IAI

Quality and Innovation

Wrist Unit WU

www.intelligentactuator.com

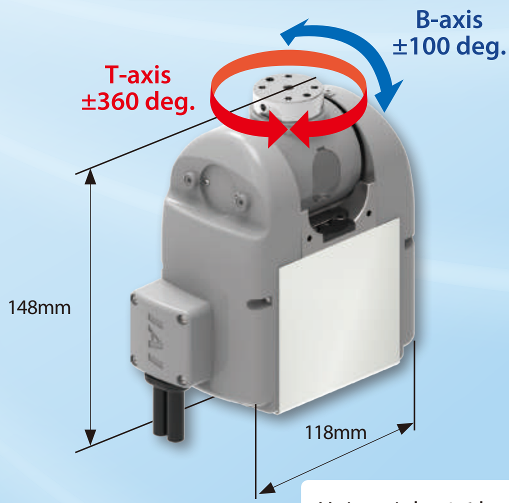
Rotating joint 2-axis unit

Wrist Unit is now available

1 IAI's Unique design makes the parts light and compact.

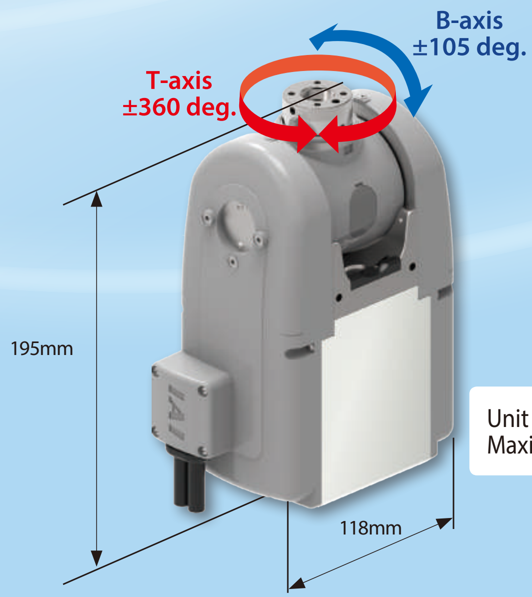
Equipped with a Battery-less Absolute Encoder as Standard

Small S type



Unit weight: 1.6 kg
Maximum Payload 1.0 kg

Medium M type



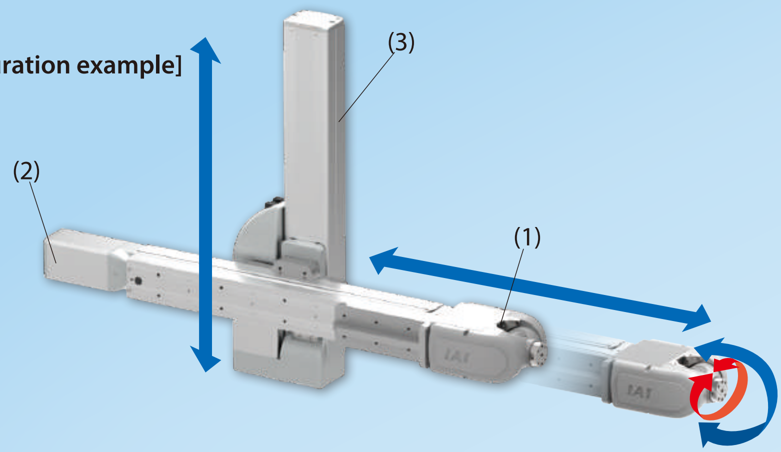
Unit weight: 2.8 kg
Maximum Payload 2.0 kg

2 Ideal for reducing the cost of equipment. Low cost compared to 6-axis articulated robots.

Diagonal approaches and tip swiveling, possible until now only with vertically articulated robots, can now be performed with the minimum required axis configuration.

Ideal for reducing the cost of equipment.

[Configuration example]



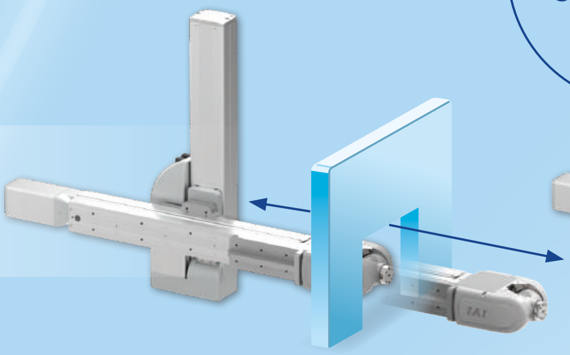
+

MSEL Controller

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

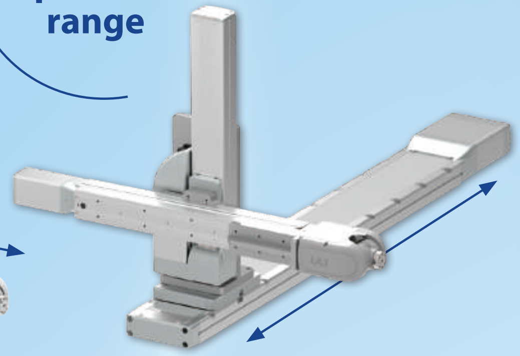
Work in tight spaces

Combination with a high-straightness cartesian robot makes it capable of avoiding obstacles and working in tight spaces.



