2-axis rotary joint unit

**Wrist Unit** is now available

1. IAI's unique design makes the unit light and compact.
   - **Compact S type**
     - Unit weight: 1.6 kg
     - Maximum Payload: 1.0 kg
   - **Medium M type**
     - Unit weight: 2.8 kg
     - Maximum Payload: 2.0 kg

2. Ideal for cost reduction of equipment. Low cost compared to 6-axis articulated robots.
   - Diagonal approaches and tip swiveling, possible until now only with vertical articulated robots, can now be performed with the minimum required axis configuration.
   - Ideal for cost reduction of equipment.

[Configuration example]

(1) Wrist Unit: WU-S
(2) Table Type: RCP6-TA6C Stroke: 320 mm
(3) Slider Type: RCP6-SA7R Stroke: 300 mm
(4) Controller: MSEL
Flexible combinations

The combination pattern, number of axes and stroke can be freely selected according to the application.

Combination with a cartesian RoboCylinder makes it capable of avoiding obstacles and working in tight spaces.

3 Interpolation function with orthogonal axes is possible

When connecting Wrist Unit and 2-axis combination (*)

(*) Mounted pulse motor actuators

Wrist Unit (for 2 axes) Single Axis/Cartesian RoboCylinder (up to 2 axes)
### Application Examples

#### Bottle labeling equipment
This device affixes labels to bottles. Adjusts the angle to the labeling surface on the B-axis and rotates the label on the T-axis to change the orientation.

#### Automotive connector inspection equipment
This device inspects the external view of connectors for automobiles, using a camera. The Wrist Unit rotates the connector for inspection from various angles.

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**Controller connection example**

“Wrist Unit + RoboCylinder 2-axis combination” can be controlled with a single MSEL controller. Please refer to P. 17 for more information.
## WU Series List

<table>
<thead>
<tr>
<th>Model</th>
<th>Compact type</th>
<th>Medium type</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-5</td>
<td></td>
<td>WU-M</td>
</tr>
</tbody>
</table>

### External view

<table>
<thead>
<tr>
<th>Axis combination</th>
<th>B-axis (wrist swing)</th>
<th>F-axis (wrist rotation)</th>
<th>B-axis (wrist swing)</th>
<th>F-axis (wrist rotation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation range</td>
<td>±100 deg.</td>
<td>±360 deg.</td>
<td>±105 deg.</td>
<td>±360 deg.</td>
</tr>
<tr>
<td>Max. torque *1</td>
<td>0.65N·m</td>
<td>0.65N·m</td>
<td>1.65N·m</td>
<td>1.65N·m</td>
</tr>
<tr>
<td>Max. allowable moment of inertia *2</td>
<td>0.0085kgm²</td>
<td>0.0075kgm²</td>
<td>0.015kgm²</td>
<td>0.0165kgm²</td>
</tr>
<tr>
<td>Max. load weight</td>
<td>1kg</td>
<td>2kg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Model Specification Items

#### WA

- **Type**: Compact type
- **Encoder Type**: Battery-less Absolute
- **Applicable Controllers**: None, 1m, 3m, 5m
- **Cable Length**
- **Options**: Specified length, Robot cable

#### PM1

- **Cable Length**
- **Options**: Specified length, Robot cable

#### WU

- **Series**: WU
- **Type**
- **Encoder Type**
- **Applicable Controllers**: None, 1m, 3m, 5m
- **Cable Length**
- **Options**: Specified length, Robot cable

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*1 Indicates the maximum torque at low speed. The output torque varies with the speed.  
*2 Indicates the maximum moment of inertia in rotation. Value when the acceleration is 0.3 G.  
*3 Maximum speed with no load.  
*4 When the rotational axes of the B-axis and T-axis are horizontal with respect to the floor surface or when the center of gravity of the transported object is offset from the rotational axis, the unit will be subject to load torque due to the weight of the object. The allowable moment of inertia decreases when load torque is present. Please refer to “Model Selection Process (P.7 on)” for more information.
### Options

#### Wiring collar

When using electric grippers or similar wiring is made easy by using the wiring collar. Use the wiring collar as the base to which the wiring bracket (to be prepared by the customer) is to be attached. Please refer to the dimensions on the product pages. (WU-S: P.14, WU-M: P.16)

![Diagram of wiring collar](image)

