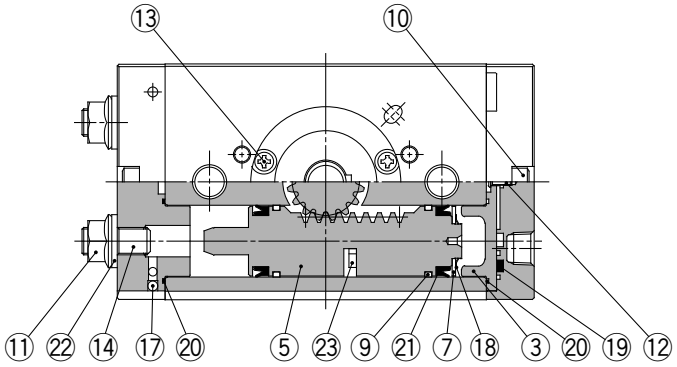
## Construction

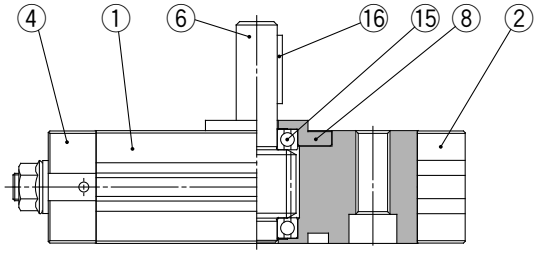
**With auto switch**
**Size 10/15**



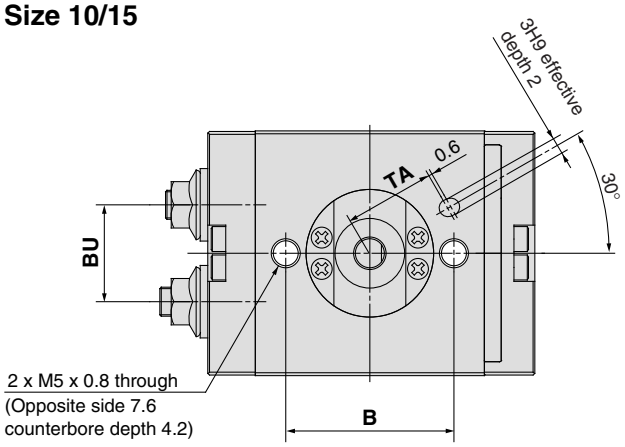

**With auto switch**
**Size 20/30/40**

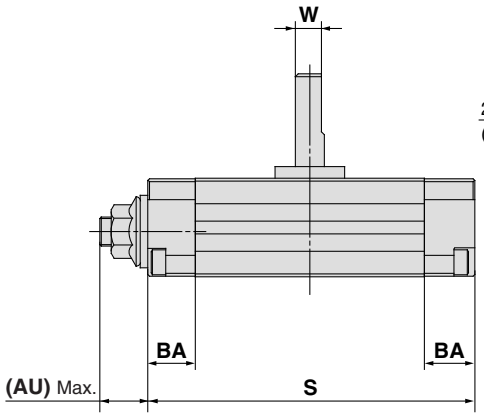


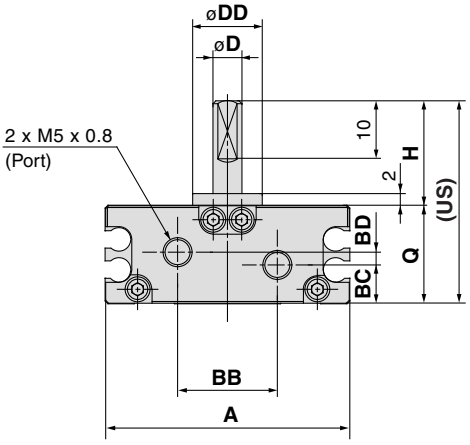



## Dimensions

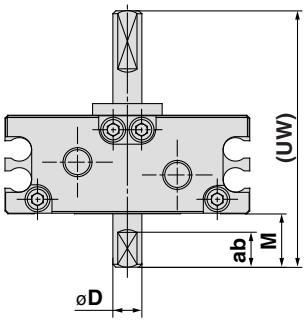
### Size 10/15

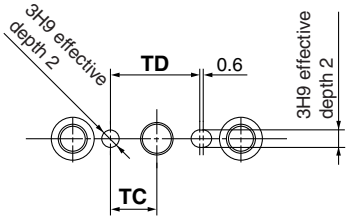



**With double shaft**




(mm)

| Size | Rotation angle | A | AU* | B | BA | BB | BC | BD | BU | D (g6) | DD (h9) | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | 90°, 180° | 42 | (8.5) | 29 | 8.5 | 17 | 6.7 | 2.2 | 16.7 | 5 | 12 | 18 |
| **15** | 90°, 180° | 53 | (9.5) | 31 | 9 | 26.4 | 10.6 | — | 23.1 | 6 | 14 | 20 |

