IAI
Quality and Innovation

Hollow Rotary

# RCP6-RTFML


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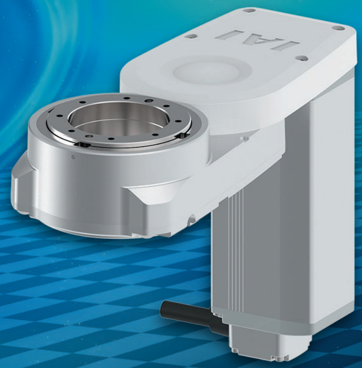
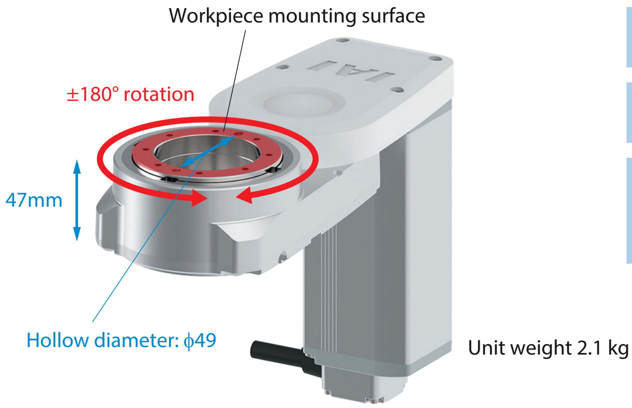
# Slim and lightweight RCP6-RTFML Rotary with large-diameter hollow shaft of ϕ49, suitable for combined axes, is now available



## 1 ϕ49 large-diameter hollow shaft
## Thin type with rotation part 47mm thickness, with unit weight of 2.1 kg

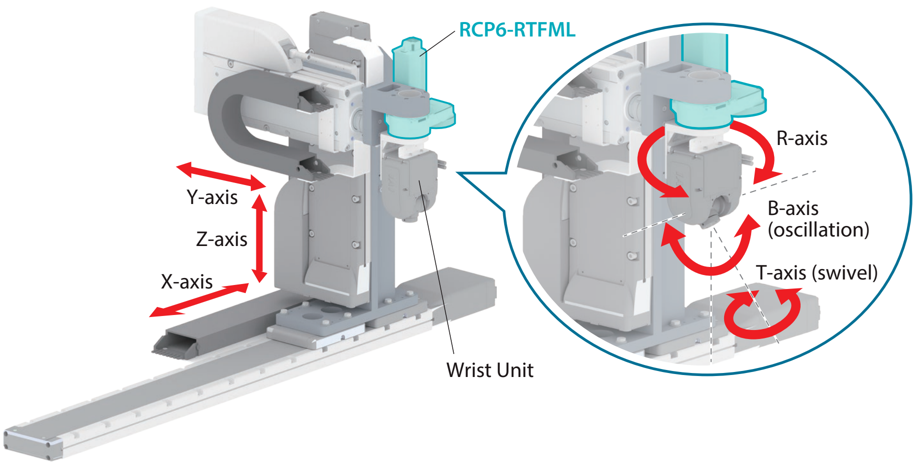
Wiring can be passed through the hollow section, reducing the design and assembly processes.



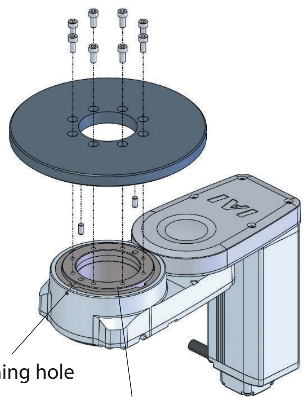

- Large-diameter hollow shaft
- Slim and lightweight
- Reduced design process  
  Reduced assembly process

## 2 Can be combined with Cartesian axis, Gripper or Wrist Unit

It can be used as a shaft for rotating grippers and Wrist Units.
It can be combined with Cartesian 3-axis and Wrist Unit rotational 2-axis to enable movement with 6 axes of freedom.

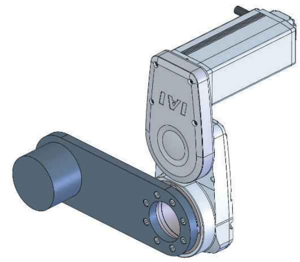


# 3 Tables and jigs can be directly mounted on the rotating section. Brake option can also be selected, and horizontal use is possible as well.



Positioning hole

Tapped mounting hole



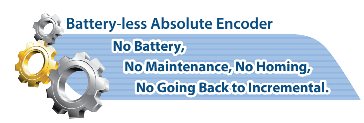
Reduced design process
Reduced parts
Reduced assembly process

* The bolts, positioning pins, mounting brackets and the like should be prepared by the customer.