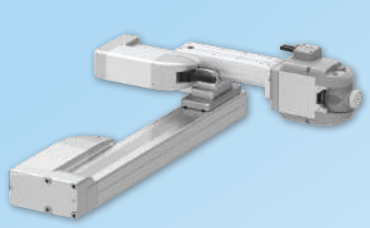
Work in a wide operation range

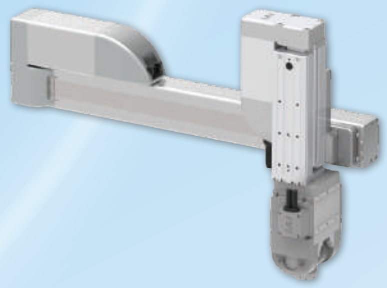
It is also ideal for work with a wide operation range.



Flexible combinations

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





3 Orthogonal axes and interpolation commands are possible

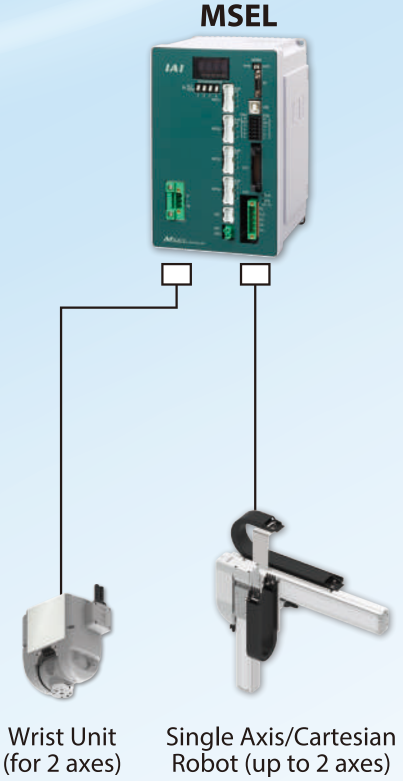
(1) When connecting Wrist Unit and 2-axis actuator (*1)

*1 Stepper motor mounted actuator

(2) When connecting Wrist Unit and 3-axis or more actuator (*2)

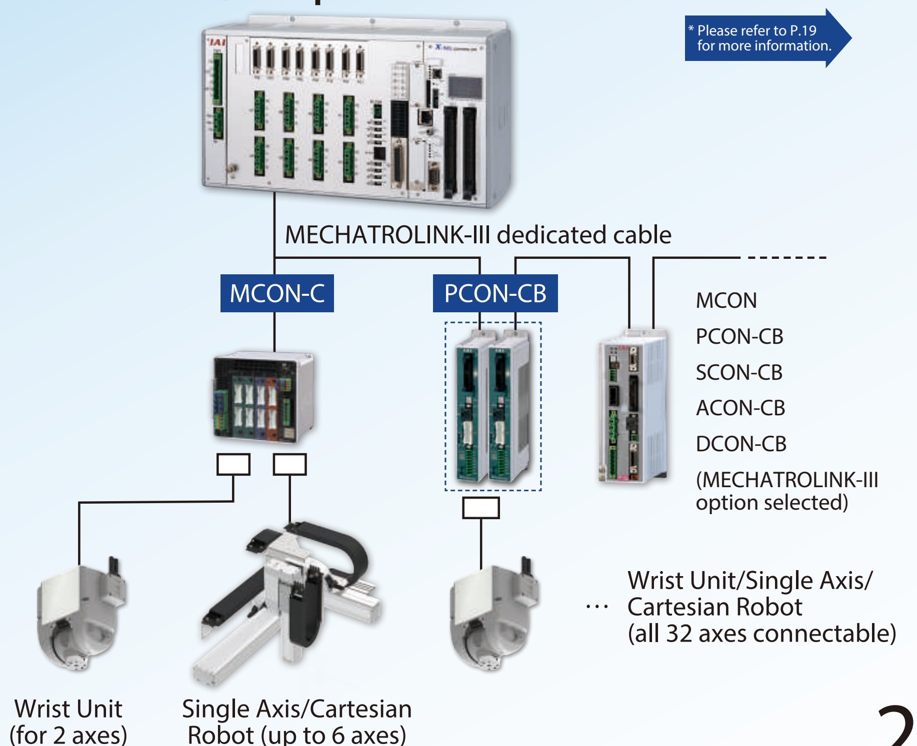
*2 Stepper/servo motor mounted actuator

MSEL



XSEL-RA/SA expanded motion control function (equipped as standard)