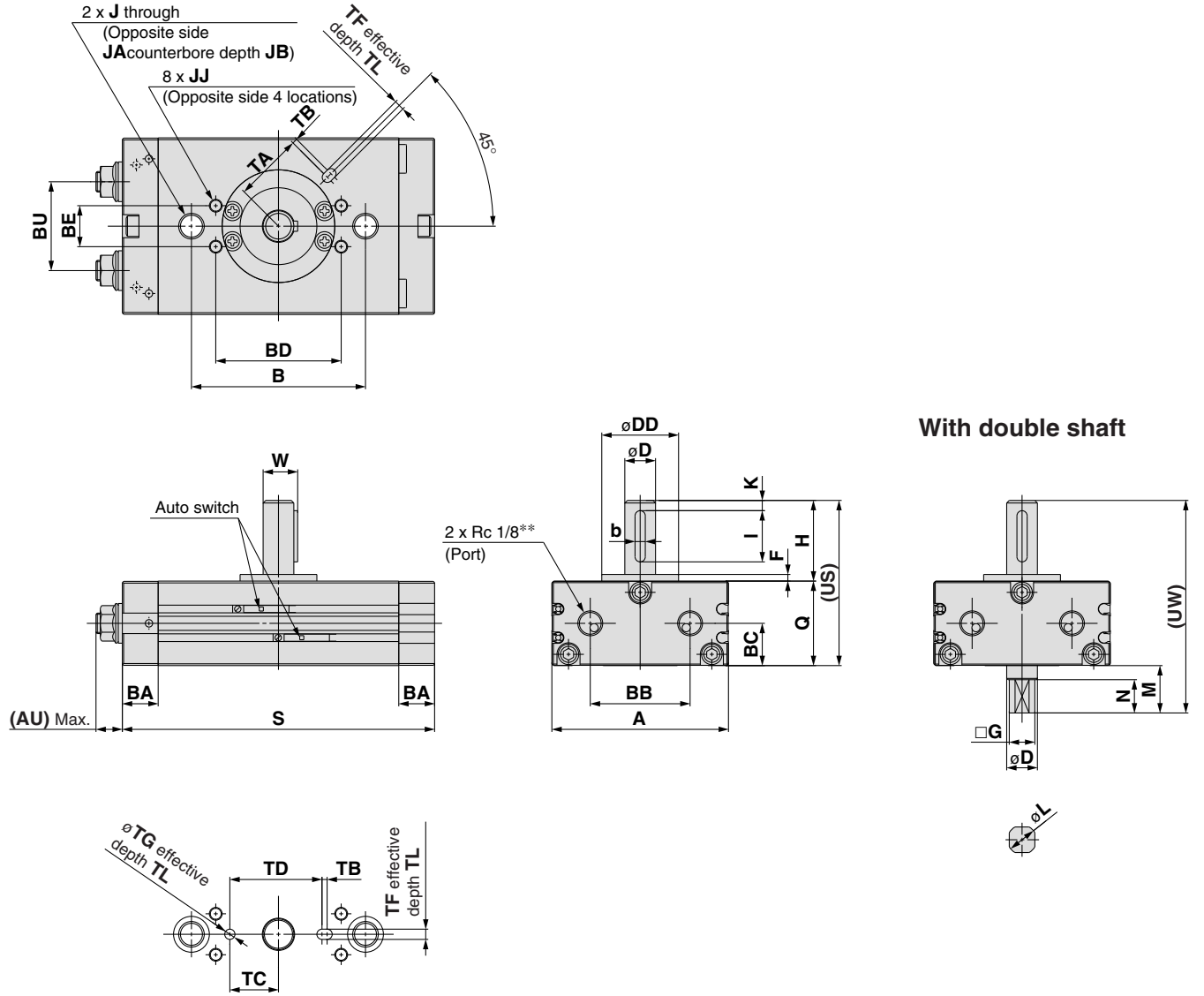
| Size | Rotation angle | W | Q | S | US | UW | ab | M | TA | TC | TD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | 90° | 4.5 | 17 | 56 | 35 | 44 | 6 | 9 | 15.5 | 8 | 15.4 |
| | 180° | | | 69 | | | | | | | |
| **15** | 90° | 5.5 | 20 | 65 | 40 | 50 | 7 | 10 | 16 | 9 | 17.6 |
| | 180° | | | 82 | | | | | | | |

∗ The AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

S: Upper 90°, Lower 180°

## Dimensions

### Size 20/30/40




(mm)

| Size | Rotation angle | A | AU* | B | BA | BB | BC | BD | BE | BU | D (g6) | DD (h9) | F | H | J | JA | JB | JJ | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **20** | 90°, 180° | 63 | (11) | 50 | 14 | 34 | 14.5 | — | — | 30.4 | 10 | 25 | 2.5 | 30 | M8 x 1.25 | 11 | 6.5 | — | 3 |
| **30** | 90°, 180° | 69 | (11) | 68 | 14 | 39 | 16.5 | 49 | 16 | 34.7 | 12 | 30 | 3 | 32 | M10 x 1.5 | 14 | 8.5 | M5 x 0.8 depth 6 | 4 |
| **40** | 90°, 180° | 78 | (13) | 76 | 16 | 47 | 18.5 | 55 | 16 | 40.4 | 15 | 32 | 3 | 36 | M10 x 1.5 | 14 | 8.6 | M6 x 1 depth 7 | 5 |

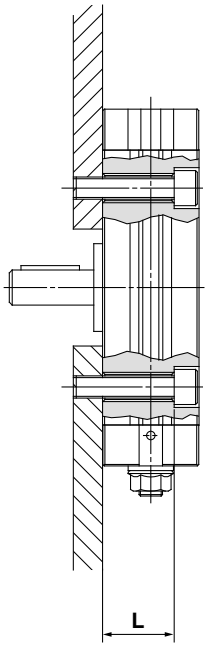
| Size | Rotation angle | Q | S | W | Keyway dimensions b | Keyway dimensions l | US | TA | TB | TC | TD | TF (H9) | TG (H9) | TL | UW | G | M | N | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **20** | 90° | 29 | 104 | 11.5 | $4^{0}_{-0.03}$ | 20 | 59 | 24.5 | 1 | 13.5 | 27 | 4 | 4 | 2.5 | 74 | $8^{0}_{-0.1}$ | 15 | 11 | $9.6^{0}_{-0.1}$ |
| | 180° | | 130 | | | | | | | | | | | | | | | | |
| **30** | 90° | 33 | 122 | 13.5 | $4^{0}_{-0.03}$ | 20 | 65 | 27 | 2 | 19 | 36 | 4 | 4 | 2.5 | 83 | $10^{0}_{-0.1}$ | 18 | 13 | $11.4^{0}_{-0.1}$ |
| | 180° | | 153 | | | | | | | | | | | | | | | | |
| **40** | 90° | 37 | 139 | 17 | $5^{0}_{-0.03}$ | 25 | 73 | 32.5 | 2 | 20 | 39.5 | 5 | 5 | 3.5 | 93 | $11^{0}_{-0.1}$ | 20 | 15 | $14^{0}_{-0.1}$ |
| | 180° | | 177 | | | | | | | | | | | | | | | | |

∗ The AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.
S: Upper 90°, Lower 180°

∗∗ In addition to Rc 1/ 8, G 1/ 8, NPT 1/ 8, NPTF 1/ 8 are also available.