# 4 Cross roller bearings provide high rigidity and high load Timing belt drive system produces no backlash

# 5 Equipped with a Battery-less Absolute Encoder as standard

No battery maintenance is required since there is no battery.
Homing operation is not required at startup or after emergency stop or malfunction.
This reduces your operation time, resulting in reduced production costs.




## Model Specification Items

| RCP6 | RTFML | WA | 42P | 30 | 360 | | | |
|---|---|---|---|---|---|---|---|---|
| Series | Type | Encoder Type | Motor Type | Deceleration Ratio | Oscillation Angle | Applicable Controllers | Motor/encoder Cable Length | Options |

**Encoder Type**

| | |
|---|---|
| WA | Battery-less Absolute |

**Motor Type**

| | |
|---|---|
| 42P | Stepper motor 42□ size |

**Deceleration Ratio**

| | |
|---|---|
| 30 | Deceleration ratio 1/30 |

**Oscillation Angle**

| | |
|---|---|
| 360 | ±180 degrees |

**Applicable Controllers**

| | |
|---|---|
| P3 | PCON-CB/CGB<br>PCON-CYB/PLB/POB<br>MCON-C/CG/LC/LCG<br>MSEL-PC/PG |
| P5 | RCM-P6PC<br>RCON-PC |

**Motor/encoder Cable Length**

| | |
|---|---|
| N | None |
| P | 1m |
| S | 3m |
| M | 5m |
| X□□ | Specified length |
| R□□ | Robot cable |

**Options**

| | |
|---|---|
| A1 | Cable exit direction (Left) |
| A2 | Cable exit direction (Top) |
| A3 | Cable exit direction (Right) |
| B | Brake |
| ML | Motor side-mounted to the left |
| MR | Motor side-mounted to the right |
| MT | Motor side-mounted on top |

* For the cable exit direction and side-mounted motor direction, check the dimensions on pages 4 to 5.

# RCP6-RTFML

Battery-less Absolute | 24v Stepper Motor

### ■ Model Specification Items

| RCP6 | - | RTFML | - | WA | - | 42P | - | 30 | - | 360 | - | | - | | - | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | - | Type | - | Encoder Type | - | Motor Type | - | Deceleration Ratio | - | Oscillation Angle | - | Applicable Controllers | - | Motor/encoder Cable Length | - | Options |

**Encoder Type**

| | |
|---|---|
| WA | Battery-less Absolute |

**Motor Type**

| | |
|---|---|
| 42P | Stepper motor 42□ Size |

**Deceleration Ratio**

| | |
|---|---|
| 30 | Deceleration ratio 1/30 |

**Oscillation Angle**

| | |
|---|---|
| 360 | ±180 degrees |

**Applicable Controllers**

| | |
|---|---|
| P3 | PCON<br>MCON<br>MSEL |
| P5 | RCM-P6PC<br>RCON |

**Motor/encoder Cable Length**

| | |
|---|---|
| N | None |
| P | 1m |
| S | 3m |
| M | 5m |
| X□□ | Specified length |
| R□□ | Robot cable |

**Options**

Refer to Options table below.

(Note) The photo above shows the motor side-mounted on top (MT).

CE RoHS


POINT Selection Notes

(1) The maximum torque is the value at low speed operation. The output torque varies with the speed. Please refer to "Output Torque by Speed (page 8)" for more information.
(2) The maximum allowable moment of inertia indicates the maximum moment of inertia during rotation. Refer to "Allowable Moment of Inertia by Speed/Acceleration (page 9)" for details.
(3) When making a selection, calculate according to the Selection Method (page 7) and check the operating conditions.

## Option

* Please check the Options reference pages to confirm each option.

| Name | Option code | Reference page |
|---|---|---|
| Cable exit direction (Left) (Note 1) | **A1** | See P.6 |
| Cable exit direction (Top) (Note 1) | **A2** | See P.6 |
| Cable exit direction (Right) (Note 1) | **A3** | See P.6 |
| Brake | **B** | See P.6 |
| Motor side-mounted to left (Note 1) (Note 2) | **ML** | See P.6 |
| Motor side-mounted to right (Note 1) (Note 2) | **MR** | See P.6 |
| Motor side-mounted on top (Note 1) (Note 2) | **MT** | See P.6 |

(Note 1) For the direction, check the dimensions on pages 4 to 5.
(Note 2) Be sure to specify one of these options when determining the Model Specification Items.