#### Cable exit direction

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 / A2 / A3</td>
<td>Specify when changing the actuator cable exit direction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exit to right side</th>
<th>Exit to bottom</th>
<th>Exit to left side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option specified: A1</td>
<td>Option specified: A2</td>
<td>Option specified: A3</td>
</tr>
</tbody>
</table>

#### Actuator cable length 1.5 m

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC1.5</td>
<td>This option extends the length of the actuator cable exiting the actuator body to 1.5 m. (Standard length is 0.2 m) When this option is selected, the maximum cable length between the actuator and controller will be 18 m (X18, R18).</td>
</tr>
</tbody>
</table>

#### Air fitting

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC</td>
<td>This option allows attachment of an air fitting (ø6) for connecting pneumatic devices such as vacuum pads to the side of the main body. It is mounted on the same side as the actuator cable outlet. Please refer to the dimensions on the product pages. (WU-S: P.14, WU-M: P.16)</td>
</tr>
</tbody>
</table>

#### Wiring collar

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCS</td>
<td>When using electric grippers or similar wiring is made easy by using the wiring collar. Use the wiring collar as the base to which the wiring bracket (to be prepared by the customer) is to be attached. Please refer to the dimensions on the product pages. (WU-S: P.14, WU-M: P.16)</td>
</tr>
</tbody>
</table>

#### Cable (air fitting) in opposite position

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVR</td>
<td>This option allows the actuator cable outlet, air fitting, and wiring collar (optional) to be mounted on the other side (opposite position). Please refer to the dimensions on the product pages. (WU-S: P.14, WU-M: P.16)</td>
</tr>
</tbody>
</table>

---

5 Options
**Reference Data**

## Mounting Method

### Body mounting method

The body mounting surface should be a machined surface or a plane with similar accuracy.

The actuator has screw holes and positioning holes for body mounting on the top (mounting surface A) and side (mounting surface B).

For details on positions and dimensions, refer to the product pages.

1. **When using mounting surface A**
   - (Thread depth WU-S: M4 through (screw depth: 6) / WU-M: M5 through (screw depth: 10)

2. **When using mounting surface B**
   - (Thread depth WU-S: M4 depth 8 / WU-M: M5 depth 10)

### Tool mounting method

The unit has screw holes for bracket mounting to the body tip (mechanical interface), screw holes for air piping mounting, and positioning holes. Refer to the dimensions (WU-S: P.14, WU-M: P.16) for details regarding the position and dimensions.

Do not apply excessive force to the output shaft when tightening bolts or air piping threads. The mechanical interface has holes for a hook wrench. Use these to fix the output shaft in the rotating direction.

1. **When using bracket mounting screws**
   - (Thread depth WU-S: M4 depth 6 / WU-M: M4 through (screw depth: 6)

2. **When using air piping mounting screws**
   - Seal the threaded part of the air piping with sealing tape, etc.
   - (Thread depth WU-S: M6 through (screw depth: 4.5) / WU-M: M6 through (screw depth: 4.5)

### Body installation orientation

All 6 orientations below are possible.

1. Mechanical interface look down
2. Mechanical interface look up
3. Actuator cable bottom
4. Actuator cable top
5. Mounting surface B top
6. Mounting surface B bottom

* Seal the threaded part of the pneumatic devices such as vacuum pads (to be prepared by the customer)
Reference Data

Model Selection Process

Follow steps 1 through 4. For a selection example, refer to the following pages.

**Step 1**

Check the weight of the transported object

![Weight of transported object ≤ Maximum payload]

**Step 2**

Check the moment of inertia

The allowable moment of inertia of the Wrist Unit decreases to the extent that load torque is applied to the B- and T-axes. First, calculate the load torque and obtain the corrected allowable moment of inertia.

If “Yes”

- Moment of inertia applied to B- and T-axes

- Corrected allowable moment of inertia for compact and medium types

* It varies with the speed and acceleration/deceleration.

If “None”

- Moment of inertia applied to B- and T-axes

- Allowable moment of inertia for compact and medium types

* It varies with the speed and acceleration/deceleration.

“Formulae for calculating moment of inertia of typical shapes” are on page 12.

**Step 3**

Check the allowable dynamic thrust load

Make sure that the thrust load (load perpendicular to the mounting surface) does not exceed the allowable dynamic thrust load.