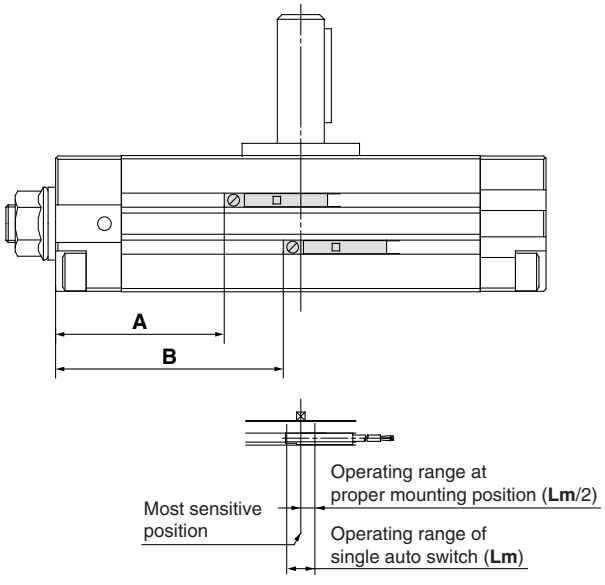
## Unit Used as Flange Mount

The L dimensions of this unit are shown in the below table. When hexagon socket head cap bolt of the JIS standard is used, the head of the bolt will recess into the groove of actuator.




| Size | L | Screw |
|---|---|---|
| **10** | 13 | M4 |
| **15** | 16 | M4 |
| **20** | 22.5 | M6 |
| **30** | 24.5 | M8 |
| **40** | 28.5 | M8 |

## Auto Switch Proper Mounting Position (at Rotation End Detection)




| Size | Rotation angle | Reed switch | | | | Solid state switch | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **A** | **B** | Operating angle (θ **m**) | Hysteresis angle | **A** | **B** | Operating angle (θ **m**) | Hysteresis angle |
| **10** | 90° | 15 | 21.5 | 63° | 12° | 19 | 25.5 | 75° | 3° |
| | 180° | 18 | 31 | | | 22 | 35 | | |
| **15** | 90° | 18.5 | 27 | 52° | 9° | 22.5 | 31 | 69° | 3° |
| | 180° | 22.5 | 39.5 | | | 26.5 | 43.5 | | |
| **20** | 90° | 36 | 48.5 | 41° | 9° | 40 | 52.5 | 56° | 4° |
| | 180° | 42 | 67.5 | | | 46 | 71.5 | | |
| **30** | 90° | 43 | 59 | 32° | 7° | 47 | 63 | 43° | 3° |
| | 180° | 51 | 82 | | | 55 | 86 | | |
| **40** | 90° | 50 | 69 | 24° | 5° | 54 | 73 | 36° | 4° |
| | 180° | 59.5 | 97.5 | | | 63.5 | 101.5 | | |

Operating angle θ**m**: Value of the operating range of single auto switch (Lm) as represented by rotation angle for shaft
Hysteresis angle: Value of the auto switch hysteresis as represented by angle

Note) For actual setting, adjustment shall be made after checking the auto switch operating condition.

# *Series CRQ2X/MSQX*
# Auto Switch Specifications

## Auto Switch Common Specifications

| Type | Reed switch | Solid state switch |
|---|---|---|
| **Leakage current** | None | 3-wire: 100 μA or less 2-wire: 0.8 mA or less |
| **Operating time** | 1.2 ms | 1 ms or less |
| **Impact resistance** | 300 m/s$^2$ | 1000 m/s$^2$ |
| **Insulation resistance** | 50 MΩ or more at 500 VDC Mega (between lead wire and case) | |
| **Withstand voltage** | 1500 VAC for 1 minute (between lead wire and case) | 1000 VAC for 1 minute (between lead wire and case) |
| **Ambient temperature** | –10 to 60°C | |
| **Enclosure** | IEC60529 standard IP67, JIS C 0920 waterproof construction | |
| **Standard** | Conforming to CE Standards | |

## Lead Wire Length

**Lead wire length indication**

**(Example)** **D-M9BW L**

**Lead wire length**

| | |
|---|---|
| **Nil** | 0.5 m |
| **M** | 1 m |
| **L** | 3 m |
| **Z** | 5 m |

Note 1) Applicable auto switch with 5 m lead wire "Z"
Solid state switch: Manufactured upon receipt of order as standard.
Note 2) To designate solid state switches with flexible specifications, add "-61" after the lead wire length. Flexible cable is used for D-M9□(V), D-M9□W(V), D-M9□A(V) as standard. There is no need to place the suffix -61 to the end of part number.
Note 3) 1 m (M): D-M9□W, D-M9□A(V).
Note 4) Lead wire length tolerance

| Lead wire length | Tolerance |
|---|---|
| 0.5 m | ±15 mm |
| 1 m | ±30 mm |
| 3 m | ±90 mm |
| 5 m | ±150 mm |

## Contact Protection Box: CD-P11, CD-P12

### <Applicable switch model>

D-A9□(V) type

The above auto switch type does not have a built-in contact protection circuit.