## Motor/encoder Cable Length (between pigtail and controller)

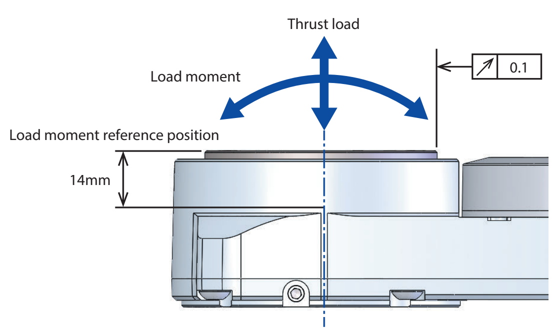
| Type | Cable code | P3 | P5 |
|---|---|---|---|
| Standard type | **P**(1m) | ○ | ○ |
| | **S**(3m) | ○ | ○ |
| | **M**(5m) | ○ | ○ |
| Specified length | **X06**(6m) ~ **X10**(10m) | ○ | ○ |
| | **X11**(11m) ~ **X15**(15m) | ○ | ○ |
| | **X16**(16m) ~ **X20**(20m) | ○ | ○ |
| Robot cable | **R01**(1m) ~ **R03**(3m) | ○ | ○ |
| | **R04**(4m) ~ **R05**(5m) | ○ | ○ |
| | **R06**(6m) ~ **R10**(10m) | ○ | ○ |
| | **R11**(11m) ~ **R15**(15m) | ○ | ○ |
| | **R16**(16m) ~ **R20**(20m) | ○ | ○ |

*CB-CAN-MPA□□□(-RB): P3(PCON/MCON/MSEL)
CB-ADPC-MPA□□□(-RB): P5(RCM-P6PC/RCON)
□□□ for length: ex. 030 for 3m
Add "-RB" for robot cable

## Main Specifications

| Item | | Description |
|---|---|---|
| Deceleration ratio | | 1/30 |
| Speed / acceleration/ deceleration | Max speed | 800 deg/s |
| | Max. acceleration/deceleration | 0.7G (6,865 deg/s²) |
| Brake | Brake specifications | Non-excitation actuated electromagnetic brake |
| | Brake retaining torque | 4.2N·m |
| Operation range | Oscillation angle | ±180 degrees |

| Item | Description |
|---|---|
| Drive system | Stepper motor + timing belt |
| Positioning repeatability | ±0.01 degrees |
| Lost motion | 0.05 degrees |
| Maximum torque | 5.2N·m |
| Maximum allowable moment of inertia | 0.08kg·m² |
| Allowable dynamic thrust load | 600N |
| Allowable dynamic load moment | 30N·m |
| Output shaft runout | 0.1mm |
| Ambient operating temp. & humidity | 0~40°C, 85% RH or less (Non-condensing) |
| Degree of protection | IP40 |
| International Standards compliance | CE marking, RoHS Directive |
| Motor type | Stepper motor |
| Encoder type | Battery-less Absolute |
| Encoder pulse count | 8192 pulse/rev |



## Output Torque by Speed

| Speed (deg/s) | Output torque (N·m) |
|---|---|
| 0 | 5.2 |
| 100 | 5.2 |
| 200 | 4.3 |
| 300 | 3.7 |
| 400 | 3.0 |
| 500 | 2.6 |
| 600 | 2.1 |
| 700 | 1.7 |
| 800 | 1.4 |