Dynamic thrust load: $F \leq$ Allowable dynamic thrust load

**Step 4**

Check the allowable dynamic load moment

Make sure that the load moment does not exceed the allowable dynamic moment.

Dynamic load moment: $M \leq$ Allowable dynamic load moment
Reference Data

Model Selection Example: Automotive Connector Inspection Equipment

The model selection example given is based on the application example "Automotive connector inspection equipment" (P. 3).

[Overview]
This device inspects the external view of connectors for automobiles, using a camera. The Wrist Unit rotates the connector for inspection from various angles.

### Step 1
Check the weight of the transported object

\[ \text{Weight of transported object} = \text{weight of tool} + \text{weight of workpiece} \]

<table>
<thead>
<tr>
<th></th>
<th>Maximum load weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-S: Compact type</td>
<td>1 kg</td>
</tr>
<tr>
<td>WU-M: Medium type</td>
<td>2 kg</td>
</tr>
</tbody>
</table>

- **Transported object**
  - **Piping/vacuum pad**: 0.02 kg
  - **Connector**: 0.013 kg

\[ \text{Transported object} = 0.02 \text{kg} + 0.013 \text{kg} = 0.033 \text{kg} \]

Both WU-S (compact) and WU-M (medium) can be used.

### Step 2
Check the moment of inertia

Check the presence of load torque on the B- and T-axes

- **If “Yes”**
  - 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 allowable value.
- **If “None”**
  - Calculate the moment of inertia and confirm that it is less than the allowable moment of inertia.

<table>
<thead>
<tr>
<th>Conditions in which load torque is applied</th>
<th>Presence of load torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation orientation</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>Gravity</td>
<td>Yes Yes None Yes Yes</td>
</tr>
<tr>
<td>B-axis</td>
<td>Yes Yes None</td>
</tr>
<tr>
<td>T-axis</td>
<td>None Yes None</td>
</tr>
</tbody>
</table>

As the current example of the "automotive connector inspection equipment" corresponds to these, the B-axis and T-axis are calculated and confirmed as described below.

1. **[B-axis] Load torque “Yes”**
2. **[T-axis] Load torque “None”**
1. Check B-axis

(1) Calculating load torque \( T_l \)

\[
T_l = T_{lT} + T_{lW} = m_T g (r_0 + r_{CT}) \times 10^{-3} + m_W g (r_0 + r_{CW}) \times 10^{-3}
\]

\[
= 0.02 \times 9.8 \times (39 + 25) \times 10^{-3} + 0.013 \times 9.8 \times (39 + 60) \times 10^{-3}
\]

\[
= 0.025 \text{ [Nm]} \quad \text{Calculation result}
\]

(2) Calculating the allowable moment of inertia correction factor \( C_j \)

\[
C_j = \frac{T_{max} - T_l}{T_{max}}
\]

[Operating conditions of the Wrist Unit]

B-axis rotation Speed: 600 [deg/s]
Acceleration: 0.3 [G]

First, calculate with the value for the compact type (S)

\[
C_j = 0.58 - 0.025 \quad \frac{0.58}{0.58}
\]

\[
= 0.96 \quad \text{Calculation result}
\]

(3) Calculating the corrected allowable moment of inertia \( J_{tl} \)

\[
J_{tl} = J_{max} C_j \quad \text{[kgm}^2]\n\]

\[
J_{max}: \text{Allowable moment of inertia (right table) [kgm}^2]
C_j: \text{Allowable moment of inertia correction factor calculation result (2)}
J_{tl} = 0.008 \times 0.96
\]

\[
= 0.0077 \quad \text{Calculation result}
\]
(4) Checking the moment of inertia of the transported object

Using the Formulae for calculating moment of inertia of typical shapes (P.12), calculate the moment of inertia of the tool and workpiece to be used and make sure they do not exceed the corrected allowable moment of inertia (4) ≤ (3) obtained in (3).