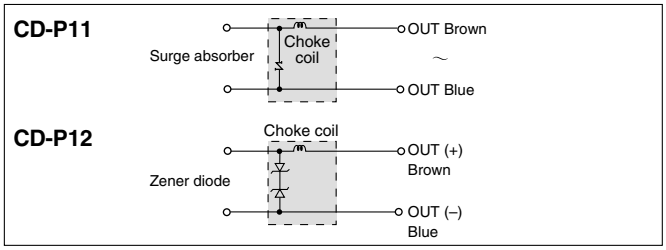
① **Where the operation load is an inductive load.**
② **Where the wiring length to load is greater than 5 m.**
③ **Where the load voltage is 100 VAC.**
**Therefore, use a contact protection box with the switch for any of the above cases:**
The contact life may be shortened (due to permanent energizing conditions). Since the solid state auto switch is a semiconductor switch which has no contacts, no contact protection box is needed.
④ **Where the load voltage is 110 VAC.**
When the load voltage is increased by more than 10% to the rating of applicable auto switches above, use a contact protection box (CD-P11) to reduce the upper limit of the load current by 10% so that it can be set within the range of the load current range.

### Specifications

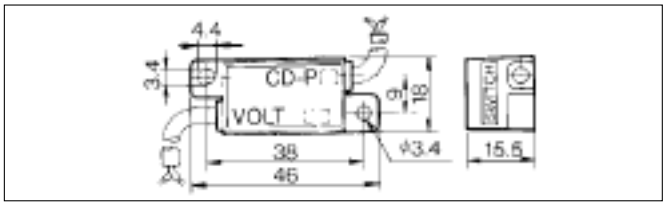
| Part no. | CD-P11 | | CD-P12 |
|---|---|---|---|
| **Load voltage** | 100 VAC | 200 VAC | 24 VDC |
| **Max. load current** | 25 mA | 12.5 mA | 50 mA |

∗ Lead wire length —— Switch connection side 0.5 m
Load connection side 0.5 m

### Internal Circuit




### Dimensions



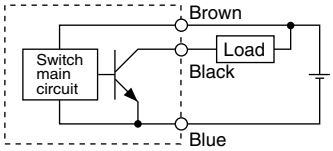

## Connection

To connect a switch unit to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch unit. Keep the switch as close as possible to the contact protection box, with a lead wire length of no more than 1 meter.

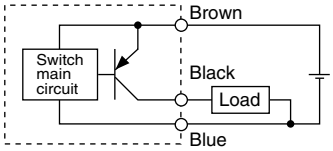
# Auto Switch Connections and Examples

## Basic Wiring

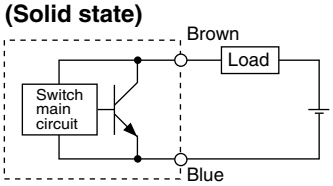
**Solid state 3-wire, NPN**



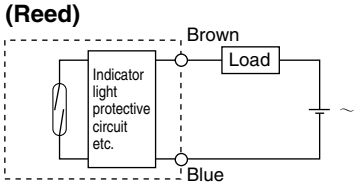

**Solid state 3-wire, PNP**



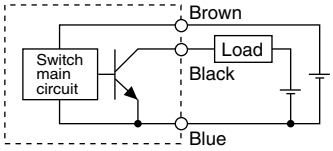

**2-wire (Solid state)**

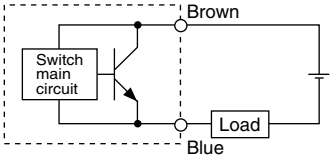


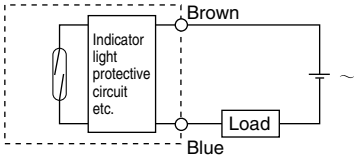

**2-wire (Reed)**




(Power supplies for switch and load are separate.)



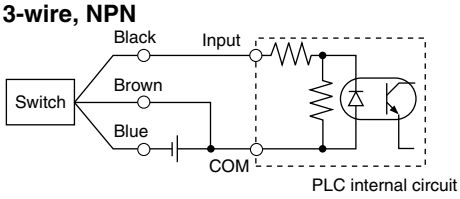



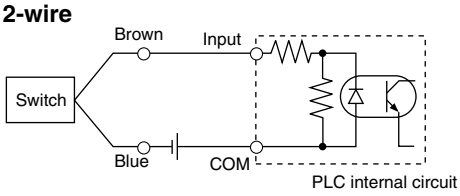

## Example of Connection to PLC (Programmable Logic Controller)

**• Sink input specification**

**3-wire, NPN**

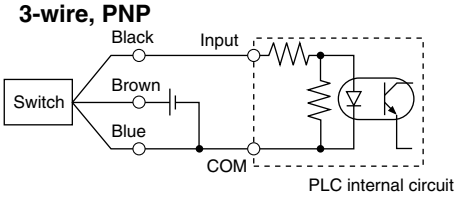



**2-wire**

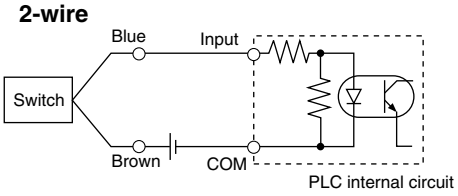



**• Source input specification**

**3-wire, PNP**




**2-wire**

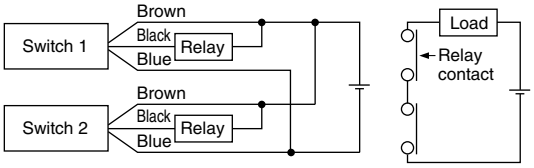



Connect according to the applicable PLC input specifications, since the connection method will vary depending on the PLC input specifications.