## Allowable Moment of Inertia by Speed/Acceleration

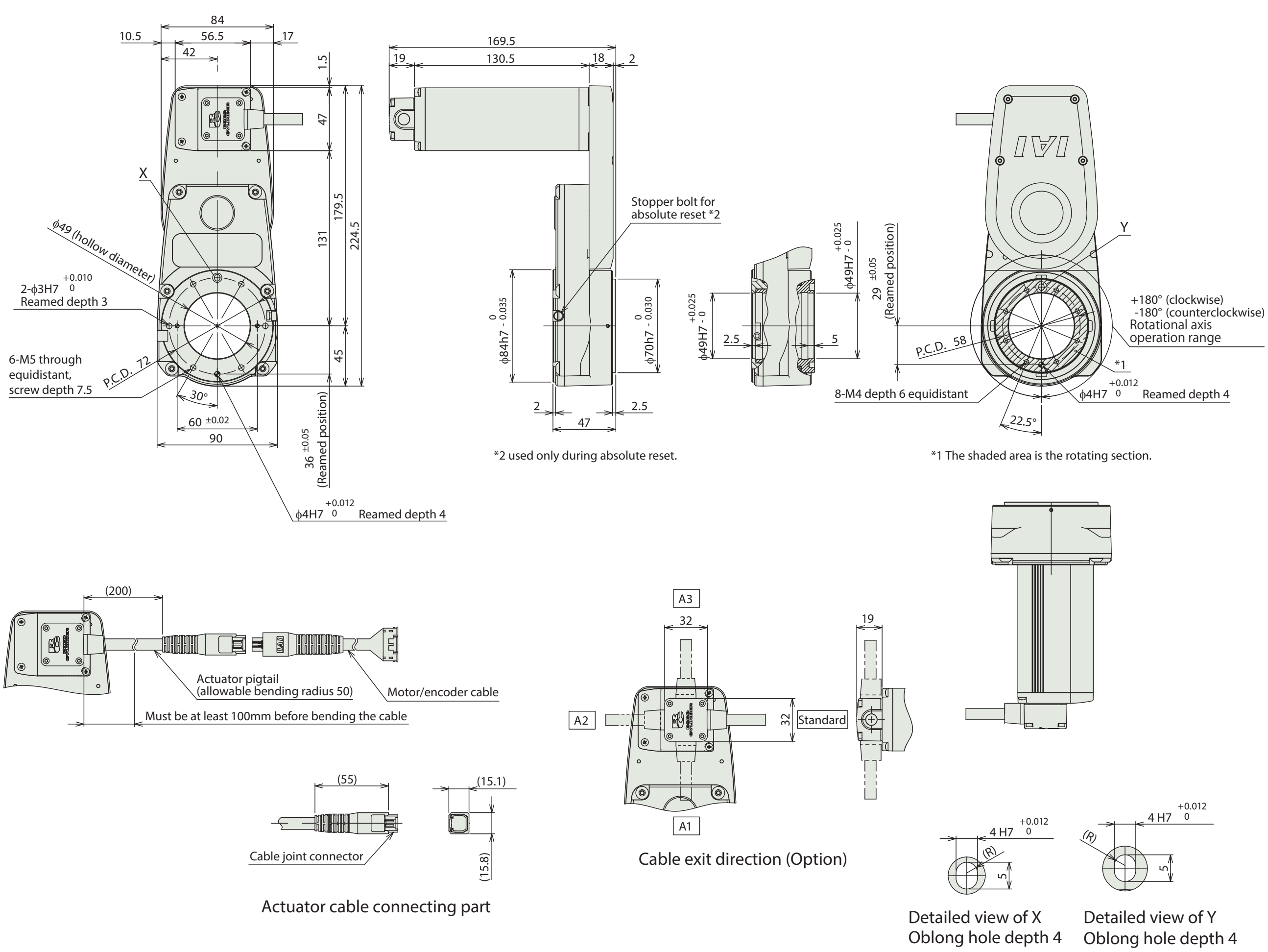
| Speed (deg/s) | Acceleration/deceleration (G) | |
|---|---|---|
| | 0.3 | 0.7 |
| 0 | 0.080 | 0.054 |
| 100 | 0.080 | 0.054 |
| 200 | 0.072 | 0.036 |
| 300 | 0.063 | 0.032 |
| 400 | 0.059 | 0.032 |
| 500 | 0.050 | 0.027 |
| 600 | 0.041 | 0.018 |
| 700 | 0.018 | 0.009 |
| 800 | 0.014 | 0.005 |

(Unit is kg·m²)

## Dimensions

CAD drawings can be downloaded from our website.
www.intelligentactuator.com
2D CAD 3D CAD

