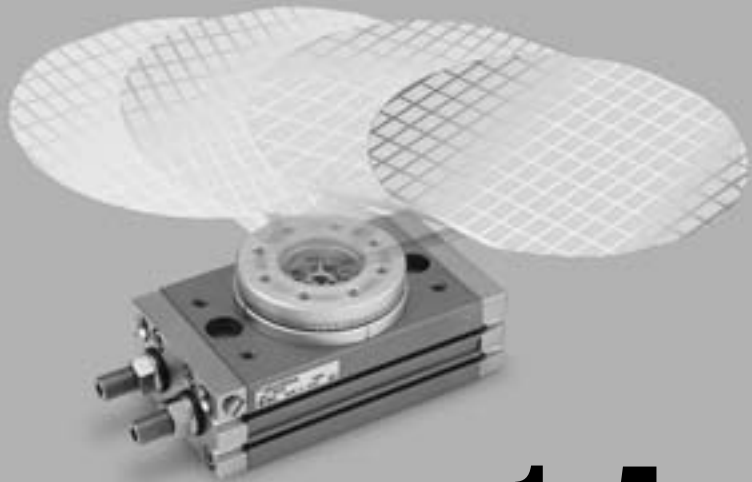


Low-Speed Rotary Actuator

Series CRQ2X/MSQX

Possible to transfer a workpiece at low-speed.

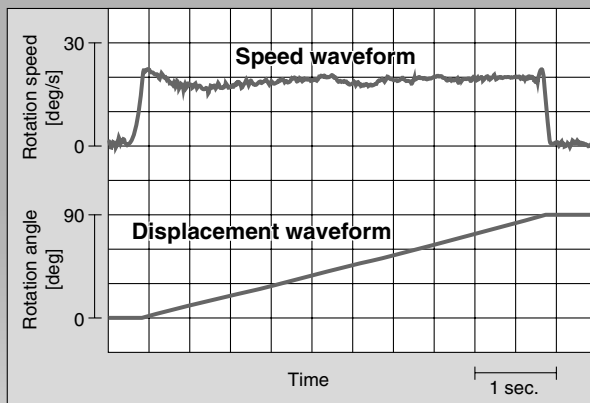


- Rotation time adjustment range: **1 to 5** (s/90°)

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	▬				
Standard	CRQ2	10, 15, 20, 30, 40	0.2 to 1 (0.2 to 0.7 for CRQ2□10,15)				
	MSQ	10, 20, 30, 50	▬				

- Realized a stable motion at 5s/90°.

Smooth motion without stick-slip phenomenon



Measurement conditions / Fluid: Air

Mounting orientation: Vertical without load
 Operating pressure: 0.5 MPa
 Pneumatic circuit: Meter-out circuit
 Ambient temperature: Room temperature

- Dimensions compatible with the CRQ2, MSQ series



CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X

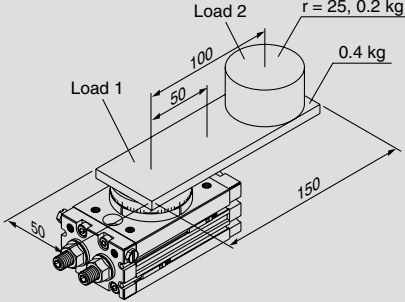
MSQX

MRQ

D-□

Series CRQ2X/MSQX Model Selection

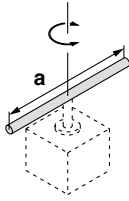
* The selection procedure of the rotary for low-speed is the same as for an ordinary rotary. If the rotation time exceeds 2s per 90°, however, the necessary torque and the kinetic energy are calculated with rotation time of 2s per 90°.

Selection Procedure	Remarks	Selection Example
<p>0 Operating conditions</p> <p>Operating conditions are as follows:</p> <ul style="list-style-type: none"> Provisionally selected model Operating pressure: MPa Mounting position Load type <ul style="list-style-type: none"> Static load: N·m Resistance load: N·m Inertial load: N·m Load dimension: m Load mass: kg Rotation time: s Rotation angle: rad 	<ul style="list-style-type: none"> See P. 314 for load type. The unit of the rotation angle is Radians. $180^\circ = \pi \text{ rad}$ $90^\circ = \pi/2 \text{ rad}$ 	 <p>Provisionally selected model: MSQXB10A Operating pressure: 0.3 MPa Mounting position: Vertical, Type of load: Inertial load Rotation time: 6s Rotation angle: $\pi \text{ rad}$ (180°)</p>
<p>1 Calculation of moment of inertia</p> <p>Calculate the moment of inertia of the load. ⇒ P. 313</p>	<ul style="list-style-type: none"> 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. 	<p>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 $I = I_1 + I_2 = 0.003896 \text{ [kg} \cdot \text{m}^2\text{]}$</p>
<p>2 Calculation of necessary torque</p> <p>Calculate necessary torque corresponding to the load type, and ensure it is within effective torque range.</p> <ul style="list-style-type: none"> Static load (T_s) Necessary torque $T = T_s$ Resistance load (T_f) Necessary torque $T = T_f \times (3 \text{ to } 5)$ Inertial load (T_a) Necessary torque $T = T_a \times 10$ ⇒ P. 314 	<ul style="list-style-type: none"> 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. <p>Necessary torque $T = T_f \times (3 \text{ to } 5) + T_a \times 10$</p>	<p>Inertial load: T_a $T_a = I \cdot \dot{\omega}$ $\dot{\omega} = \frac{2\theta}{t^2} \text{ [rad/s}^2\text{]}$ Necessary torque: T $T = T_a \times 10$ $= 0.003896 \times \frac{2 \times \pi}{4^2} \times 10 = 0.015 \text{ [N} \cdot \text{m]}$ (t is calculated with 2s per 90°.) $0.109 \text{ N} \cdot \text{m} < \text{Effective torque OK}$</p>
<p>3 Checking rotation time</p> <p>Confirm that it is within the adjustable range of rotation time. ⇒ P. 315</p>	<ul style="list-style-type: none"> Converted to the time per 90° for comparison. (For comparison, 6s/180° is converted to 3s/90°.) 	<p>$1.0 \leq t \leq 5$ $t = 3\text{s}/90^\circ \text{ OK}$</p>
<p>4 Calculation of kinetic energy</p> <p>Confirm that the load's kinetic energy is within the allowable value.</p> <p>Can be confirmed by the graph of the moment of inertia and the rotation time. ⇒ P. 315</p>	<ul style="list-style-type: none"> 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. 	<p>$E = \frac{1}{2} \cdot I \cdot \omega^2$ $\omega = \frac{2 \cdot \theta}{t}$ Kinetic energy $\frac{1}{2} \times 0.003896 \times \left(\frac{2 \times \pi}{4}\right)^2 = 0.0048 \text{ [J]}$ (t is calculated with 2s per 90°.) $0.0048 \text{ [J]} < \text{Allowable energy OK}$</p>
<p>5 Checking allowable load</p> <p>Check if the load applied to the product is within the allowable range. ⇒ P. 316</p>	<ul style="list-style-type: none"> If the allowable value is exceeded, an external bearing needs to be installed. 	<p>$M = 0.4 \times 9.8 \times 0.05 + 0.2 \times 9.8 \times 0.1$ $= 0.392 \text{ [N} \cdot \text{m]}$ $0.392 \text{ [N} \cdot \text{m]} < \text{Allowable moment load OK}$</p>
<p>6 Calculation of air consumption and necessary air quantity</p> <p>Calculate air consumption and necessary air quantity as required. ⇒ P. 317</p>		

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

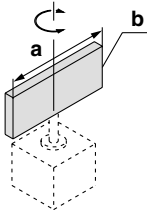
Position of rotational axis:
Perpendicular to the shaft through the center of gravity



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

2. Thin rectangular plate

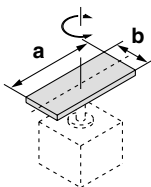
Position of rotational axis:
Parallel to side b through the center of gravity



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

3. Thin rectangular plate (Including rectangular parallelepiped)

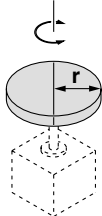
Position of rotational axis:
Perpendicular to the plate through the center of gravity



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

4. Round plate (Including column)

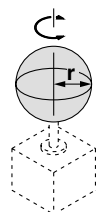
Position of rotational axis:
Passing through the center axis



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

5. Solid sphere

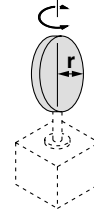
Position of rotational axis:
Passing through the diameter



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

6. Thin round plate

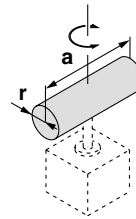
Position of rotational axis:
Passing through the diameter