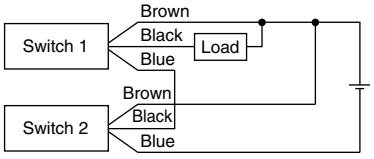
## Example of AND (Serial) and OR (Parallel) Connection

**• 3-wire**

**AND connection for NPN output (using relays)**

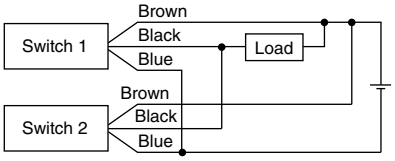



**AND connection for NPN output (performed with switches only)**

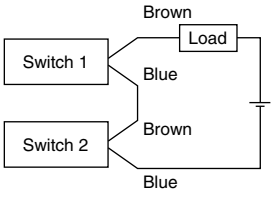



The indicator lights will illuminate when both switches are turned ON.

**OR connection for NPN output**




**2-wire with 2-switch AND connection**




When two switches are connected in series, a load may malfunction because the load voltage will decrease when in the ON state.
The indicator lights will illuminate if both of the switches are in the ON state.

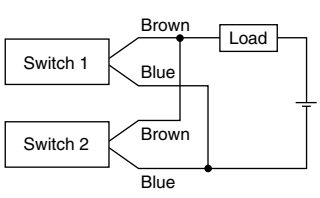
$$\text{Load voltage at ON} = \frac{\text{Power supply voltage}}{} - \frac{\text{Residual voltage}}{} \times 2 \text{ pcs.}$$

$$= 24 \text{ V} - 4 \text{ V} \times 2 \text{ pcs.}$$

$$= 16 \text{ V}$$

Example: Power supply is 24 VDC.
Internal voltage drop in switch is 4 V.

**2-wire with 2-switch OR connection**




(Solid state)
When two switches are connected in parallel, a malfunction may occur because the load voltage will increase when in the OFF state.

$$\text{Load voltage at OFF} = \text{Leakage current} \times 2 \text{ pcs.} \times \text{Load impedance}$$

$$= 1 \text{ mA} \times 2 \text{ pcs.} \times 3 \text{ k}\Omega$$

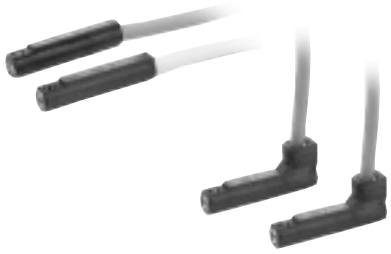
$$= 6 \text{ V}$$

Example: Load impedance is 3 kΩ.
Leakage current from switch is 1 mA.

(Reed)
Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of switches in the ON state, the indicator lights may sometimes dim or not light because of the dispersion and reduction of the current flowing to the switches.

# Reed Switch: Direct Mounting Style
# D-A90(V)/D-A93(V)/D-A96(V)

**Grommet**



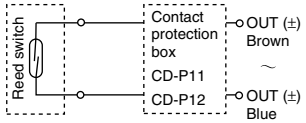
## ⚠Caution

**Precautions**

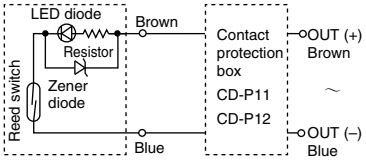
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied is used.

## Auto Switch Internal Circuit

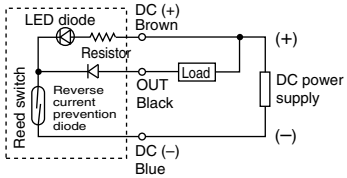
**D-A90(V)**




**D-A93(V)**




**D-A96(V)**




Note) ① In a case where the operation load is an inductive load.
② In a case where the wiring load is greater than 5 m.
③ In a case where the load voltage is 100 VAC.

Use the auto switch with a contact protection box in any of the above mentioned cases. (For details about the contact protection box, refer to page 22.)

## Auto Switch Specifications

PLC: Programmable Logic Controller

| **D-A90/D-A90V (Without indicator light)** | | | | | | |
|---|---|---|---|---|---|---|
| Auto switch part no. | **D-A90** | **D-A90V** | **D-A90** | **D-A90V** | **D-A90** | **D-A90V** |
| Electrical entry direction | In-line | Perpendicular | In-line | Perpendicular | In-line | Perpendicular |
| Applicable load | IC circuit, Relay, PLC | | | | | |
| Load voltage | 24 VAC/DC or less | | 48 VAC/DC or less | | 100 VAC/DC or less | |
| Maximum load current | 50 mA | | 40 mA | | 20 mA | |
| Contact protection circuit | None | | | | | |
| Internal resistance | 1 Ω or less (including lead wire length of 3 m) | | | | | |
| Standard | Conforming to CE Standards | | | | | |
| **D-A93/D-A93V/D-A96/D-A96V (With indicator light)** | | | | | | |
| Auto switch part no. | **D-A93** | **D-A93V** | **D-A93** | **D-A93V** | **D-A96** | **D-A96V** |
| Electrical entry direction | In-line | Perpendicular | In-line | Perpendicular | In-line | Perpendicular |
| Applicable load | Relay, PLC | | | | IC circuit | |
| Load voltage | 24 VDC | | 100 VAC | | 4 to 8 VDC | |
| Load current range and max. load current | 5 to 40 mA | | 5 to 20 mA | | 20 mA | |
| Contact protection circuit | None | | | | | |
| Internal voltage drop | D-A93 — 2.4 V or less (to 20 mA)/3 V or less (to 40 mA)<br>D-A93V — 2.7 V or less | | | | 0.8 V or less | |
| Indicator light | Red LED illuminates when turned ON. | | | | | |
| Standard | Conforming to CE Standards | | | | | |

- Lead wires
  D-A90(V)/D-A93(V) — Oilproof heavy-duty vinyl cable: ø2.7, 0.18 mm² x 2 cores (Brown, Blue), 0.5 m
  D-A96(V) — Oilproof heavy-duty vinyl cable: ø2.7, 0.15 mm² x 3 cores (Brown, Black, Blue), 0.5 m

Note 1) Refer to page 22 for reed switch common specifications.
Note 2) Refer to page 22 for lead wire lengths.
Note 3) If load current is less than 5 mA, the visibility of the indicator light is decreased. If less than 2.5 mA, the light may become invisible. From the point of view of contact output, however, it is not a problem as long as the load current is more than 1 mA.