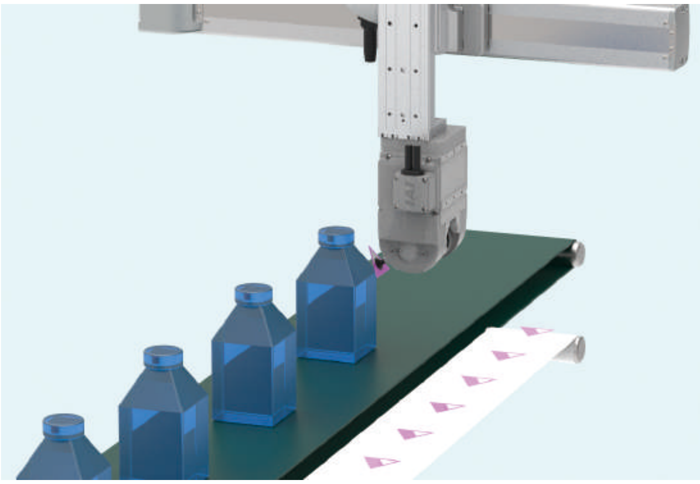
* Please refer to P.19 for more information.



Application Examples

Bottle labeling equipment

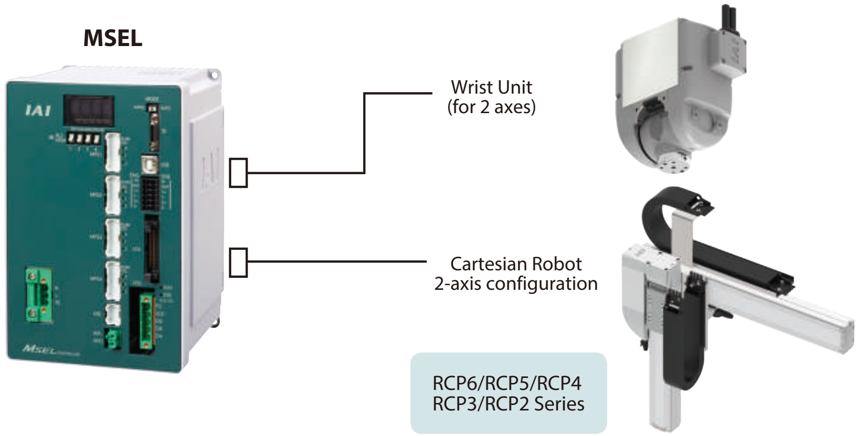
This device affixes labels to bottles. Adjusts the angle to the labeling surface on the B-axis and rotates the label on the T-axis to change the orientation.



Controller connection example

"Wrist Unit + ROBO Cylinder 2-axis configuration" can be controlled with a single MSEL controller.

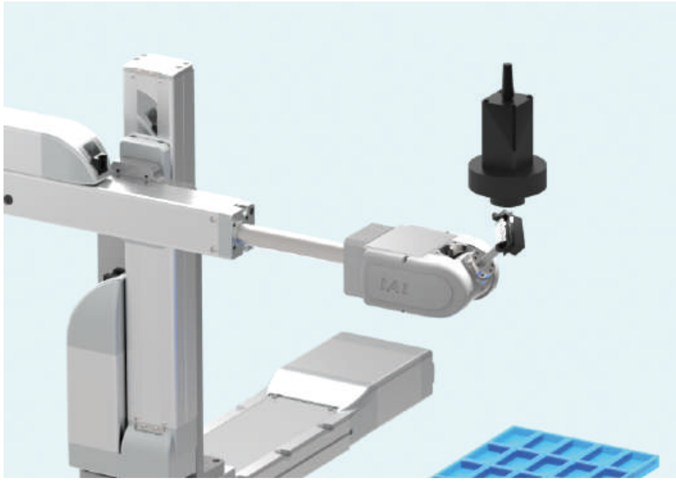
Please refer to P.17 for more information.



Automotive connector inspection equipment

This device inspects the external view of connectors for automobiles, using a camera.