### ■ Motor side-mounted on top (MT)



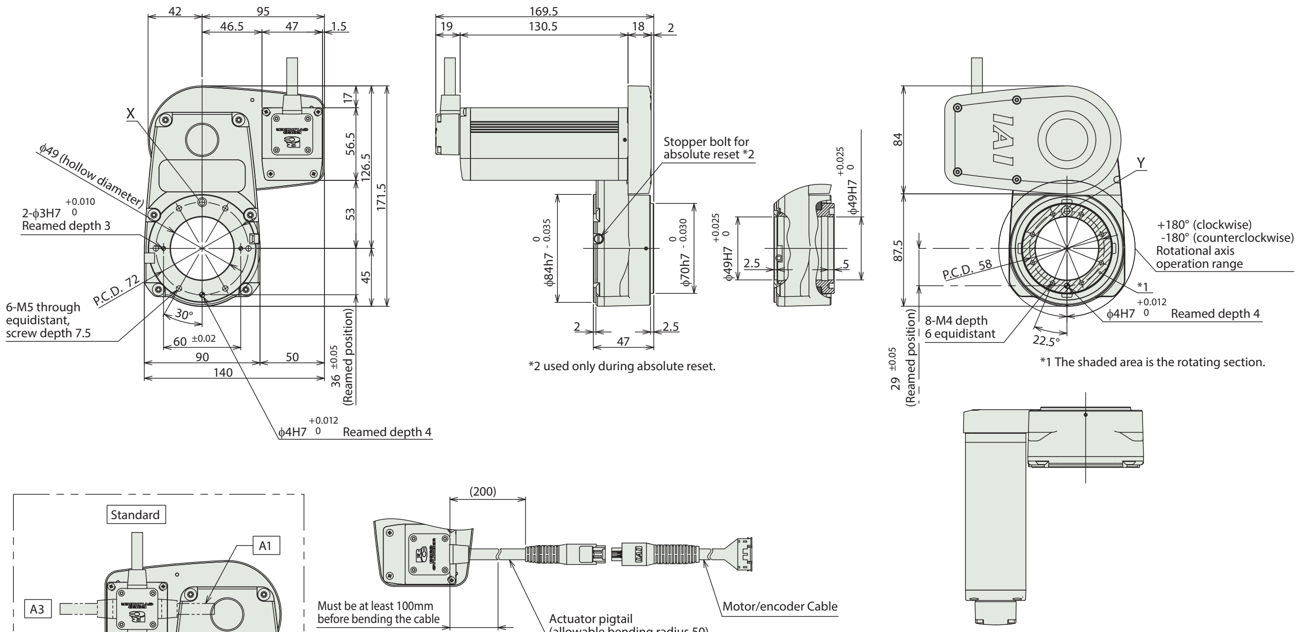

### ■ Weight

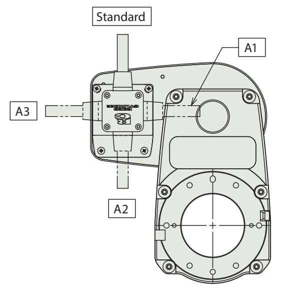
| Type | | RTFML |
|---|---|---|
| Mass (kg) | W/o Brake | 2.1 |
| | With Brake | 2.2 |

## Dimensions

CAD drawings can be downloaded from our website. www.intelligentactuator.com 2D CAD 3D CAD

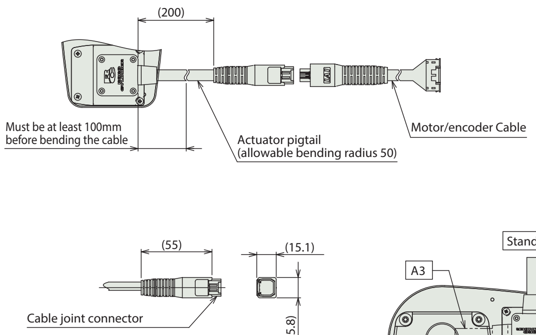
### ■ Motor side-mounted to right (MR)
(The type with motor side-mounted to left (ML) has a symmetrical design.)



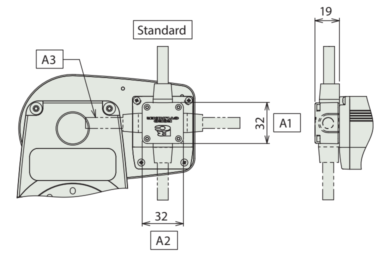




*3 Motor side-mounted to left

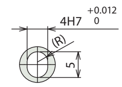
*3 The type with motor side-mounted to the left has a symmetrical design.



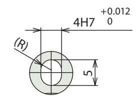

Actuator cable connecting part




Cable exit direction (Option)




Detailed view of X
Oblong hole depth 4




Detailed view of Y
Oblong hole depth 4

### ■ Weight

| Type | | RTFML |
|---|---|---|
| Mass (kg) | W/o Brake | 2.1 |
| | With Brake | 2.2 |

## Applicable Controllers

The actuators on this page can be operated by the controllers indicated below. Please select the type depending on your intended use. Motor size of RCP6-RTFML: 42P

| Name | External view | Max. number of connectable axes | Power supply voltage | Control method | | | | | | | | | | | | | | | Maximum number of positioning points | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Positioner | Pulse-train | Program | Network option * | | | | | | | | | | | | | |
| | | | | | | | DV | CC | CIE | PR | CN | ML | ML3 | EC | EP | PRT | SSN | ECM | | |
| MCON-C/CG |  | 8 (Note 2) | 24VDC | - | - | - | ● | ● | - | ● | ● | - | ● | ● | ● | ● | ● | ● | 256 | Please contact IAI for more information. |
| MCON-LC/LCG |  | 6 (Note 2) | | - | - | ● | ● | ● | - | ● | ● | - | - | ● | ● | ● | - | - | 256 | |
| MSEL-PC/PG |  | 4 | Single phase 100~230VAC | - | - | ● | ● | ● | - | ● | - | - | - | ● | ● | ● | - | - | 30000 | |
| PCON-CB/CGB |  | 1 | 24VDC | ● (Note 1) Option | ● (Note 1) Option | - | ● | ● | - | ● | ● | ● | ● | ● | ● | ● | - | - | 512 (768 for network spec.) | |
| PCON-CYB/PLB/POB |  | 1 | | ● (Note 1) Option | ● (Note 1) Option | - | - | - | - | - | - | - | - | - | - | - | - | - | 64 | |
| RCM-P6PC |  | 1 | Can be used within the RCP6S Gateway system. | | | | | | | | | | | | | | | | 768 | |
| RCON |  | 16 | 24VDC | - | - | - | ● | ● | ● | ● | - | - | - | ● | ● | ● | - | - | 128 | RCON Pamphlet |