## Weight

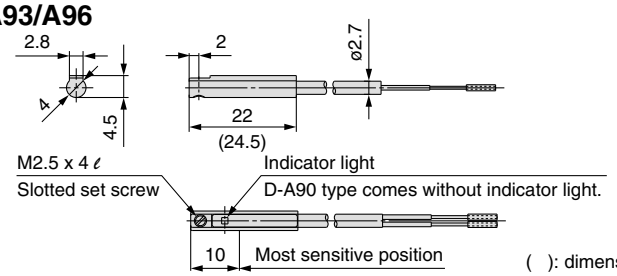
Unit: g

| Auto switch part no. | | D-A90(V) | D-A93(V) | D-A96(V) |
|---|---|---|---|---|
| Lead wire length (m) | 0.5 | 6 | 6 | 8 |
| | 3 | 30 | 30 | 41 |

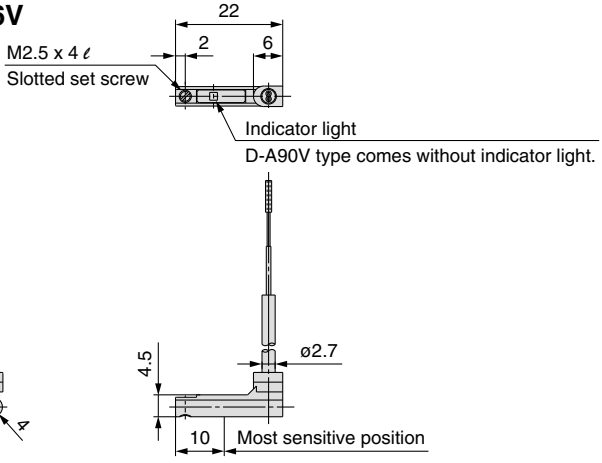
## Dimensions

Unit: mm

**D-A90/A93/A96**




**D-A90V/A93V/A96V**



# Solid State Switch: Direct Mounting Style
# D-M9N(V)/D-M9P(V)/D-M9B(V) CE

## Grommet

- **2-wire load current is reduced (2.5 to 40 mA).**
- **UL certified (style 2844) lead cable is used.**
- **Flexibility is 1.5 times greater than the conventional model (SMC comparison).**
- **Using flexible cable as standard spec.**
- **Brightness of indicator light is 2 times greater than the conventional model (SMC comparison).**

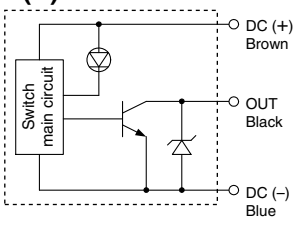
## ⚠Caution

### Precautions

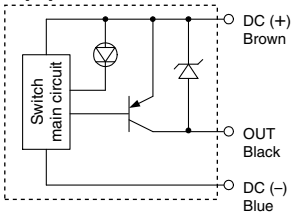
Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied is used.

### Auto Switch Internal Circuit

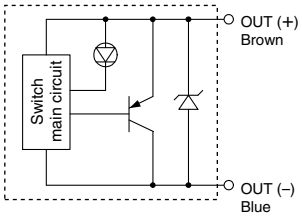
**D-M9N(V)**




**D-M9P(V)**




**D-M9B(V)**




## Auto Switch Specifications

PLC: Programmable Logic Controller

| D-M9□/D-M9□V (With indicator light) | | | | | | |
|---|---|---|---|---|---|---|
| Auto switch part no. | D-M9N | D-M9NV | D-M9P | D-M9PV | D-M9B | D-M9BV |
| Electrical entry direction | In-line | Perpendicular | In-line | Perpendicular | In-line | Perpendicular |
| Wiring type | 3-wire | | | | 2-wire | |
| Output type | NPN | | PNP | | — | |
| Applicable load | IC circuit, Relay, PLC | | | | 24 VDC relay, PLC | |
| Power supply voltage | 5, 12, 24 VDC (4.5 to 28 V) | | | | — | |
| Current consumption | 10 mA or less | | | | — | |
| Load voltage | 28 VDC or less | | — | | 24 VDC (10 to 28 VDC) | |
| Load current | 40 mA or less | | | | 2.5 to 40 mA | |
| Internal voltage drop | 0.8 V or less | | | | 4 V or less | |
| Leakage current | 100 μA or less at 24 VDC | | | | 0.8 mA or less | |
| Indicator light | Red LED illuminates when turned ON. | | | | | |
| Standard | Conforming to CE Standards | | | | | |

- Lead wires — Oilproof heavy-duty vinyl cable: ø2.7 x 3.2 ellipse
  D-M9B(V) 0.15 mm² x 2 cores
  D-M9N(V), D-M9P(V) 0.15 mm² x 3 cores

Note 1) Refer to page 22 for solid state switch common specifications.
Note 2) Refer to page 22 for lead wire lengths.