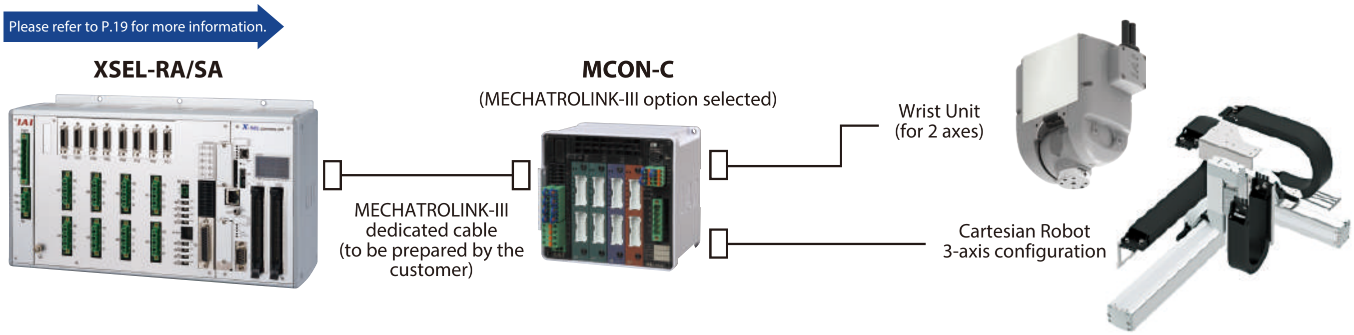
The Wrist Unit rotates the connector for inspection from various angles.



Controller connection example

"Wrist Unit + ROBO Cylinder 3-axis configuration" can be controlled with the MCON controller, using XSEL-RA/SA expanded motion control.

Please refer to P.19 for more information.



WU Series List

Type		Compact type		Medium type	
Model		WU-S		WU-M	
External view					
Axis configuration		B-axis (wrist swing)	T-axis (wrist rotation)	B-axis (wrist swing)	T-axis (wrist rotation)
Operation range		±100 deg.	±360 deg.	±105 deg.	±360 deg.
Max. torque *1		0.65N·m	0.65N·m	1.65N·m	1.65N·m
Max. allowable moment of inertia *2		0.0085kgm^2	0.0075kgm^2	0.015kgm^2	0.0165kgm^2
Max. load weight		1kg		2kg	
Max. speed *3	Independent operation	750 deg/s	1200 deg/s	900 deg/s	1200 deg/s
	Simultaneous operation of the B- and T-axes	600 deg/s	600 deg/s	600 deg/s	600 deg/s
Max. acceleration/ deceleration	Without load torque *4	0.7 G (6865 deg/s^2)	0.7 G (6865 deg/s^2)	0.7 G (6865 deg/s^2)	0.7 G (6865 deg/s^2)
	With load torque *4	0.3 G (2942 deg/s^2)	0.3 G (2942 deg/s^2)	0.3 G (2942 deg/s^2)	0.3 G (2942 deg/s^2)
Motor type		28□ Stepper motor	28□ Stepper motor	35□ Stepper motor	35□ Stepper motor
Unit weight		1.6kg		2.8kg	
Reference page		P.13		P.15	

*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 set 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.

Model Specification Items

WU	—	□	—	WA	—	PM1	—	□	—	□
Series	—	Type	—	Encoder Type	—	Applicable Controllers	—	Cable Length	—	Options

Type

S	Compact type
M	Medium type

Encoder Type

WA	Battery-less Absolute

Applicable Controllers

PM1	MSEL

Cable Length

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

Options

A1	Cable exit direction (Right)
A2	Cable exit direction (Bottom)
A3	Cable exit direction (Left)
AC1.5	Actuator's pigtail cable length change
VC	With air fitting
CVR	Cable (air fitting) in opposite position
WCS	With wiring collar

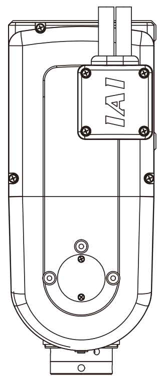
Options

Cable exit direction

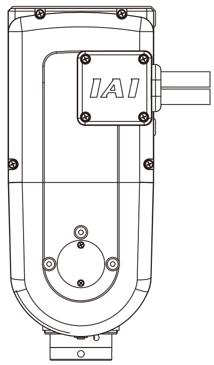
Model A1 / A2 / A3

Description Specify when changing the Actuator's pigtail cable exit direction.

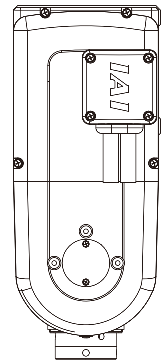
Top direction exit (standard)
■ No option specified (blank)



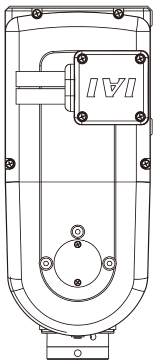
Exit to right side
■ Option specified: A1



Exit to bottom
■ Option specified: A2



Exit to left side
■ Option specified: A3



Actuator's pigtail cable length change

Model AC1.5

Description This option extends the length of the Actuator's pigtail 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).