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

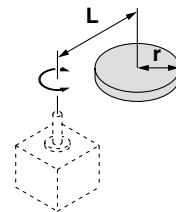
7. Cylindrical

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



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

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

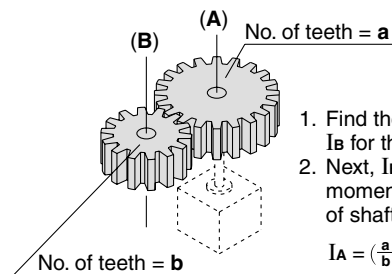


$$I = K + m \cdot L^2$$

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

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

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

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

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X
MSQX

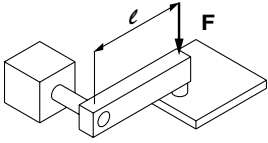
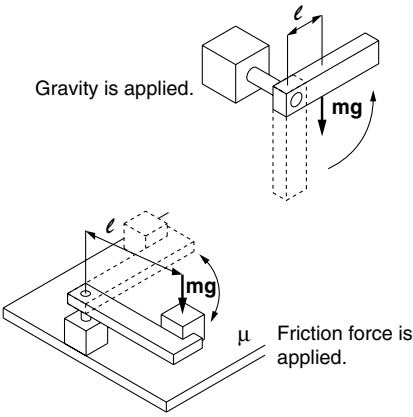
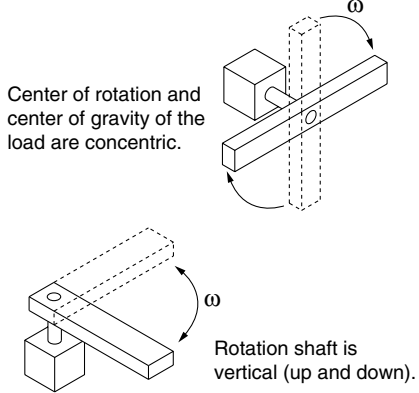
MRQ

D-□

Model Selection

Load Type

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

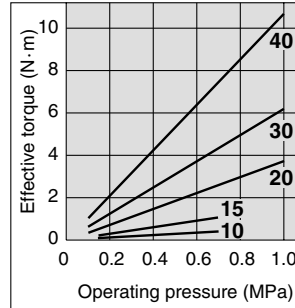
Load type		
Static load: T_s	Resistance load: T_f	Inertial load: T_a
<p>Only pressing force is necessary. (e.g. for clamping)</p> 	<p>Weight or friction force is applied to rotating direction.</p> 	<p>Rotate the load with inertia.</p> 
<p>$T_s = F \cdot l$</p> <p>T_s: Static load (N·m) F: Clamping force (N) l: Distance from the rotation center to the clamping position (m)</p>	<p>Gravity is applied in rotating direction.</p> <p>$T_f = m \cdot g \cdot l$</p> <p>Friction force is applied in rotating direction.</p> <p>$T_f = \mu \cdot m \cdot g \cdot l$</p> <p>$T_f$: Resistance load (N·m) m: Load mass (kg) g: Gravitational acceleration 9.8 (m/s²) l: Distance from the rotation center to the point of application of the weight or friction force (m) μ: Friction coefficient</p>	<p>$T_a = I \cdot \omega = I \cdot \frac{2\theta}{t^2}$</p> <p>$T_a$: Inertial load (N·m) I: Moment of inertia (kg·m²) ω: Angular acceleration (rad/s²) θ: Rotation angle (rad) t: Rotation time (s)</p> <p>For low speed rotary, if the rotation time exceeds 2s per 90°, inertial load is calculated with rotation time of 2s per 90°.</p>
Necessary torque: $T = T_s$	Necessary torque: $T = T_f \times (3 \text{ to } 5)$ ^{Note)}	Necessary torque: $T = T_a \times 10$ ^{Note)}
<p>• 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. $T = T_f \times (3 \text{ to } 5) + T_a \times 10$</p> <p>• 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. $T = T_a \times 10$</p> <p>Note) To adjust the speed, margin is necessary for T_f and T_a.</p>		

Effective Torque

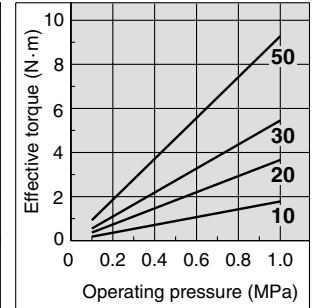
Unit: N·m

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

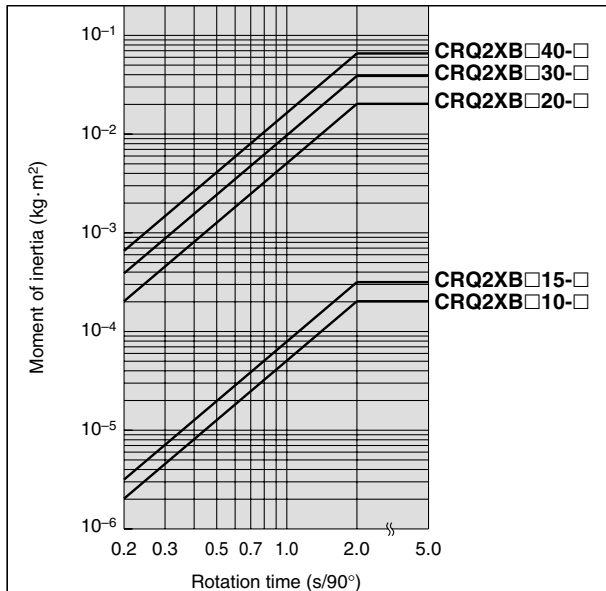
Set the rotation time, within stable operational guidelines, using the adjustment range specification table as detailed below. When operating at low-speeds which exceed the rotation time adjustment range, use caution as it may result in sticking or malfunction.

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	
	30	0.048	
	40	0.081	
MSQX	10	0.007	1 to 5
	20	0.025	
	30	0.048	
	50	0.081	

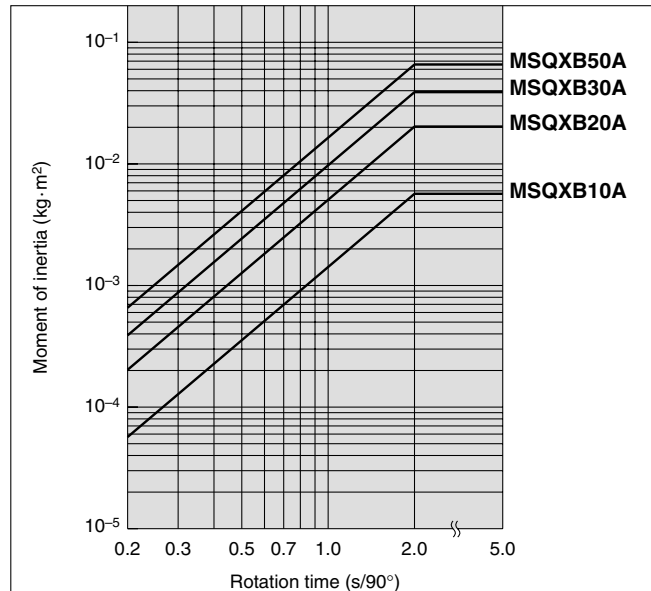
Model Selection

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

CRQ2X



MSQX



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

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X

MSQX

MRQ

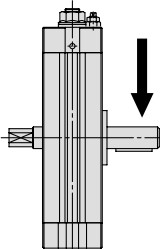
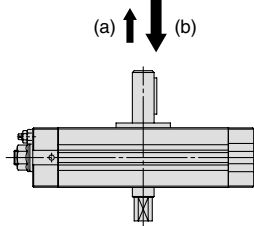
D-□

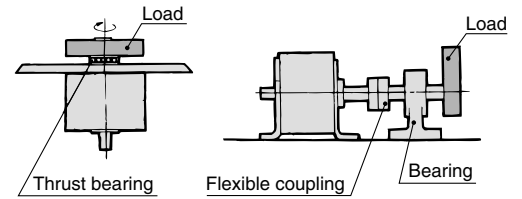
Model Selection

Allowable Load

CRQ2X

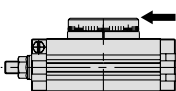
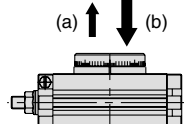
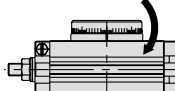
A load up to the allowable radial/thrust load can be applied provided that a dynamic load is not generated. However, applications which apply a load directly to the shaft should be avoided whenever possible. In order to further improve the operating conditions, a method such as that shown in the drawing 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 table below. (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 table below, and can be used to simplify the calculation.