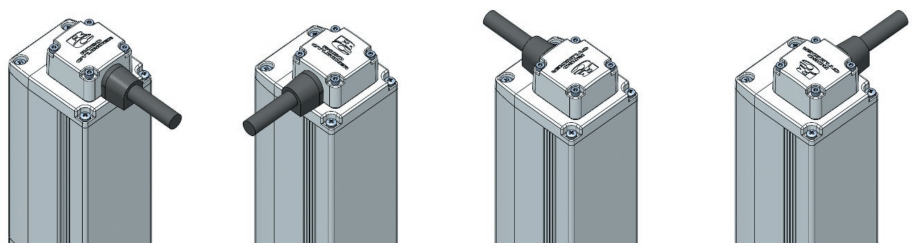
(Note 1) For network abbreviations such as DV and CC, please contact IAI.
(Note 2) These values are the max no. of axes connectable with all non-high output axes. RCP6-RTFML does not support non-high output mode. The max no. of connectable axes with all high-output mode is 4 for C and 3 for LC.

# Options

## Cable Exit Direction

**Model** **A1 / A2 / A3**

**Description** Pigtail cable exit direction can be specified.
See pages 4 and 5 for details.



Standard　A1　A2　A3

## With Brake

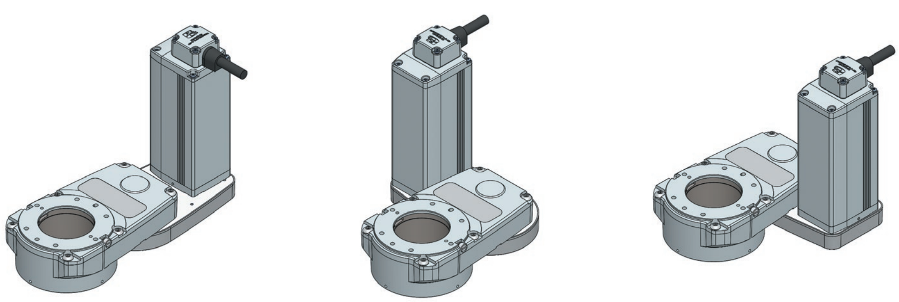
**Model** **B**

**Description** This is used to prevent the rotary motion due to gravity and/or external force during power outages or when the servo is OFF. When using the output shaft horizontally, it is possible to prevent workpieces and the like from falling due to the rotation of the output shaft.

## Side-mounted Motor Direction

**Model** **MT / ML / MR**

**Description** The side-mounting direction of the motor unit can be specified.
The top side-mounted direction is MT, left is ML and right is MR.
Check the dimensions and details on pages 4 and 5.



Top side-mounted (MT)　Left side-mounted (ML)　Right side-mounted (MR)

# Selection Method

The following conditions must be satisfied for operation. Calculate 1 and 2 to determine the conditions.

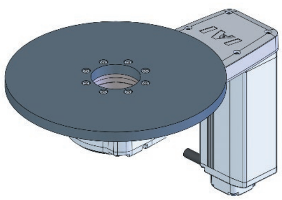
**Condition 1**

Check the moment of inertia
(1) Without load torque
(2) With load torque
*The confirmation method for moment of inertia differs depending on whether load torque is present.

(1) Without load torque

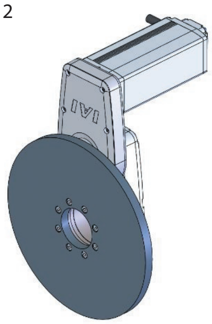
When used as shown in the images below, the unit will not be subject to load torque due to gravity. In this case, calculate only the moment of inertia of the loaded object and make sure that it does not exceed the allowable moment of inertia. Using the formulae of typical shapes (page 10), calculate the moment of inertia of the tool and workpiece to be used.