With air fitting

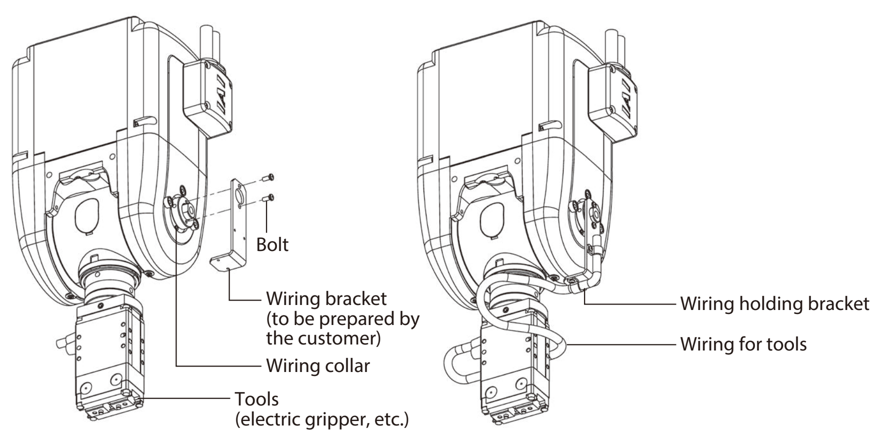
Model VC

Description This option allows attachment of an air fitting (ϕ6) 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's pigtail cable outlet. Please refer to the dimensions on the product pages. (WU-S: P.14, WU-M: P.16)

With wiring collar

Model WCS

Description 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)



Cable (air fitting) in opposite position

Model CVR

Description This option allows the Actuator's pigtail 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)

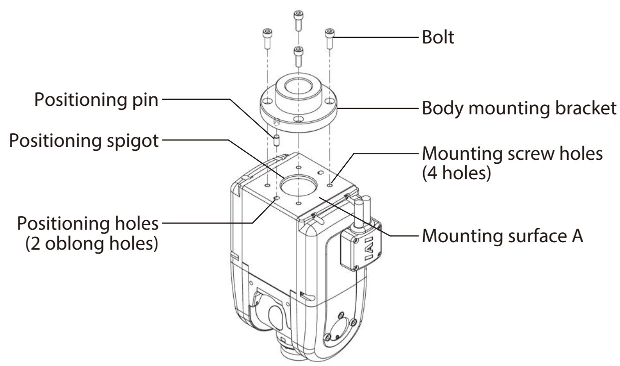
Reference Data

Mounting Method

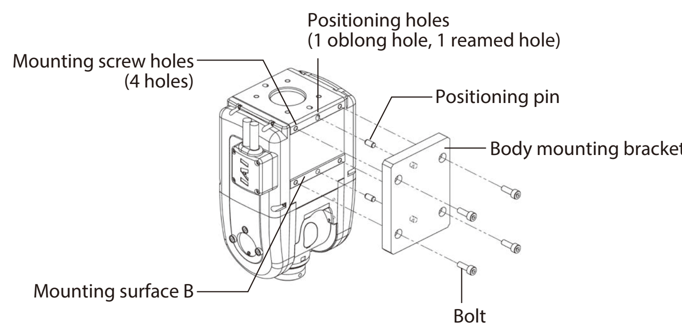
Body mounting method

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)

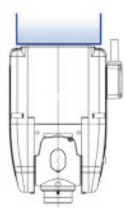


(2) When using mounting surface B
(Thread depth WU-S: M4 depth 8 / WU-M: M5 depth 10)

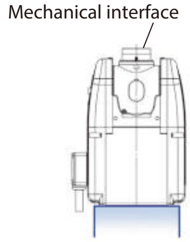


Body installation orientation

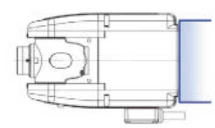
All 6 orientations below are possible.