Formulas

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

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

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

- 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 [cm³]
 P = Operating pressure [MPa]
 L = Length of piping [mm]
 a = Internal cross section of piping [mm²]
 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

$$Q_{c2} = Q_C \times n \times \text{Number of actuators} \times \text{Reserve factor}$$

- 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

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X
MSQX

MRQ

D-□

Low-Speed Compact Rotary Actuator Rack & Pinion Style

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 table below.

Applicable Auto Switch/Refer to pages 761 to 809 for detailed auto switch specification.


Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage		Auto switch model		Lead wire length (m)				Pre-wired connector	Applicable load			
					DC	AC	Perpendicular	In-line	0.5 (Nil)	1 (M)	3 (L)	5 (Z)		IC circuit	Relay, PLC		
Solid state switch	Diagnostic indication (2-color display)	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	—	M9NV	M9N	●	●	●	○	○	IC circuit	Relay, PLC	
				3-wire (PNP)				M9PV	M9P	●	●	●	○	○			
				2-wire				M9BV	M9B	●	●	●	○	○			
				3-wire (NPN)				M9NVV	M9NV	●	●	●	○	○			
				3-wire (PNP)				M9PVV	M9PW	●	●	●	○	○			
				2-wire				M9BVV	M9BW	●	●	●	○	○			
	Water resistant (2-color indication)			3-wire (NPN)	M9NAV**	M9NA**	○	○	●	○	○	IC circuit					
				3-wire (PNP)	M9PAV**	M9PA**	○	○	●	○	○	IC circuit					
				2-wire	M9BAV**	M9BA**	○	○	●	○	○	—					
Reed switch	—	Grommet	Yes	3-wire (NPN equiv.)	24 V	5 V	—	A96V	A96	●	—	●	—	—	IC circuit	—	
				2-wire				100 V	A93V	A93	●	—	●	—	—	—	Relay, PLC
								100 V or less	A90V	A90	●	—	●	—	—	—	IC circuit

** 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 (Example) M9NWM
 3 m L (Example) M9NWL
 5 m Z (Example) M9NWZ

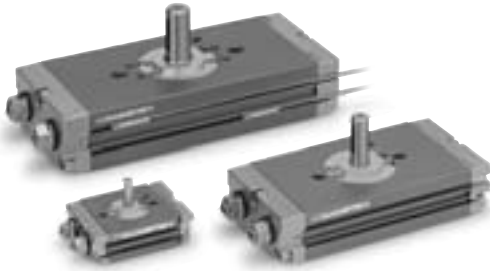
* Auto switches are shipped together, (but not assembled).

* Auto switches marked with a "○" are produced upon receipt of orders.

 Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.

Low-Speed Compact Rotary Actuator Rack & Pinion Style **Series CRQ2X**

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

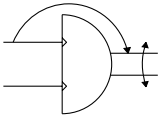
* Output under the operating pressure at 0.5 MPa. Refer to page 315 for further information.

Allowable Kinetic Energy and Rotation Time Adjustment Range

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.

JIS Symbol



Mass

Size	Standard mass* (g)	
	90°	180°
10	120	150
15	220	270
20	600	700
30	900	1100
40	1400	1600

* Not including the mass of auto switch.

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X
MSQX

MRQ

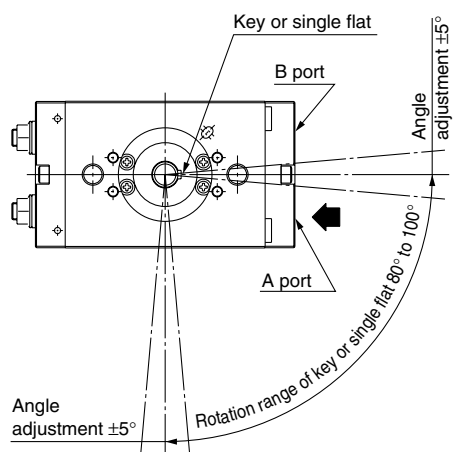
D-□

Series CRQ2X

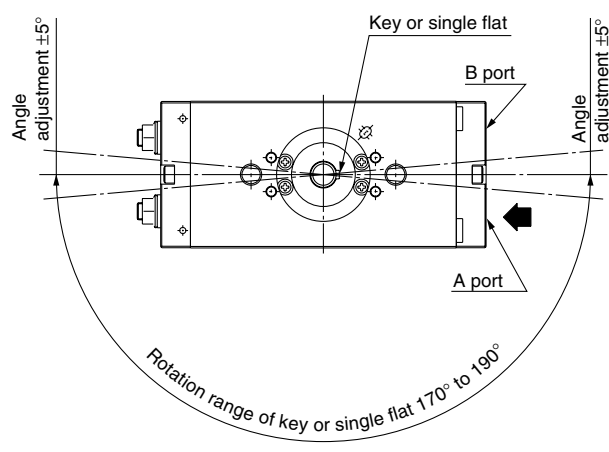
Rotation Range

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

Rotation angle: 90°

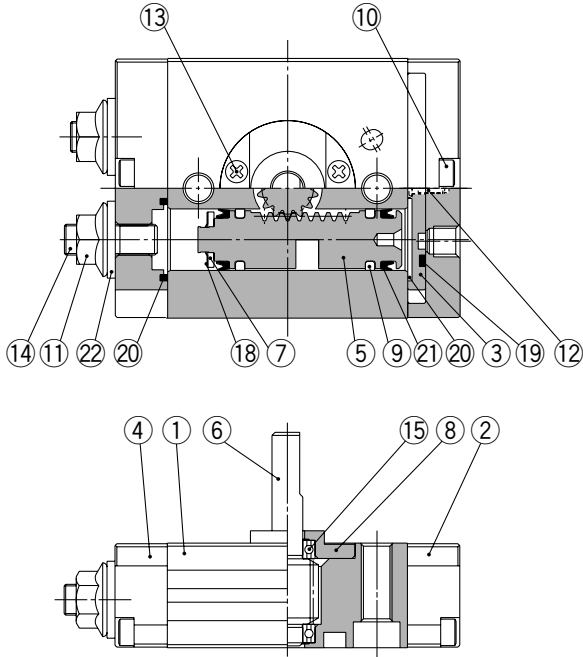


Rotation angle: 180°

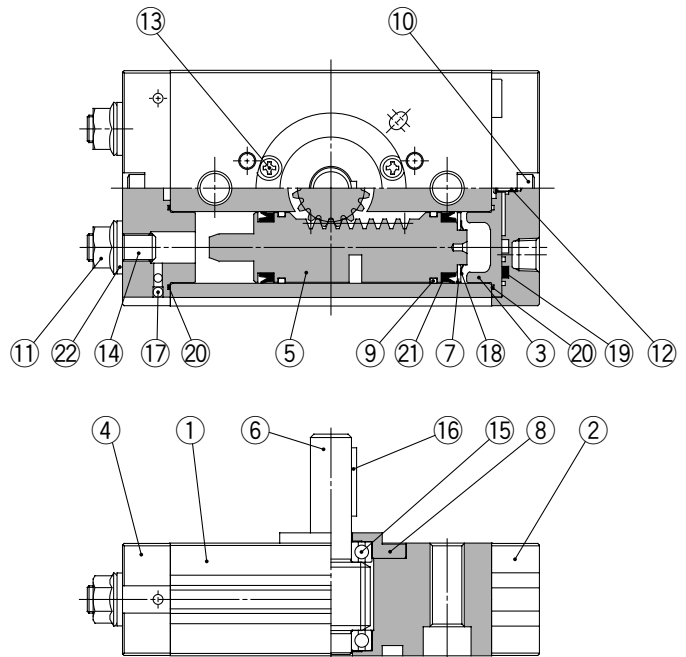


Construction

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	Shaft	Size: 10, 15 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	Type CS 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

Parts included in Seal Kit

No.	Description	Qty.	Note
9	Wear ring	4	
19	Seal	1	
20	Gasket for cover	2	Size: 10, 15
	Gasket for end cover	1	
	Gasket	4	Size: 20, 30, 40
21	Piston seal	4	
22	Seal washer	2	

* A set includes all parts above.

A grease pack (10 g) is included. When only a grease pack is needed, order with the following part number.