## Weight

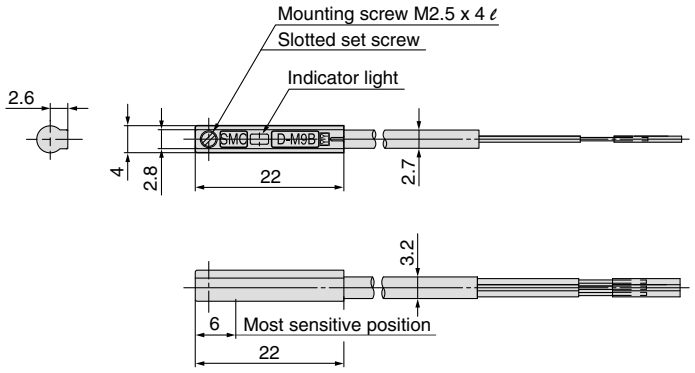
Unit: g

| Auto switch part no. | | D-M9N(V) | D-M9P(V) | D-M9B(V) |
|---|---|---|---|---|
| Lead wire length (m) | 0.5 | 8 | 8 | 7 |
| | 3 | 41 | 41 | 38 |
| | 5 | 68 | 68 | 63 |

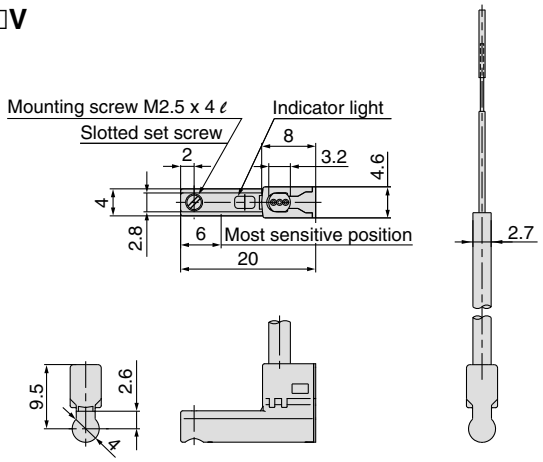
## Dimensions

Unit: mm

**D-M9□**




**D-M9□V**






SMC

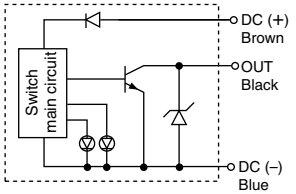
# 2-Color Indication Solid State Switch: Direct Mounting Style
# D-M9NW(V)/D-M9PW(V)/D-M9BW(V)

## Grommet

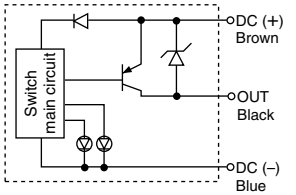
- 2-wire load current is reduced (2.5 to 40 mA).
- UL certified (style 2844) lead cable is used.
- Flexibility is 1.5 times greater than the conventional model (SMC comparison).
- Using flexible cable as standard spec.
- The optimum operating position can be determined by the color of the light. (Red → Green ← Red)
- Brightness of indicator light is 2 times greater than the conventional model (SMC comparison).

## Auto Switch Internal Circuit

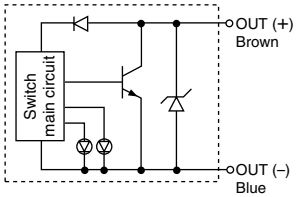
### D-M9NW(V)



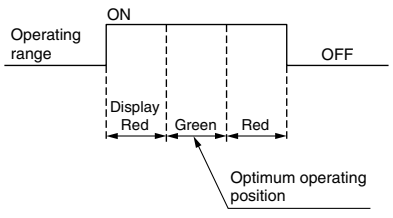

### D-M9PW(V)




### D-M9BW(V)




### Indicator light / Display method




## Auto Switch Specifications

PLC: Programmable Logic Controller

| D-M9□W/D-M9□WV (With indicator light) | | | | | | |
|---|---|---|---|---|---|---|
| Auto switch part no. | D-M9NW | D-M9NWV | D-M9PW | D-M9PWV | D-M9BW | D-M9BWV |
| Electrical entry direction | In-line | Perpendicular | In-line | Perpendicular | In-line | Perpendicular |
| Wiring type | 3-wire | | | | 2-wire | |
| Output type | NPN | | PNP | | — | |
| Applicable load | IC circuit, Relay, PLC | | | | 24 VDC relay, PLC | |
| Power supply voltage | 5, 12, 24 VDC (4.5 to 28 V) | | | | — | |
| Current consumption | 10 mA or less | | | | — | |
| Load voltage | 28 VDC or less | | — | | 24 VDC (10 to 28 VDC) | |
| Load current | 40 mA or less | | | | 2.5 to 40 mA | |
| Internal voltage drop | 0.8 V or less at 10 mA (2 V or less at 40 mA) | | | | 4 V or less | |
| Leakage current | 100 μA or less at 24 VDC | | | | 0.8 mA or less | |
| Indicator light | Operating position ····· Red LED illuminates.<br>Optimum operating position ····· Green LED illuminates. | | | | | |
| Standard | Conforming to CE Standards | | | | | |

- Lead wires — Oilproof heavy-duty vinyl cable: ø2.7 x 3.2 ellipse
  D-M9BW(V) 0.15 mm² x 2 cores
  D-M9NW(V), D-M9PW(V) 0.15 mm² x 3 cores

Note 1) Refer to page 22 for solid state switch common specifications.
Note 2) Refer to page 22 for lead wire lengths.