Example 1



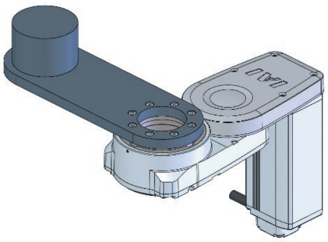

Load center mass location: Rotary shaft center
Body installation: Rotary shaft upward or downward

Example 2




Load center mass location: Rotary shaft center
Body installation: Rotary shaft horizontal

Example 3




Load center mass location: Offset from rotary shaft center
Body installation: Rotary shaft upward or downward

**[Allowable Moment of Inertia by Speed/Acceleration]**

| **Speed** (deg/s) | **Acceleration/deceleration** | |
|---|---|---|
| | 0.3G | 0.7G |
| 0 | 0.080 | 0.054 |
| 100 | 0.080 | 0.054 |
| 200 | 0.072 | 0.036 |
| 300 | 0.063 | 0.032 |
| 400 | 0.059 | 0.032 |
| 500 | 0.050 | 0.027 |
| 600 | 0.041 | 0.018 |
| 700 | 0.018 | 0.009 |
| 800 | 0.014 | 0.005 |

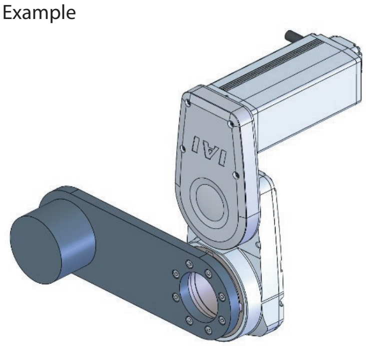
(Unit is kg·m²)

(2) With load torque

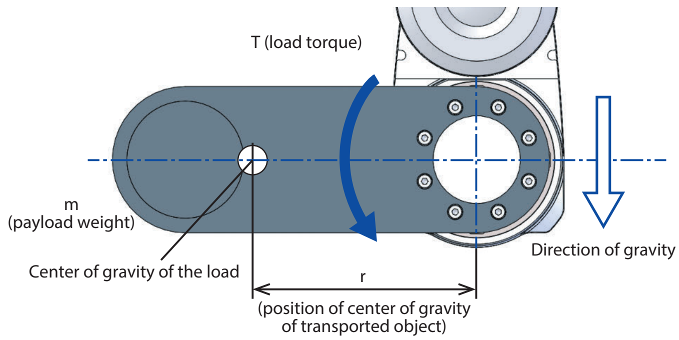
When used as shown in the image below, the unit will be subjected to load torque due to gravity, reducing the allowable moment of inertia accordingly.

First, calculate the load torque and obtain the corrected allowable moment of inertia. Then calculate the moment of inertia and check that it does not exceed the corrected allowable moment of inertia. A calculation example is shown below.

Example




Load: Offset from rotary shaft center
Body installation: Rotary shaft horizontal




(Step 1) Calculating the load torque T

$T = mgr \times 10^{-3}$ [N·m]

m: Mass of transported object [kg]

g: Gravitational acceleration [$m/s^2$]

r: Center of gravity of the transported object [mm]

(Step 2) Calculating the allowable moment of inertia correction factor Cj

$$Cj = \frac{T_{max} - T}{T_{max}}$$

$T_{max}$: Output torque [N·m]

* Refer to the table below for the value of output torque $T_{max}$.

**[Output Torque by Speed $T_{max}$]**

| **Speed** (deg/s) | **Output torque (N·m)** |
|---|---|
| 0 | 5.2 |
| 100 | 5.2 |
| 200 | 4.3 |
| 300 | 3.7 |
| 400 | 3.0 |
| 500 | 2.6 |
| 600 | 2.1 |
| 700 | 1.7 |
| 800 | 1.4 |

# Operating Conditions

(Step 3) Calculating the corrected allowable moment of inertia Jtl

$J_{tl} = J_{max} \times C_j$ [kg·m²]

$J_{max}$: Allowable moment of inertia [kg·m²]

* Refer to the table below for the value of allowable moment of inertia $J_{max}$.

**[Allowable Moment of Inertia by Speed/Acceleration $J_{max}$]**

| **Speed** (deg/s) | **Acceleration/deceleration** | |
|---|---|---|
| | 0.3G | 0.7G |
| 0 | 0.080 | 0.054 |
| 100 | 0.080 | 0.054 |
| 200 | 0.072 | 0.036 |
| 300 | 0.063 | 0.032 |
| 400 | 0.059 | 0.032 |
| 500 | 0.050 | 0.027 |
| 600 | 0.041 | 0.018 |
| 700 | 0.018 | 0.009 |
| 800 | 0.014 | 0.005 |

(Unit is kg·m²)