Replacement parts/Grease pack part no: P523010-21 (10 g)

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X
MSQX

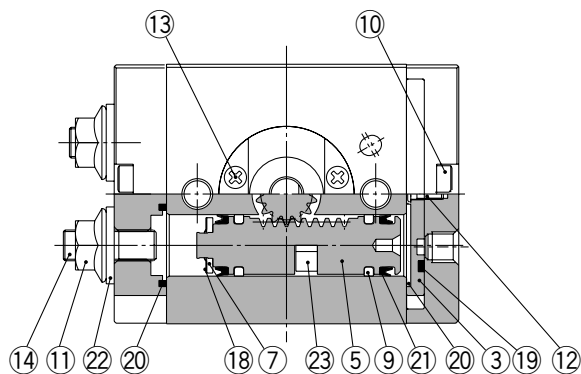
MRQ

D-□

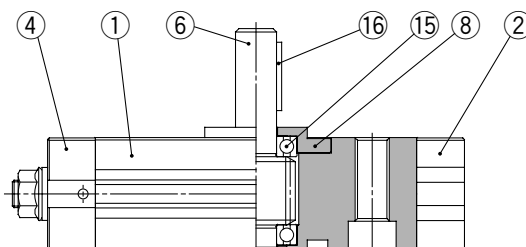
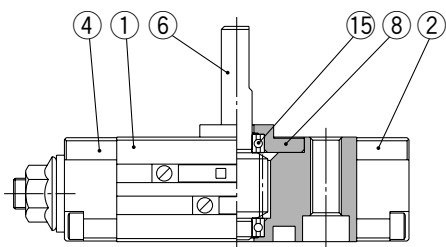
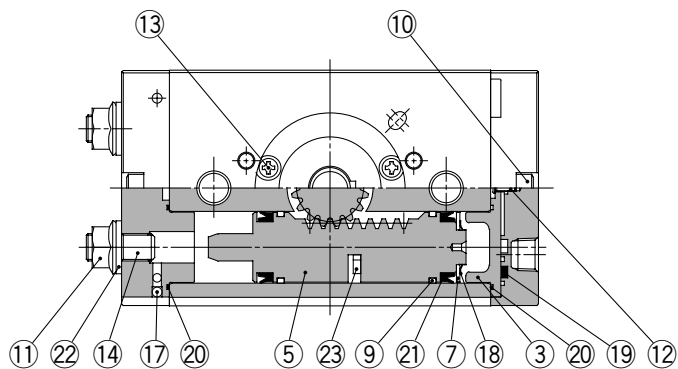
Series CRQ2X

Construction

With auto switch
Size 10/15

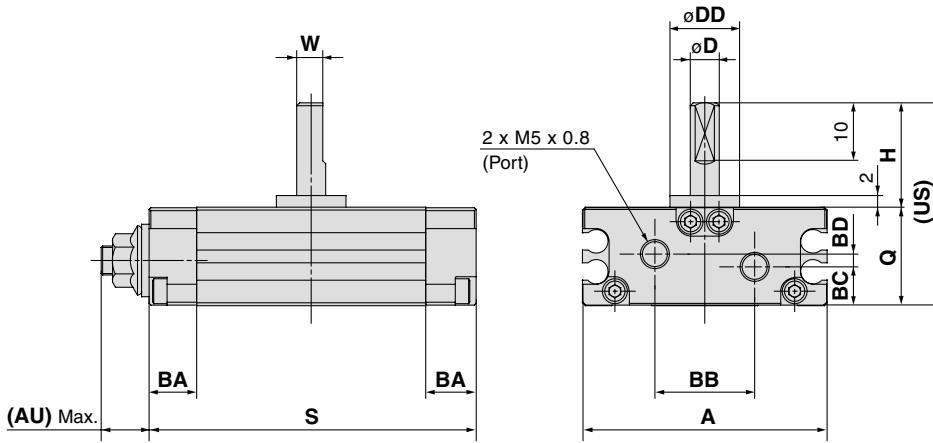
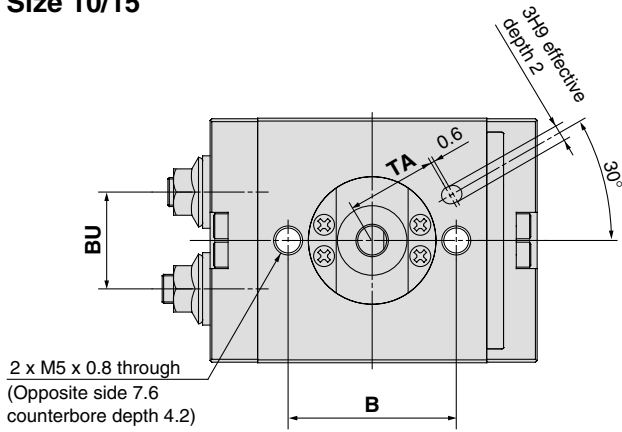


With auto switch
Size 20/30/40

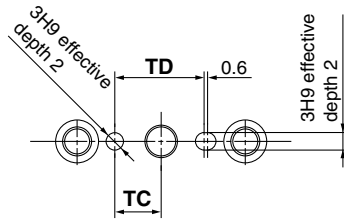
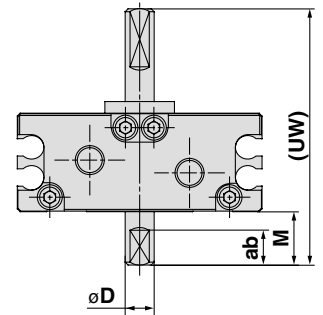


Dimensions

Size 10/15



With double shaft



- CRB2
- CRBU2
- CRB1
- MSU
- CRJ
- CRA1
- CRQ2
- MSQ
- MSZ
- CRQ2X**
- MSQX**
- MRQ

(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.

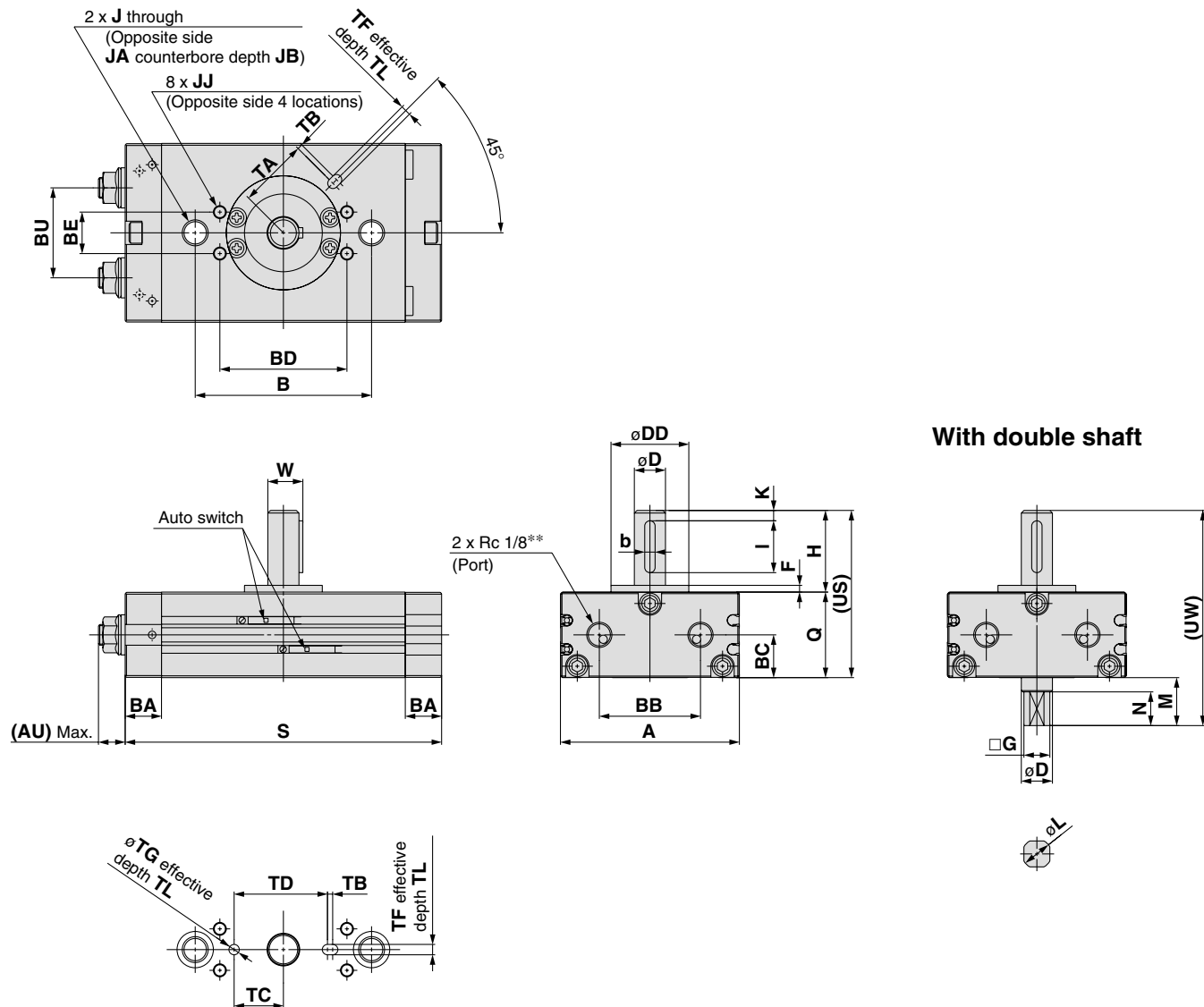
S: Upper 90°, Lower 180°

D-□

Series CRQ2X

Dimensions

Size 20/30/40



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	Key dimensions		US	TA	TB	TC	TD	TF (H9)	TG (H9)	TL	UW	G	M	N	L
					b	I													
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		9.6 ⁰ _{-0.1}														
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		11.4 ⁰ _{-0.1}														
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		14 ⁰ _{-0.1}														