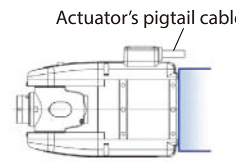
(1) Mechanical interface below



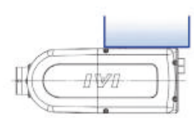
(2) Mechanical interface above



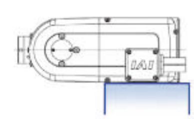
(3) Actuator's pigtail cable below



(4) Actuator's pigtail cable above



(5) Mounting surface B above



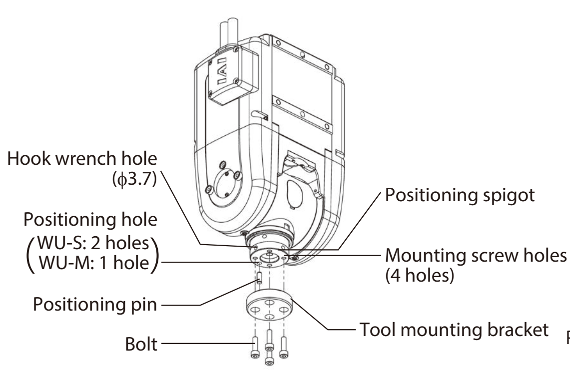
(6) Mounting surface B below

Tool mounting method

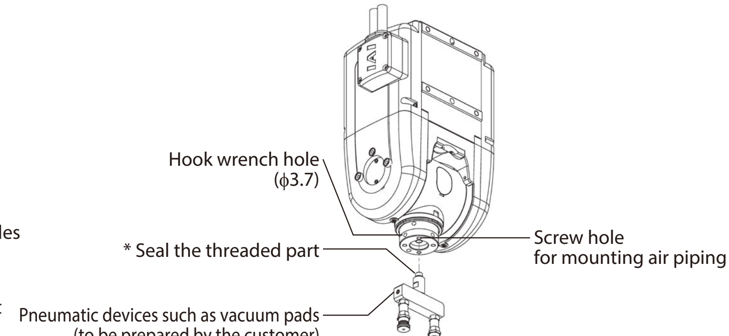
The unit is provided with screw holes for bracket mounting to the body tip (mechanical interface), screw holes for air piping mounting, and positioning holes. Refer to the dimensions (WU-S: P.12, WU-M: P.14) for details regarding the position and dimensions.

Do not apply excessive force to the output shaft when tightening bolts or air piping threads. The mechanical interface is provided with 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)



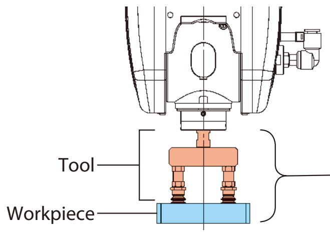
Reference Data

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



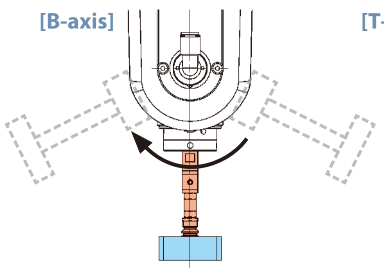
Weight of transported object ≤ Maximum payload

Step 2

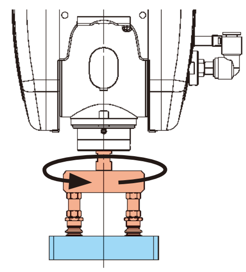
Check the moment of inertia

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.

[B-axis]



[T-axis]



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

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*

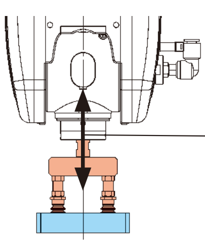
* It varies with the speed and acceleration/deceleration.

"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.

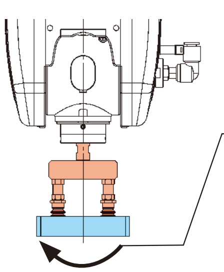


Dynamic thrust load: F ≤ Allowable dynamic thrust load

Step 4

Check the allowable dynamic load moment

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



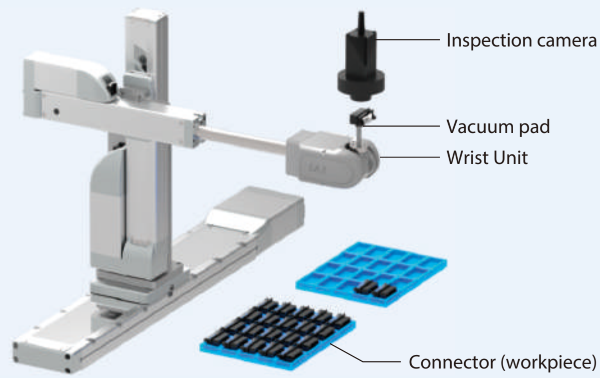
Dynamic load moment: M ≤ Allowable dynamic load moment

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).

■ Automotive connector inspection equipment



[Overview]

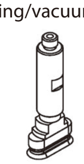
This device inspects the external view of connectors for automobiles, using a camera. The Wrist Unit rotates the connector for inspection from various angles.

Step 1 Check the weight of the transported object

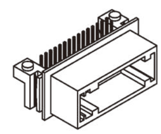
<Weight of transported object = weight of tool + weight of workpiece>

	Maximum load weight
WU-S: Compact type	1kg
WU-M: Medium type	2kg

Transported object = Piping/vacuum pad



0.02[kg] + Connector



0.013[kg] = **0.033[kg]**

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

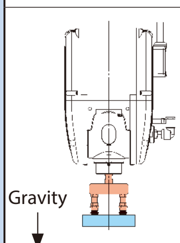
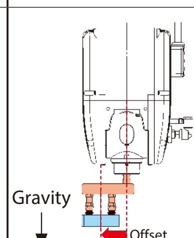
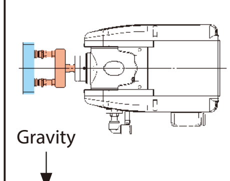
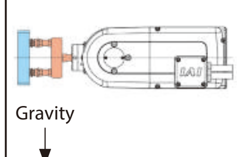
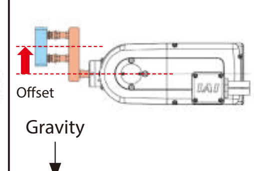
Step 2 Check the moment of inertia

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.