(1) Moment of inertia of piping/vacuum pad: $J_{BT}$

$$L=r+e=0.064m$$

Calculation when simplified to cylinder

$$m_{c} \left( \frac{D^{2}}{4} + \frac{H^{2}}{3} \right) + m_{c}(r_{e} + r_{C})^{2}$$

$$= 0.02 \times \left( \frac{0.01^{2}}{4} + \frac{0.05^{2}}{3} \right) + 0.02 \times (0.039 + 0.025)^{2}$$

$$= 8.62 \times 10^{-3}$$

P.12 formula 2.(5) used

P: Cylinder weight 0.02 [kg]
D: Cylinder diameter 0.01 [m]
H: Cylinder length 0.05 [m]

(2) Moment of inertia of connector: $J_{BW}$

Calculation when simplified to cuboid

$$m_{w} \left( \frac{A^{2} + C^{2}}{12} \right) + m_{w}(r_{e} + r_{C})^{2}$$

$$= 0.013 \times \left( \frac{0.03^{2} + 0.02^{2}}{12} \right) + 0.13 \times (0.039 + 0.06)^{2}$$

$$= 1.28 \times 10^{-4}$$

P.12 formula 2.(6) used

mW: Cuboid weight 0.013 [kg]
A: One side of cuboid 0.03 [m]
C: One side of cuboid 0.02 [m]

From the results of (1) and (2)

$$\text{Moment of inertia of transported object around B-axis} = J_{BT} + J_{BW}$$

$$= 8.62 \times 10^{-3} + 1.28 \times 10^{-4}$$

$$= 2.1 \times 10^{-4}$$

Usable, as it is less than the corrective allowable moment of inertia obtained in (3)

2. Checking T-axis

If load torque is not applied, using the Formulae for calculating moment of inertia of typical shapes (P.12), calculate the moment of inertia of the tool and workpiece to be used and make sure they do not exceed the corrected allowable moment of inertia.

(1) Moment of inertia of piping/vacuum pad: $J_{TT}$

$$J_{TT} = \frac{m_{c} \times D^{2}}{8}$$

$$= \frac{0.02 \times 0.01^{2}}{8}$$

$$= 2.50 \times 10^{-7}$$

P.12 formula 1.(1) used

m: Cylinder weight 0.02 [kg]
D: Cylinder diameter 0.01 [m]
From the results of (1) and (2)\

Moment of inertia of transported object around T-axis\

\[ J_{T} = J_{TW} = \frac{m_{W}(A^2 + B^2)}{12} = \frac{0.013(0.03^2 + 0.05^2)}{12} = 3.68 \times 10^{-6} [\text{kgm}^2] \]

From the allowable moment of inertia (table below), we see that WU-S (compact) can be used.

### Operating conditions of the Wrist Unit

<table>
<thead>
<tr>
<th>T-axis rotation</th>
<th>Speed</th>
<th>B-axis</th>
<th>Acceleration/deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>deg/s</td>
<td>0.3G</td>
<td>0.7G</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0.0065</td>
<td>0.0075</td>
</tr>
<tr>
<td>150</td>
<td>0.0065</td>
<td>0.0065</td>
<td>0.0075</td>
</tr>
<tr>
<td>300</td>
<td>0.0065</td>
<td>0.005</td>
<td>0.0065</td>
</tr>
<tr>
<td>450</td>
<td>0.0065</td>
<td>0.005</td>
<td>0.0065</td>
</tr>
<tr>
<td>600</td>
<td>0.0065</td>
<td>0.005</td>
<td>0.0065</td>
</tr>
<tr>
<td>750</td>
<td>0.005</td>
<td>0.0065</td>
<td>0.0025</td>
</tr>
<tr>
<td>900</td>
<td>0.0065</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td>0.0065</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>0.0065</td>
<td>0.0025</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WU-M: Medium type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>450</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>750</td>
</tr>
<tr>
<td>900</td>
</tr>
<tr>
<td>1050</td>
</tr>
<tr>
<td>1200</td>
</tr>
</tbody>
</table>

### Step 3: Check the allowable dynamic thrust load

\[
F = (m_T + m_W) \cdot (a + g) \cdot 9.8[N]
\]

\[
F = (0.02 + 0.013) \cdot (0.3 + 1.0) \cdot 9.8 = 0.033 \times 1.3 \times 9.8 = 0.42[N]
\]

From the allowable dynamic thrust load (table below), we see that WU-S (compact) can be used.