## Weight

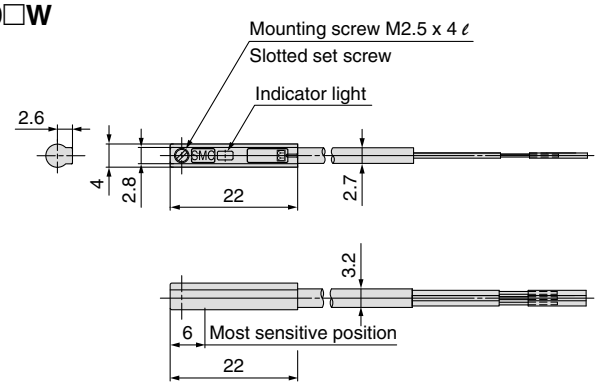
Unit: g

| Auto switch part no. | | D-M9NW(V) | D-M9PW(V) | D-M9BW(V) |
|---|---|---|---|---|
| Lead wire length (m) | 0.5 | 8 | 8 | 7 |
| | 1 | 14 | 14 | 13 |
| | 3 | 41 | 41 | 38 |
| | 5 | 68 | 68 | 63 |

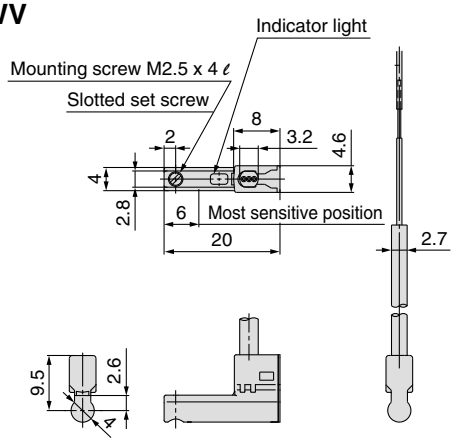
## Dimensions

Unit: mm

### D-M9□W



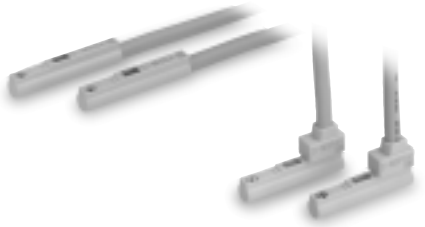

### D-M9□WV



# Water Resistant 2-Color Indication Solid State Switch: Direct Mounting Style
# D-M9NA(V)/D-M9PA(V)/D-M9BA(V) CE

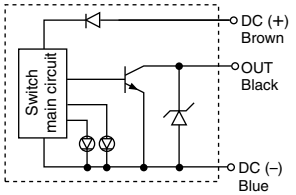
## Grommet

- Water (coolant) resistant type
- 2-wire load current is reduced (2.5 to 40 mA).
- UL certified (style 2844) lead cable is used.
- The optimum operating position can be determined by the color of the light. (Red Green Red)

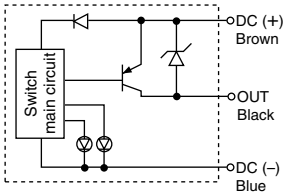


### Auto Switch Internal Circuit

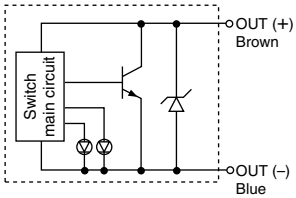
**D-M9NA(V)**



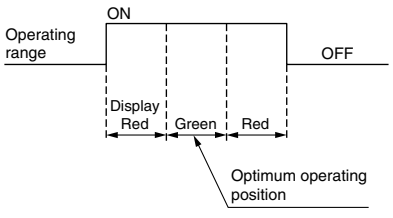

**D-M9PA(V)**




**D-M9BA(V)**




### Indicator light / Display method




## Auto Switch Specifications

PLC: Programmable Logic Controller

| D-M9□A/D-M9□AV (With indicator light) | | | | | | |
|---|---|---|---|---|---|---|
| Auto switch part no. | D-M9NA | D-M9NAV | D-M9PA | D-M9PAV | D-M9BA | D-M9BAV |
| Electrical entry direction | In-line | Perpendicular | In-line | Perpendicular | In-line | Perpendicular |
| Wiring type | 3-wire | | | | 2-wire | |
| Output type | NPN | | PNP | | — | |
| Applicable load | IC circuit, Relay, PLC | | | | 24 VDC relay, PLC | |
| Power supply voltage | 5, 12, 24 VDC (4.5 to 28 V) | | | | — | |
| Current consumption | 10 mA or less | | | | — | |
| Load voltage | 28 VDC or less | | — | | 24 VDC (10 to 28 VDC) | |
| Load current | 40 mA or less | | | | 2.5 to 40 mA | |
| Internal voltage drop | 0.8 V or less at 10 mA (2 V or less at 40 mA) | | | | 4 V or less | |
| Leakage current | 100 μA or less at 24 VDC | | | | 0.8 mA or less | |
| Indicator light | Operating position ····· Red LED illuminates.<br>Optimum operating position ····· Green LED illuminates. | | | | | |
| Standard | Conforming to CE Standards | | | | | |

- Lead wires — Oilproof heavy-duty vinyl cable: ø2.7 x 3.2 ellipse
  D-M9BA(V) 0.15 mm² x 2 cores
  D-M9NA(V), D-M9PA(V) 0.15 mm² x 3 cores

Note 1) Refer to page 22 for solid state switch common specifications.
Note 2) Refer to page 22 for lead wire lengths.

## Weight

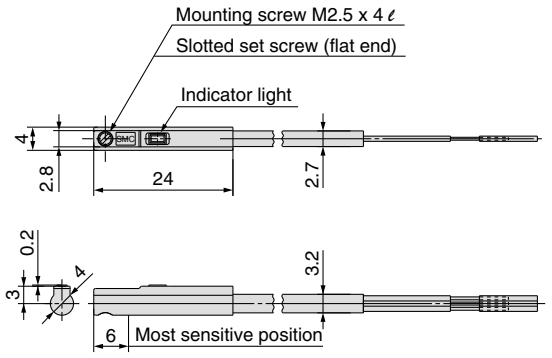
Unit: g

| Auto switch part no. | | D-M9NA(V) | D-M9PA(V) | D-M9BA(V) |
|---|---|---|---|---|
| Lead wire length (m) | 0.5 | 8 | 8 | 7 |
| | 1 | 14 | 14 | 13 |
| | 3 | 41 | 41 | 38 |
| | 5 | 68 | 68 | 63 |

## Dimensions

Unit: mm

**D-M9□A**




**D-M9□AV**