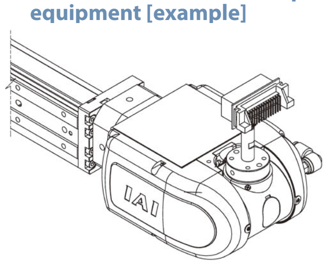
If "None" ➡ Calculate the moment of inertia and confirm that it is less than the allowable moment of inertia.

■ Conditions in which load torque is applied

	Presence of load torque				
	(1)	(2)	(3)	(4)	(5)
Installation orientation					
B-axis	Yes	Yes	None	Yes	Yes
T-axis	None	Yes	None	None	Yes

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.

■ Automotive connector inspection equipment [example]

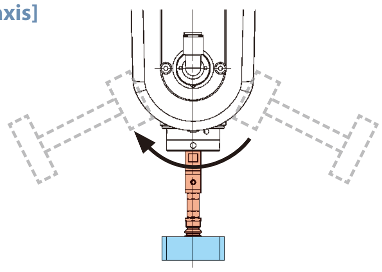


1 [B-axis] Load torque "Yes"

2 [T-axis] Load torque "None"

1. Check B-axis

[B-axis]



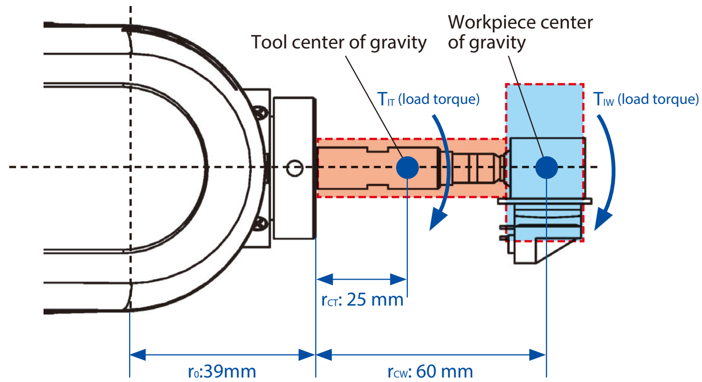
Load torque "Yes"

Moment of inertia applied on B-axis < Corrected allowable moment of inertia for compact and medium types*

* It varies with the speed and acceleration/deceleration.

(1) Calculating load torque T_l

T_{lT}: Load torque due to tool weight [N·m]
T_{lW}: Load torque due to workpiece weight [N·m]
m_T: Tool weight [kg]
m_W: Workpiece weight [kg]
g: Gravitational acceleration [m/s^2]
r_0: Mounting surface distance [mm]
r_{CT}: Tool center mass location [mm]
r_{CW}: Workpiece center mass location [mm]



$$T_l=T_{lT}+T_{lW}$$
$$=m_T\cdot g(r_0+r_{CT})\times10^{-3}+m_W\cdot g(r_0+r_{CW})\times10^{-3}$$
$$=0.02\times9.8\times(39+25)\times10^{-3}+0.013\times9.8\times(39+60)\times10^{-3}$$
$$=\mathbf{0.025}\text{[Nm]}$$

Calculation result

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

$$C_j=\frac{T_{max}-T_l}{T_{max}}$$

T_{max}: Output torque (right table) [Nm]
T_l: Load torque calculation result (1)

[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)

$$C_j=\frac{T_{max}-T_l}{T_{max}}$$
$$=\frac{0.58-0.025}{0.58}$$
$$=\mathbf{0.96}$$

Calculation result

■ Output torque by speed [Nm]

WU-S: Compact type

Speed deg./s	B-axis	T-axis
0	0.65	0.65
150	0.65	0.65
300	0.62	0.62
450	0.6	0.6
600	0.58	0.58
750	0.52	0.52
900	0.45	0.45
1050	0.45	0.45
1200	0.45	0.45

WU-M: Medium type

Speed deg./s	B-axis	T-axis
0	1.65	1.65
150	1.65	1.65
300	1.65	1.65
450	1.65	1.65
600	1.58	1.58
750	1.36	1.36
900	1.14	1.14
1050	0.96	0.96
1200	0.79	0.79

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

$$J_{tl}=J_{max}C_j\ (\text{kgm}^2)$$

J_{max}: Allowable moment of inertia (right table) [kgm^2]
C_j: Allowable moment of inertia correction factor calculation result (2)

$$J_{tl}=0.008\times0.96$$
$$=\mathbf{0.0077}$$

Calculation result

■ Allowable moment of inertia by speed/acceleration [kgm^2]