<table>
<thead>
<tr>
<th>Allowable thrust load</th>
<th>WU-S: Compact type</th>
<th>WU-M: Medium type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>330N</td>
<td>450N</td>
</tr>
</tbody>
</table>
Step 4  
Check the allowable dynamic load moment

\[ M = m T \cdot a \cdot 9.8 \left( L_0 + r_{CT} \right) \times 10^{-3} + m W \cdot a \cdot 9.8 \left( L_0 + r_{CW} \right) \times 10^{-3} \]  
\[ \text{[Nm]} \]

- **mT**: Tool weight 0.02 [kg]
- **mW**: Workpiece weight 0.013 [kg]
- **a**: Travel acceleration of X-axis 0.3 [G]
- **L0**: Load center of mass position
  - WU-S (Compact) 17.5 [mm]
  - WU-M (Medium) 21.5 [mm]
- **rCT**: Tool center mass location 25 [mm]
- **rCW**: Workpiece center mass location 60 [mm]

**Formula**

\[ I = M \times D^2 / 8 \]

Moment of inertia of cylinder:

\[ I = M \times (D^2 / 4 + H^2 / 3) / 4 \]

Moment of inertia of cuboid:

\[ I = M \times (A^2 + B^2) / 12 \]

**WU-S (compact)** can be used, as seen from the results of steps 1 to 4

<table>
<thead>
<tr>
<th>Allowable dynamic load moment</th>
<th>WU-S: Compact type</th>
<th>1.40 Nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-M: Medium type</td>
<td>4.20 Nm</td>
<td></td>
</tr>
</tbody>
</table>

From the allowable dynamic moment (table below), we see that WU-S (compact) can be used.

- **Formulae for calculating moment of inertia of typical geometrical 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)
      \[ I = M \times D^2 / 8 \]
      Moment of inertia of cylinder: \( I \) (kg·m²)
      Cylinder weight: \( M \) (unit: kg)
      Cylinder diameter: \( D \) (m)

2. **Moment of inertia of cylinder 2**
   \[ I = M \times (D^2 / 4 + H^2 / 3) / 4 \]
   Moment of inertia of cylinder: \( I \) (kg·m²)
   Cylinder weight: \( M \) (kg)
   Cylinder diameter: \( D \) (m)
   Cylinder length: \( H \) (m)

3. **Moment of inertia of cuboid 1**
   * The same formula can be applied irrespective of the height of the cuboid (also for rectangular plate)
   \[ I = M \times (A^2 + B^2) / 12 \]
   Moment of inertia of cuboid: \( I \) (kg·m²)
   First side of cuboid: \( A \) (m)
   Second side of cuboid: \( B \) (m)

4. **Moment of inertia of cylinder 3**
   * The same formula can be applied irrespective of the height of the cylinder (also for circular plate)
   \[ I = M \times D^2 / 8 + M \times L^2 \]
   Moment of inertia of cylinder: \( I \) (kg·m²)
   Cylinder weight: \( M \) (kg)
   Cylinder diameter: \( D \) (m)
   Distance from rotational axis to center: \( L \) (m)

5. **Moment of inertia of cylinder 4**
   \[ I = M \times (D^2 / 4 + H^2 / 3) / 4 + M \times L^2 \]
   Moment of inertia of cylinder: \( I \) (kg·m²)
   Cylinder weight: \( M \) (kg)
   Cylinder diameter: \( D \) (m)
   Cylinder length: \( H \) (m)
   Distance from rotational axis to center: \( L \) (m)

6. **Moment of inertia of cuboid 2**
   * The same formula can be applied irrespective of the height of the cuboid (also for rectangular plate)
   \[ I = M \times (A^2 + B^2) / 12 + M \times L^2 \]
   Moment of inertia of cuboid: \( I \) (kg·m²)
   Cuboid weight: \( M \) (kg)
   First side of cuboid: \( A \) (m)
   Second side of cuboid: \( B \) (m)
   Distance from rotational axis to center: \( L \) (m)
WU-S Wrist Unit

**Model Specifications**

<table>
<thead>
<tr>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-axis (wrist swing) T-axis (wrist rotation)</td>
</tr>
<tr>
<td>Drive system</td>
</tr>
<tr>
<td>Positioning repeatability</td>
</tr>
<tr>
<td>Lost motion</td>
</tr>
<tr>
<td>Allowable dynamic load moment</td>
</tr>
<tr>
<td>Allowable dynamic load moment with load torque</td>
</tr>
<tr>
<td>Unit weight</td>
</tr>
<tr>
<td>Brake retaining torque</td>
</tr>
<tr>
<td>Ambient operating temperature, humidity</td>
</tr>
</tbody>
</table>