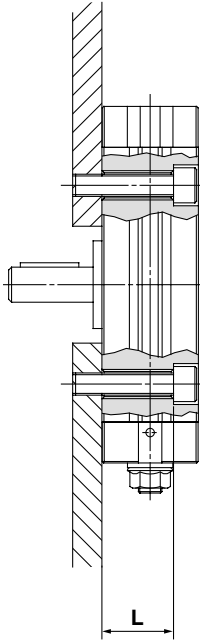
* The AU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

S: Upper 90°, Lower 180°

** In addition to Rc 1/8, G 1/8, NPT 1/8 and 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

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

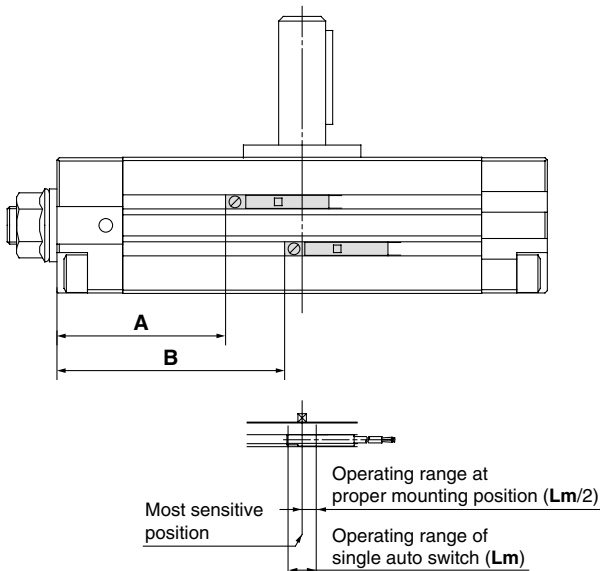
MSQ

MSZ

CRQ2X
MSQX

MRQ

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	61°	5°
	180°	18	31			22	35		
15	90°	18.5	27	52°	9°	22.5	31	47°	4°
	180°	22.5	39.5			26.5	43.5		
20	90°	36	48.5	41°	9°	40	52.5	40°	4°
	180°	42	67.5			46	71.5		
30	90°	43	59	32°	7°	47	63	29°	2°
	180°	51	82			55	86		
40	90°	50	69	24°	5°	54	73	24°	2°
	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) Since the above values are only provided as a guideline, they are not guaranteed.

In the actual setting, adjust them after confirming the auto switch operating condition.

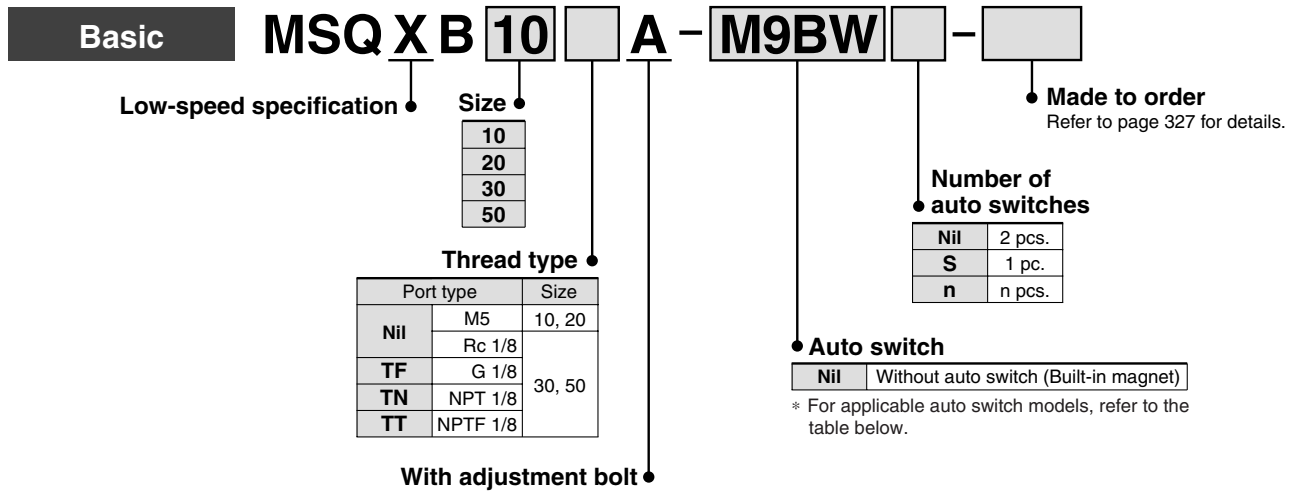
D-□

Low-Speed Rotary Table Rack & Pinion Style

Series MSQX

Size: 10, 20, 30, 50


How to Order



Applicable Auto Switch/Refer to pages 761 to 809 for detailed auto switch specification.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage		Auto switch model		Lead wire length (m)				Pre-wired connector	Applicable load						
					DC	AC	Perpendicular	In-line	0.5 (Nil)	1 (M)	3 (L)	5 (Z)								
Solid state switch	—	Grommet	Yes	3-wire (NPN)	5 V, 12 V	—	M9NV	M9N	●	●	○	○	○	○	IC circuit	Relay, PLC				
				3-wire (PNP)			M9PV	M9P	●	●	○	○								
	2-wire			M9BV	M9B		●	●	○	○	—									
	3-wire (NPN)			M9NWV	M9NW		●	●	○	○										
	3-wire (PNP)			M9PWV	M9PW		●	●	○	○	—									
	2-wire			M9BWV	M9BW		○	●	○	○										
	Water resistant (2-color indication)			3-wire (NPN)	M9NAV**		M9NA**	○	○	●	○	○					○	○	IC circuit	—
				3-wire (PNP)	M9PAV**		M9PA**	○	○	●	○	○								
				2-wire	M9BAV**		M9BA**	○	○	●	○	○								
				—	—		—	—	—	—	—	—								
Reed switch	—	Grommet	Yes	3-wire (NPN equiv.)	—	—	A96V	A96	●	—	●	—	—	—	IC circuit	—				
				2-wire			A93V	A93	●	—	●	—								
				—	A90V		A90	●	—	●	—	—					IC circuit	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 * Auto switches marked with a "○" are produced upon receipt of orders.
 1 m M (Example) M9NWM
 3 m L (Example) M9NWL
 5 m Z (Example) M9NWZ
 * Auto switches are shipped together, (but not assembled).

 Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.

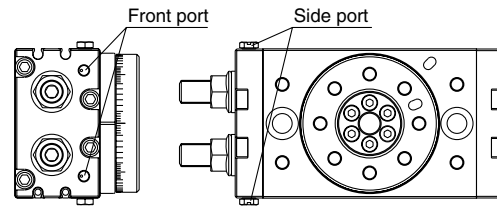
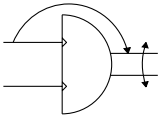
Specifications



Size		10	20	30	50
Fluid		Air (Non-lube)			
Max. operating pressure		1 MPa			
Min. operating pressure		0.1 MPa			
Ambient and fluid temperature		0° to 60°C (No freezing)			
Cushion		Not attached			
Angle adjustment range		0 to 190°			
Maximum rotation angle		190°			
Port size	End port	M5 x 0.8		Rc 1/8, G 1/8, NPT 1/8, NPTF 1/8	
	Side port	M5 x 0.8			
Output (N·m)*		0.89	1.8	2.7	4.6

* Output under the operating pressure at 0.5 MPa. Refer to page 315 for further information.

JIS Symbol



Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (J)	Stable operational rotation time adjustment range (s/90°)
10	0.007	1 to 5
20	0.025	
30	0.048	
50	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.



Made to order

Refer to page 333 for details.