(Step 4) Checking the moment of inertia of the transported object

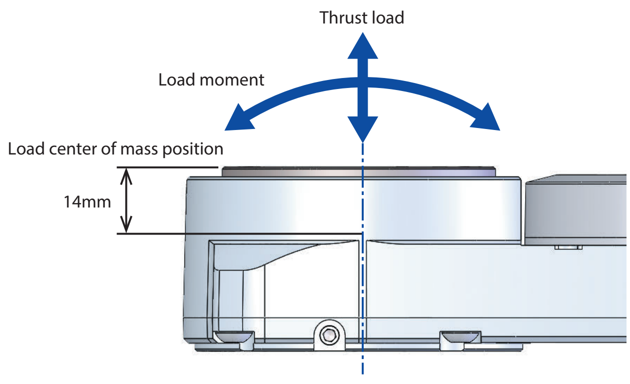
Using the "Formulae for calculating moment of inertia of typical shapes" on page 10, calculate the moment of inertia of the loaded object and make sure it does not exceed the corrected allowable moment of inertia obtained in step 3.

**Condition 2**

Check the load moment and thrust load

Make sure that the load moment and thrust load applied to the output shaft are within the allowable values.
If the allowable values are exceeded, this may lead to shortened product life or failure.

| Item | Description |
|---|---|
| Allowable dynamic thrust load | 600N |
| Allowable dynamic load moment | 30N·m |



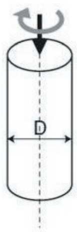
## ● Formulae for calculating moment of inertia of typical shapes

1. When the rotational axis passes through the center of the object

(1) Moment of inertia of cylinder 1

* The same formula can be applied irrespective of the height of the cylinder (also for circular plate)

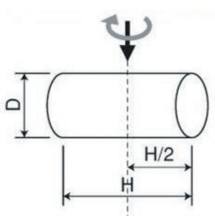
<Formula> $I = M \times (D \times 10^{-3})^2 / 8$ [kg·m²]




Moment of inertia of cylinder: I (kg·m²)
Cylinder mass: M (kg)
Cylinder diameter: D (mm)

(2) Moment of inertia of cylinder 2

<Formula> $I = M \times ((D \times 10^{-3})^2 / 4 + (H \times 10^{-3})^2 / 3) / 4$ [kg·m²]

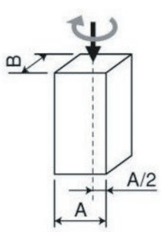



Moment of inertia of cylinder: I (kg·m2)
Cylinder mass: M (kg)
Cylinder diameter: D (mm)
Cylinder length: H (mm)

(3) Moment of inertia of prism 1

* The same formula can be applied irrespective of the height of the prism (also for rectangular plate)

<Formula> $I = M \times ((A \times 10^{-3})^2 + (B \times 10^{-3})^2) / 12$ [kg·m²]



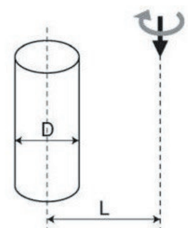

Moment of inertia of prism: I (kg·m2)
One side of prism: A (mm)
One side of prism: B (mm)
Prism mass: M (kg)

2. When the center of the object is offset from the rotational axis

(4) Moment of inertia of cylinder 3

* The same formula can be applied irrespective of the height of the cylinder (also for circular plate)

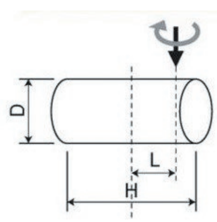
<Formula> $I = M \times (D \times 10^{-3})^2 / 8 + M \times (L \times 10^{-3})^2$ [kg·m²]




Moment of inertia of cylinder: I (kg·m²)
Cylinder mass: M (kg)
Cylinder diameter: D (mm)
Distance from rotational axis to center: L (mm)

(5) Moment of inertia of cylinder 4

<Formula> $I = M \times ((D \times 10^{-3})^2 / 4 + (H \times 10^{-3})^2 / 3) / 4 + M \times (L \times 10^{-3})^2$ [kg·m²]

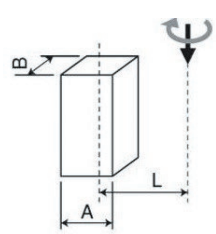



Moment of inertia of cylinder: I (kg·m²)
Cylinder mass: M (kg)
Cylinder diameter: D (mm)
Cylinder length: H (mm)
Distance from rotational axis to center: L (mm)

(6) Moment of inertia of prism 2

* The same formula can be applied irrespective of the height of the prism (also for rectangular plate)

<Formula> $I = M \times ((A \times 10^{-3})^2 + (B \times 10^{-3})^2) / 12 + M \times (L \times 10^{-3})^2$ [kg·m²]




Moment of inertia of prism: I (kg·m²)
Prism mass: M (kg)
One side of prism: A (mm)
One side of prism: B (mm)
Distance from rotational axis to center: L (mm)

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