**Actuator Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Axis configuration</th>
<th>Operation range (deg.)</th>
<th>Max. speed (deg/s)</th>
<th>Max. payload (kg)</th>
<th>Max. acceleration/deceleration (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-S-WA-PM1</td>
<td>B-axis (wrist swing)</td>
<td>±100</td>
<td>750</td>
<td>600</td>
<td>0.7 G (6865 deg/s²)</td>
</tr>
<tr>
<td></td>
<td>T-axis (wrist rotation)</td>
<td>±360</td>
<td>1200</td>
<td>600</td>
<td>0.7 G (6865 deg/s²)</td>
</tr>
</tbody>
</table>

**Cable Length <per axis>”1>**

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard type</td>
<td>P (1m)</td>
</tr>
<tr>
<td></td>
<td>S (3m)</td>
</tr>
<tr>
<td></td>
<td>M (5m)</td>
</tr>
<tr>
<td>Specified length</td>
<td>X(0-14)m to X(10)m</td>
</tr>
<tr>
<td></td>
<td>X(11-15)m to X(15)m</td>
</tr>
<tr>
<td></td>
<td>X(16-20)m to X(20)m</td>
</tr>
<tr>
<td>Robot cable</td>
<td>R0(1-4)m to R0(5)m</td>
</tr>
<tr>
<td></td>
<td>R0(6-9)m to R0(10)m</td>
</tr>
<tr>
<td></td>
<td>R0(11-15)m to R0(15)m</td>
</tr>
<tr>
<td></td>
<td>R0(16-20)m to R0(20)m</td>
</tr>
</tbody>
</table>

**Name and Coordinates of Each Axis**

<table>
<thead>
<tr>
<th>Name</th>
<th>Option code</th>
<th>Reference page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable exit direction (Right)</td>
<td>A1</td>
<td>See P.14</td>
</tr>
<tr>
<td>Cable exit direction (Bottom)</td>
<td>A2</td>
<td>See P.14</td>
</tr>
<tr>
<td>Cable exit direction (Left)</td>
<td>A2</td>
<td>See P.14</td>
</tr>
<tr>
<td>Actuator cable length 1.5 m</td>
<td>ACL5</td>
<td>See P.14</td>
</tr>
<tr>
<td>Cable (air fitting) in opposite position</td>
<td>VC</td>
<td>See P.14</td>
</tr>
<tr>
<td>Air fitting</td>
<td>VC</td>
<td>See P.14</td>
</tr>
<tr>
<td>Wiring collar</td>
<td>WCS</td>
<td>See P.14</td>
</tr>
</tbody>
</table>

*1 Using the unit with a load exceeding the values above leads to reduced service life and/or damage.
*2 Equipped with brake as standard.
**Applicable Controllers**

<table>
<thead>
<tr>
<th>Name</th>
<th>External view</th>
<th>Max. number of connectable axes</th>
<th>Power supply voltage</th>
<th>Control method</th>
<th>Maximum number of positioning points</th>
<th>Reference page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSEL-PC/PG</td>
<td><img src="image" alt="icon" /></td>
<td>4</td>
<td>Single phase 100 to 230 V AC</td>
<td>–</td>
<td>–</td>
<td>30000</td>
</tr>
</tbody>
</table>

### Options

- **Cable exit direction**
  - Left side (model: A3)
  - Right side (model: A1)
  - Bottom (model: A2)
- **Air fitting (model: VC)**
- **Wiring collar (model: WCS)**
- **Cable (air fitting) opposite position (model: CVR)**

### Dimensions

- **B-axis operation range**: ±180°
- **T-axis operation range**: +180° to -180°
- **B-axis home position**: ±0°
- **T-axis home position**: ±0°

### Note

CAD drawings can be downloaded from our website:

[www.robocylinder.de](http://www.robocylinder.de)
WU-M

Model Specification Items

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Encoder Type</th>
<th>Applicable Controllers</th>
<th>Cable Length</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-M-WA-PM1</td>
<td>M: Medium Type</td>
<td>WA: Battery-less Absolute</td>
<td>PM-1: MSEL</td>
<td>N: None</td>
<td>Refer to Options table below:</td>
</tr>
</tbody>
</table>

* Does not include a controller

*1 Using the unit with a load exceeding the values above leads to reduced service life and/or damage.