Symbol	Specifications/Content
-X15□	With external stopper

Mass

Size	10	20	30	50
Basic	530	990	1290	2080

(g)

* Not including the mass of auto switch.

CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X
MSQX

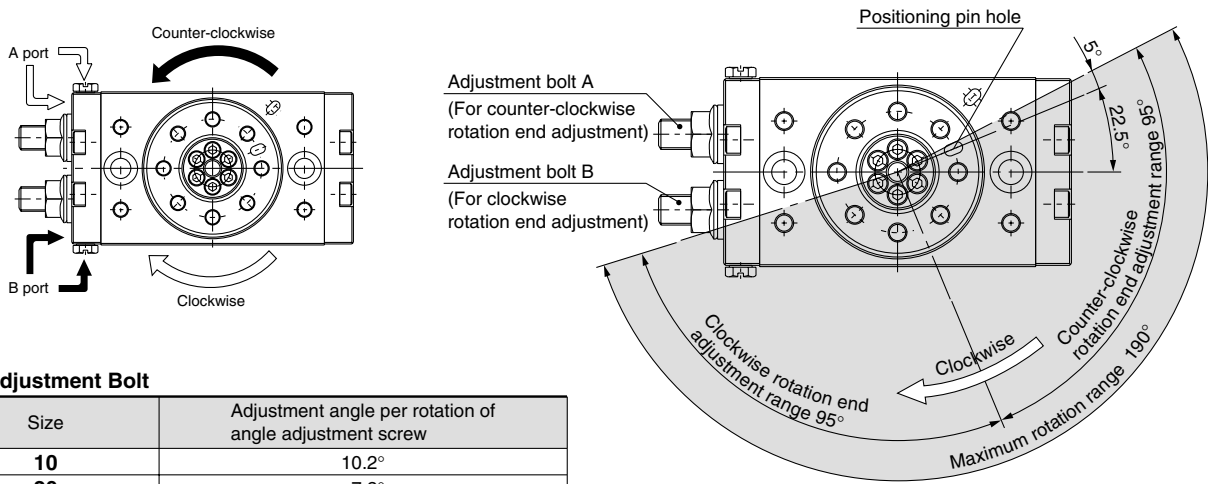
MRQ

D-□

Series MSQX

Rotation Direction and Rotation Angle

- The rotary table turns in the clockwise direction when the A port is pressurized, and in the counter-clockwise direction when the B port is pressurized.
- By adjusting the adjustment bolt, the rotation end can be set within the range shown in the drawing for the desired rotation angle.



With Adjustment Bolt

Size	Adjustment angle per rotation of angle adjustment screw
10	10.2°
20	7.2°
30	6.5°
50	8.2°

- Note) • The drawing shows the rotation range of the positioning pin hole.
 • The pin hole position in the drawing shows the counter-clockwise rotation end when the adjustment bolts A and B are tightened equally and the rotation is adjusted 180°.

Rotation Angle Range Example

- Various rotation ranges are possible as shown in the drawings below using adjustment bolts A and B. (The drawings also show the rotation ranges of the positioning pin hole.)
- The rotation angle can also be set on a type with inertial absorber.

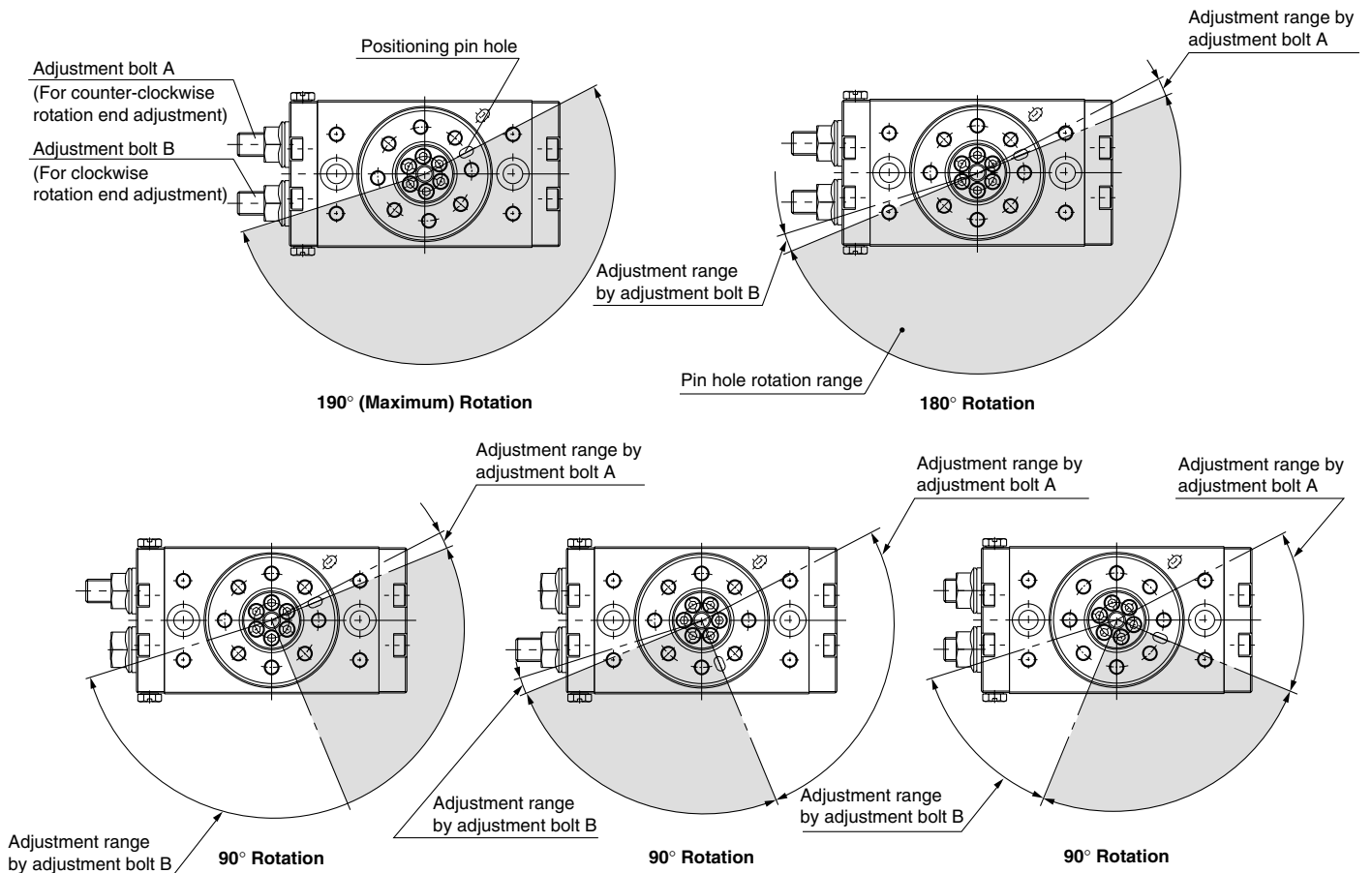
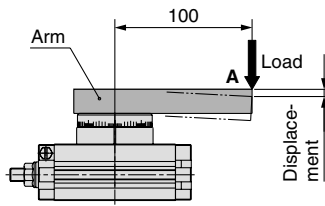
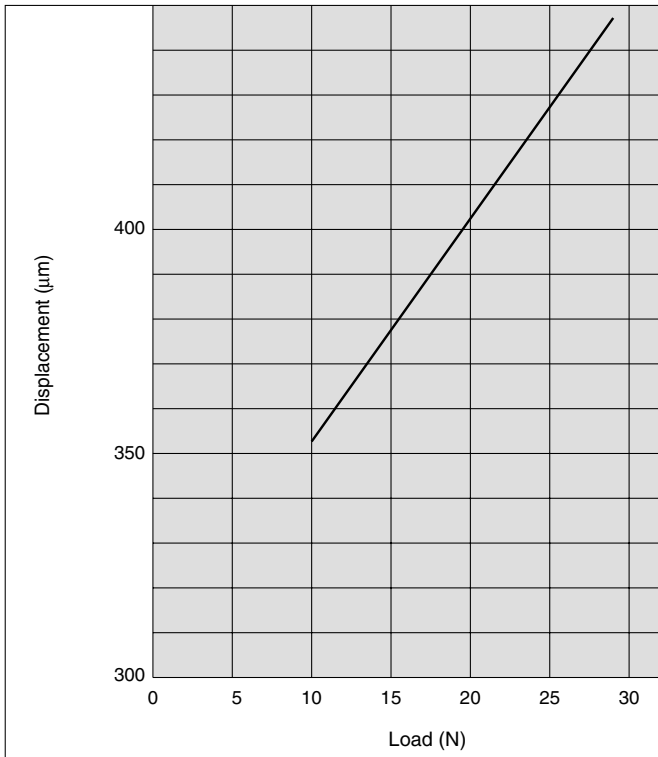