When making a selection, it is necessary to calculate the moment of inertia of the operating conditions and to use a model that allows that moment of inertia. Calculate the moment of inertia of the transported object for the B- and T-axes respectively. Please refer to "Model Selection Process (P.7 on)" for more information.

(Note 1) Shows maximum set speed with no load.

(Note 2) When the rotational axes of the B-axis and T-axis are horizontal with respect to the floor surface or when the center of gravity of the transported object is offset from the rotational axis, the unit will be subject to load torque due to the weight of the object. The allowable moment of inertia decreases when load torque is present. Please refer to "Model Selection Process (P.7 on)" for more information.

Actuator Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Axis configuration</th>
<th>Operation range (deg.)</th>
<th>Max. speed (deg/s)</th>
<th>Max. payload (kg)</th>
<th>Max. acceleration/deceleration (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WU-M-WA-PM1</td>
<td>B-axis (wrist swing)</td>
<td>±105</td>
<td>900</td>
<td>600</td>
<td>0.7 G (6865 deg/s²)</td>
</tr>
<tr>
<td></td>
<td>T-axis (wrist rotation)</td>
<td>±360</td>
<td>1200</td>
<td>600</td>
<td>0.7 G (6865 deg/s²)</td>
</tr>
</tbody>
</table>

Cable Length <per axis *1>

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard type</td>
<td>P (1m)</td>
</tr>
<tr>
<td>Specified length</td>
<td>X06 (6m) to X10 (10m)</td>
</tr>
<tr>
<td>Robot cable</td>
<td>R01 (1m) to R03 (3m)</td>
</tr>
</tbody>
</table>

Cable between actuator and controller.

*1 Required for both B- and T-axes. Select the cable length in the model name to have 2 cables attached.

*2 When actuator cable length change "AC1.5" is selected as an option, 18 m (X18, R18) will be the maximum length.

Options

<table>
<thead>
<tr>
<th>Name</th>
<th>Option Code</th>
<th>Reference page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable exit direction (Right)</td>
<td>A1</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Cable exit direction (Bottom)</td>
<td>A2</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Cable exit direction (Left)</td>
<td>A3</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Actuator cable length 1.5 m</td>
<td>AC1.5</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Cable (air fitting) in opposite position</td>
<td>CVR</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Air fitting</td>
<td>VC</td>
<td>See P.5, P.16</td>
</tr>
<tr>
<td>Wiring collar</td>
<td>WCS</td>
<td>See P.5, P.16</td>
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</tbody>
</table>

Name and Coordinates of Each Axis

WU-M
## Applicable Controllers

<table>
<thead>
<tr>
<th>Name</th>
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<th>Max. number of connectable axes</th>
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<td>30000</td>
<td>See P.17</td>
</tr>
</tbody>
</table>
# MSEL Controller

## RCP6/RCP5/RCP4/RCP3/RCP2 Program Controller for Wrist Unit WU

### List of Models

Program controller available for operation of RCP6/RCP5/RCP4/RCP3/RCP2 series actuators. A single unit can handle various forms of control with up to 4 axes.

<table>
<thead>
<tr>
<th>Model Specification Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type name</strong></td>
</tr>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Max. number of controlled axes</td>
</tr>
<tr>
<td>No. of positions</td>
</tr>
<tr>
<td>Power supply</td>
</tr>
<tr>
<td>Safety category</td>
</tr>
</tbody>
</table>

*1: To comply with the safety category, the customer will need to install a safety circuit externally to the controller.

### Model Specification Items

| MSEL Series Type | Number of Connectable Axes | Motor Type | Encoder Type | Options | Motor Type | Encoder Type | Options | Standard I/O Type | Expansion I/O Type | I/O Cable Length | Power Supply Voltage | Simple Absolute Unit | Controller Mounting Specification |
|------------------|----------------------------|------------|--------------|---------|------------|--------------|---------|-------------------|--------------------|-------------------|----------------------|---------------------|-------------------|---------------------|
| **PC** 1-axis specification | (Axis 1) | B | Brake |
| **PG** 2-axis specification | (Axis 2 to Axis 4) | B | Brake |
| **WAI** Battery-less absolute specification | | | |
| **SA** Incremental specification | | | |
| **NP** Simple absolute specification | | | |
| **PN** Simple absolute specification | | | |

* When selecting the simple absolute specification "SA", be sure to select ABB/ABBN.