Table Displacement (Reference values)

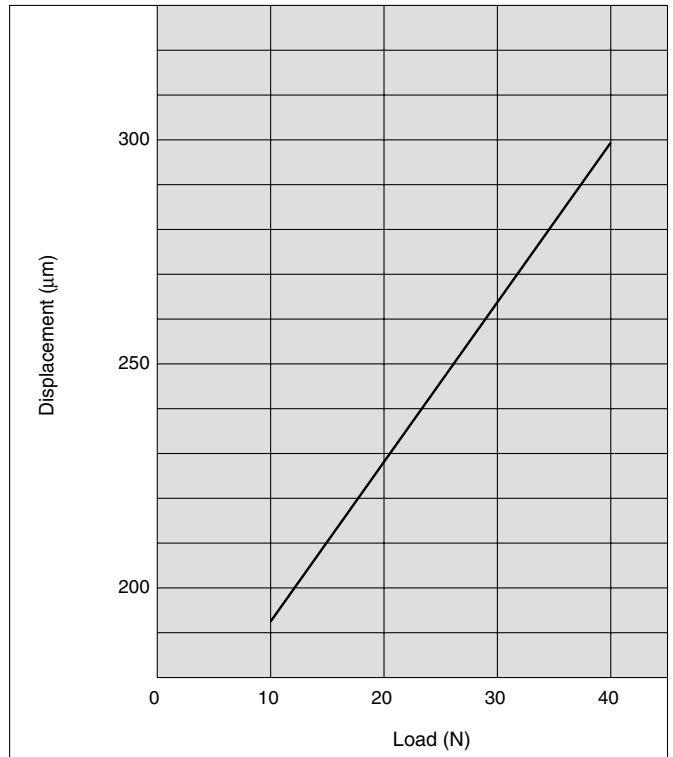
- The following graphs show the displacement at point A, which is 100 mm apart from the center of rotation, where the load is applied.



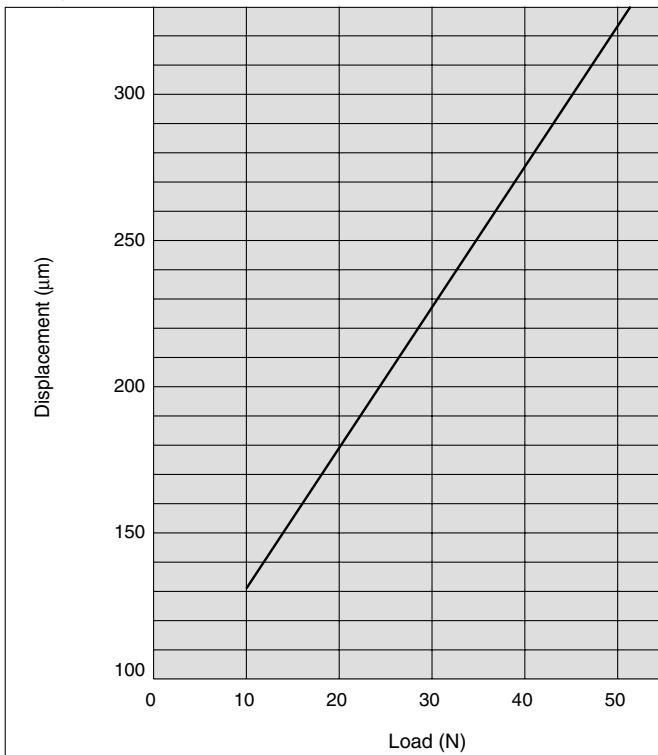
MSQXB10A



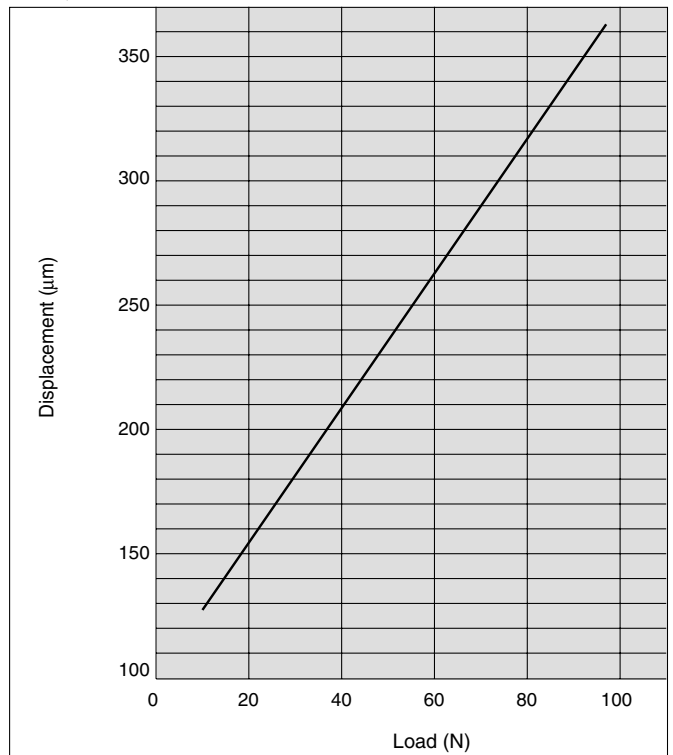
MSQXB20A



MSQXB30A



MSQXB50A



CRB2

CRBU2

CRB1

MSU

CRJ

CRA1

CRQ2

MSQ

MSZ

CRQ2X

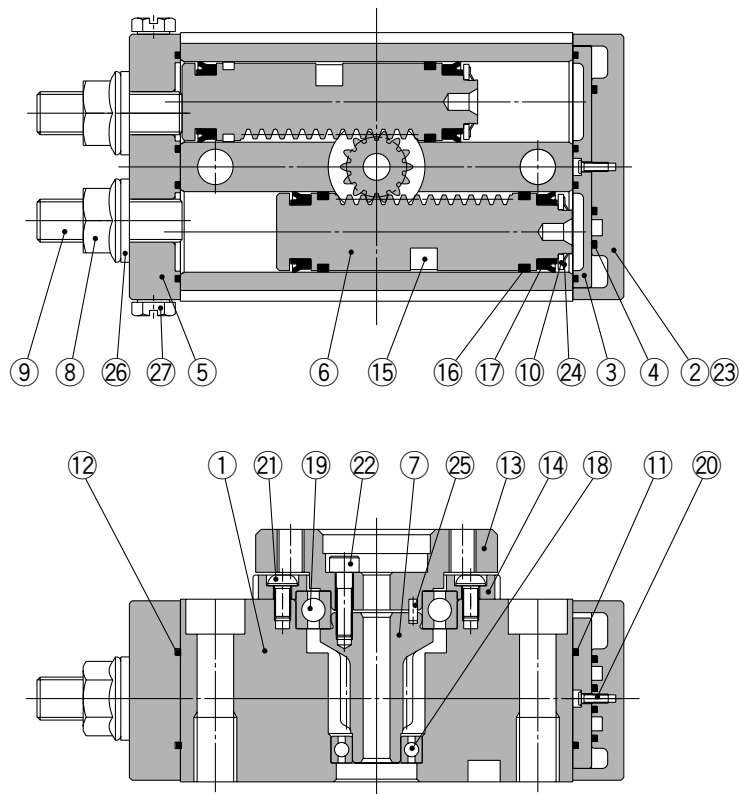
MSQX

MRQ

D-□

Series MSQX

Construction



Component Parts

No.	Description	Material
1	Body	Aluminium alloy
2	Cover	Aluminium alloy
3	Plate	Resin
4	Seal	NBR
5	End cover	Aluminium alloy
6	Piston	Stainless steel
7	Pinion	Chrome molybdenum steel
8	Hexagon nut with flange	Steel wire
9	Adjustment bolt	Chrome molybdenum steel
10	Seal retainer	Aluminium alloy
11	Gasket	NBR
12	Gasket	NBR
13	Table	Aluminium alloy
14	Bearing retainer	Aluminium alloy

Component Parts

No.	Description	Material	
15	Magnet	—	
16	Wear ring	Resin	
17	Piston seal	NBR	
18	Deep groove ball bearing	Bearing steel	
19	Deep groove ball bearing	Bearing steel	
20	Cross recessed screw No. 0	Steel wire	
21	Cross recessed screw	Stainless steel	
	Low head cap screw	Size: 10	Chrome molybdenum steel
22	Hexagon socket head cap screw	Size: 20 to 50	Stainless steel
23	Hexagon socket head cap screw		Stainless steel
24	Type CS retaining ring		Spring steel
25	Parallel pin		Carbon steel
26	Seal washer		NBR
27	Plug		Brass

Replacement Parts

Description	Part no.											
	10			20			30			50		
Seal kit	P523010-20			P523020-20			P523030-20			P523040-20		
	No.	Description	Qty.	No.	Description	Qty.	No.	Description	Qty.	No.	Description	Qty.
Parts included in seal kit	4	Seal	1	4	Seal	1	4	Seal	1	4	Seal	1
	11	Gasket	1	11	Gasket	1	11	Gasket	1	11	Gasket	1
	12	Gasket	1	12	Gasket	1	12	Gasket	1	12	Gasket	1
	16	Wear ring	4	16	Wear ring	4	16	Wear ring	4	16	Wear ring	4
	17	Piston seal	4	17	Piston seal	4	17	Piston seal	4	17	Piston seal	4
	26	Seal washer	2	26	Seal washer	2	26	Seal washer	2	26	Seal washer	2

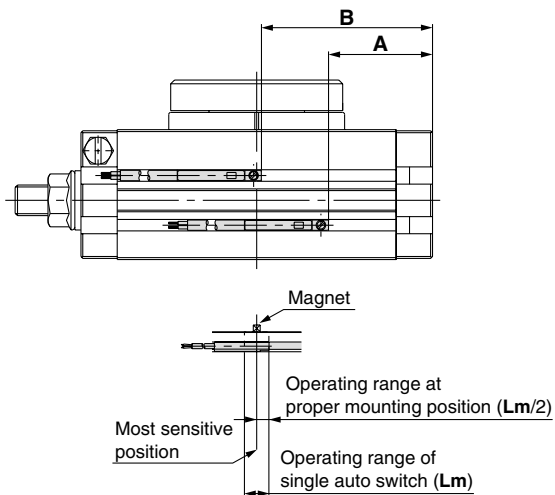
* A set includes all parts above.

A grease pack (10 g) is included. When only a grease pack is needed, order with the following part number.

Replacement parts/Grease pack part no: P523010-21 (10 g)

Series MSQX

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	190°	27	45	90°	10°	31	49	55°	10°
20	190°	35	62	80°	10°	39	66	45°	10°
30	190°	39	68	65°	10°	43	72	35°	10°
50	190°	49	83	50°	10°	53	87	30°	10°

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) Since the above values are only provided as a guideline, they are not guaranteed.

In the actual setting, adjust them after confirming the auto switch operating condition.



Please contact SMC for detailed specifications, lead times and prices.

Symbol

With External Stopper

X150/X151/X152/X153

Prevent holding torque from being halved at the rotation end.

How to Order

MSQXB 10 **AX - M9NW - X150**

Size	Port type	Size
10	M5	10, 20
20		
30	Rc 1/8	30, 50
50	G 1/8	
	NPT 1/8	
	NPTF 1/8	

Auto switch	
Nil	Without auto switch (Built-in magnet)

Connection port location and rotation angle

X150	Standard, 180°
X151	Standard, 90°
X152	Symmetric type, 180°
X153	Symmetric type, 90°

Specifications

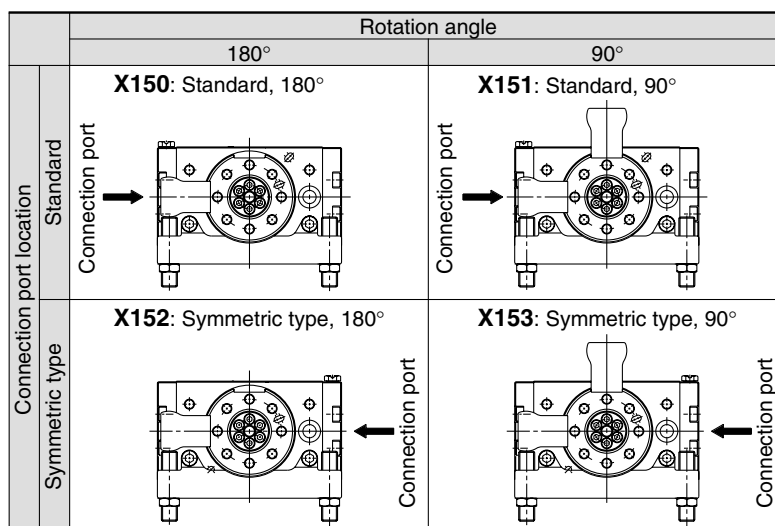
Size	10	20	30	50
Rotation angle	90°, 180°			
Angle adjustment range	Each rotation end $\pm 3^\circ$			

* Specifications other than the above are the same as standard.

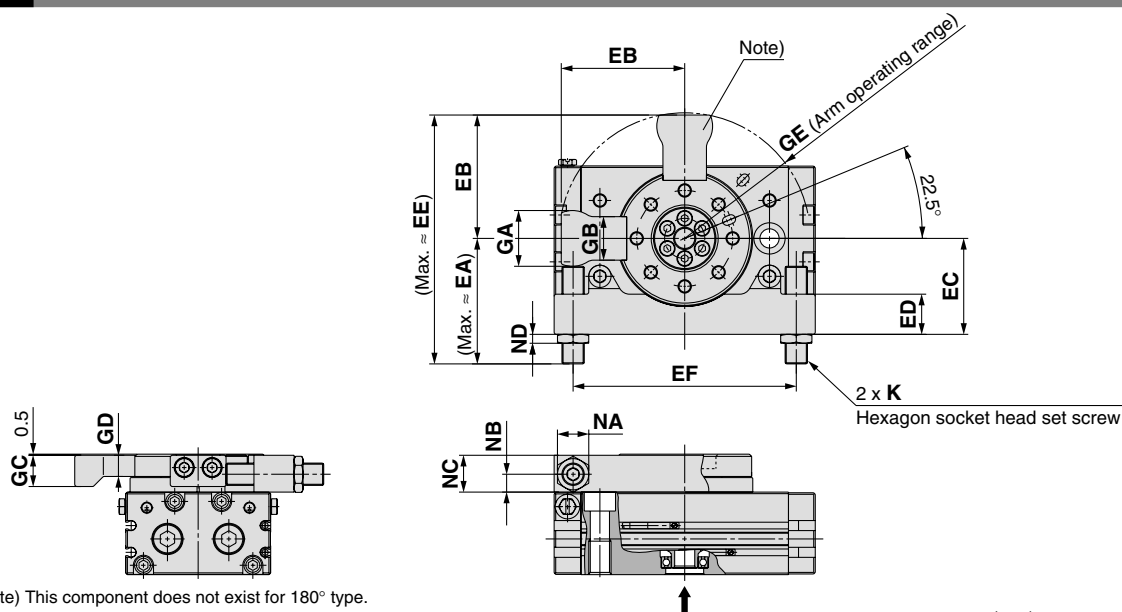
Mass

Size	10	20	30	50
90° spec.	630	1200	1520	2480
180° spec.	600	1140	1450	2370

* Values not including the auto switch mass.



Dimensions



Note) This component does not exist for 180° type.

Size	EA	EB	EC	ED	EE	EF	GA	GB	GC	GD	GE	K	NA	NB	NC	ND
10	47.1	44.3	33.5	14	91.4	80	20	15.6	11	7.5	45.2	M8 x 1	10	5.5	12.5	4
20	57.1	55.3	43	18	112.4	100	25	19.5	14	9.5	56.4	M10 x 1	14	8	16.5	4
30	58.4	60.3	46	19.5	118.7	110	27	21.5	14	9.5	61.5	M10 x 1	14	8	16.5	4
50	74.4	71.4	56	22	145.8	130	32	28	18	11.5	72.9	M14 x 1.5	19	8.5	19.5	6

* Dimensions other than the above are the same as standard.

- CRB2
- CRBU2
- CRB1
- MSU
- CRJ
- CRA1
- CRQ2
- MSQ
- MSZ
- CRQ2X
- MSQX
- MRQ

D-□



Series CRQ2X/MSQX

Specific Product Precautions

Be sure to read before handling.

Refer to front matters 38 and 39 for Safety Instructions and pages 4 to 13 for Rotary Actuator and Auto Switch Precautions.

Selection

Caution

- 1. Changes in speed occur in applications in which there are changes to the load during operation, such as the load being lifted (lowered) against gravity.**
- 2. The purpose of this product is stable rotation at low-speed.**
It does not provide any function to cushion the impact at the operation start or end.
- 3. Speed may vary at the rotation end depending on operating conditions. (This phenomenon can be avoided by using the external stopper.)**