**Notes:**

- The motor type symbol is normally the same as that of the actuator to be connected, but there are some models for which motor types of the controller and actuator do not match. Be sure to check the corresponding models listed below during selection.
- *20P: Supports 20SP pulse motor *35P: Supports 35SP pulse motor *42P: Supports 42SP pulse motor *56P: Supports 56SP pulse motor

### List of Models

Program controller available for operation of RCP6/RCP5/RCP4/RCP3/RCP2 series actuators. A single unit can handle various forms of control with up to 4 axes.

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### Model Specification Items

<table>
<thead>
<tr>
<th>MSEL Series Type</th>
<th>Number of Connectable Axes</th>
<th>Motor Type</th>
<th>Encoder Type</th>
<th>Options</th>
<th>Motor Type</th>
<th>Encoder Type</th>
<th>Options</th>
<th>Standard I/O Type</th>
<th>Expansion I/O Type</th>
<th>I/O Cable Length</th>
<th>Power Supply Voltage</th>
<th>Simple Absolute Unit</th>
<th>Controller Mounting Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PC</strong> 1-axis specification</td>
<td>(Axis 1)</td>
<td>B</td>
<td>Brake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PG</strong> 2-axis specification</td>
<td>(Axis 2 to Axis 4)</td>
<td>B</td>
<td>Brake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WAI</strong> Battery-less absolute specification</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>SA</strong> Incremental specification</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td><strong>NP</strong> Simple absolute specification</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PN</strong> Simple absolute specification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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* When selecting the simple absolute specification "SA", be sure to select ABB/ABBN.

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### List of Models

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</tr>
<tr>
<td>Safety category</td>
</tr>
</tbody>
</table>

*1: To comply with the safety category, the customer will need to install a safety circuit externally to the controller.
**System Configuration**

- **Actuator RCP2 Series**
  - Integrated Motor-encoder Cable: Model CB-SEP-MPA
    - Standard: 1 m/3 m/5 m
  - Supplied with the actuator

- **Actuator RCP2 compact rotary**
  - Integrated Motor-encoder Cable: Model CB-SEP-MPA
    - Standard: 1 m/3 m/5 m
  - Supplied with the actuator

- **Actuator RCP3 Series**
  - Integrated Motor-encoder Cable: Model CB-APSEP-MPA
    - Standard: 1 m/3 m/5 m
  - Supplied with the actuator

**Options**

- **Teaching Pendant**
  - Model: TB-02-CC
    - *Supported versions: PC/PG Ver.1.10 or later

- **Emergency stop switch**

- **Enable switch**

- **PLC**

- **PIO flat cable**
  - Model: CB-PAC-PID020
    - Standard: 2m

- **Connector conversion cable**
  - Model: CB-SEL-MPS022
    - Standard: 2m

- **Dummy plug**
  - Model: DP-4S
    - Included with MSEL-PG / IA-101-X-USBS

- **Absolute data backup battery box**
  - Model: AB-7

- **Teaching Pendant**
  - Model: TB-02-CC
    - *Supported versions: PC/PG Ver.1.10 or later

- **Connecting cable**
  - Model: CB-MSEL-AB005
    - Included with MSEL-ABB

- **Absolute data backup battery box**
  - Model: MSEL-ABB

- **Replacement battery**
  - Model: AB-7

- **PC compatible software**
  - Model: IA-101-X-MW-JS
    - *Supported versions: PC/PG Ver.1.10 or later

**Accessory Connections**

- **Wrist Unit**
  - Connectable actuators:
    - MPG1
    - MPG2
    - MPG3
    - MPG4

- **Actuator RCP2 compact rotary**
  - Integrated Motor-encoder Cable: Model CB-SEP-MPA
    - Standard: 1 m/3 m/5 m
  - Supplied with the actuator

- **Actuator RCP3 Series**
  - Integrated Motor-encoder Cable: Model CB-APSEP-MPA
    - Standard: 1 m/3 m/5 m
  - Supplied with the actuator

- **Actuator RCP6 Series**
  - WU Series

**Notes**

- When using the Wrist Unit, connect the combination of symbols in "Actuator cable", "Cable", and "Controller" to be matched.
- The figure above is an example when connecting the Wrist Unit to the second and third axes of the MSEL controller.

* *Emergency stop switch, enable switch, electromagnetic contactor, and other devices may be connected and wired as necessary. The factory setting (short-circuit bridge) with no external devices connected still operates properly.*