WU-S: Compact type

Speed	B-axis	T-axis
	Acceleration/deceleration	
deg./s	0.3G	0.3G
0	0.008	0.0035
150	0.008	0.0035
300	0.008	0.0035
450	0.008	0.0035
600	0.008	0.0035
750		0.0035
900		0.0035
1050		0.0035
1200		0.0025

WU-M: Medium type

Speed	B-axis	T-axis
	Acceleration/deceleration	
deg./s	0.3G	0.3G
0	0.0150	0.0126
150	0.0150	0.0126
300	0.0118	0.0072
450	0.0055	0.0054
600	0.0055	0.0054
750		0.0054
900		0.0036
1050		0.0036
1200		0.0036

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

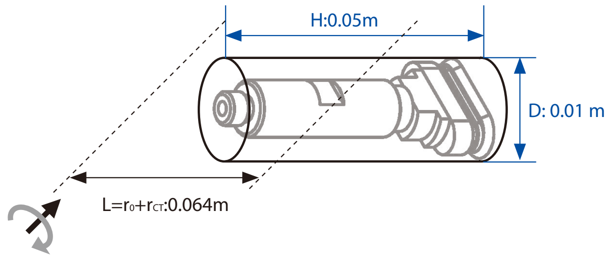
Using the Formulae for calculating moment of inertia of typical shapes (P.12), calculate the moment of inertia of the tool and workpiece to be used and make sure they do not exceed the corrected allowable moment of inertia (4) ≤ (3) obtained in (3).

Points

Calculations can be made easier by positing simplified shapes for transported objects such as tools and workpieces.

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

Calculation when simplified to cylinder



P.12 2. (5) formula used

m_T: Cylinder weight 0.02 [kg]
D: Cylinder diameter 0.01 [m]
H: Cylinder length 0.05 (m)

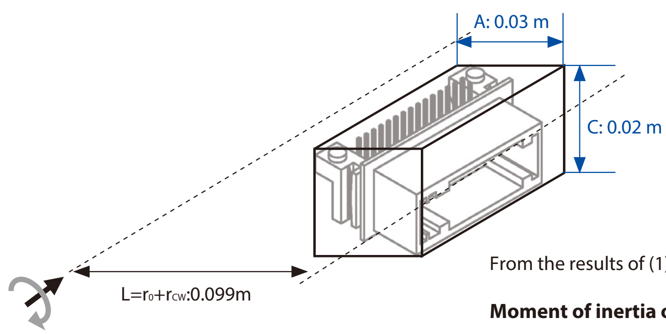
$$J_{BT}=\frac{m_T\left(\frac{D^2}{4}+\frac{H^2}{3}\right)}{4}+m_T(r_0+r_{CT})^2$$

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

$$=8.62\times10^{-5}$$

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

Calculation when simplified to cuboid



P.12 2. (6) formula used

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

$$J_{BW}=\frac{m_W(A^2+C^2)}{12}+m_W(r_0+r_{CW})^2$$

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

$$=1.28\times10^{-4}$$

From the results of (1) and (2)

Moment of inertia of transported object around B-axis

$=J_{BT}+J_{BW}$

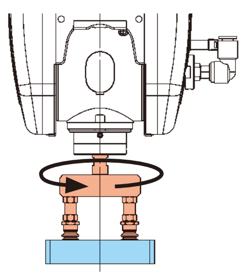
$=8.62\times10^{-5}+1.28\times10^{-4}$

$=2.1\times10^{-4}$

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

2. Checking T-axis

[T-axis]



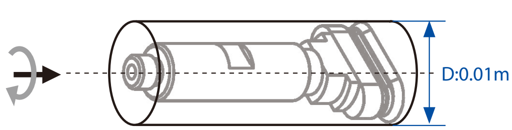
Load torque "None"

Moment of inertia applied on T-axis < Allowable moment of inertia for compact and medium types *

* It varies with the speed and acceleration/deceleration.

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}



P.12 2. (1) formula used

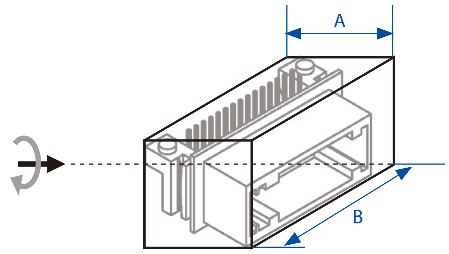
m_T: Cylinder weight 0.02 [kg]
D: Cylinder diameter 0.01 [m]

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

$$=\frac{0.02\times0.01^2}{8}$$

$$=2.50\times10^{-7}$$

(2) Moment of inertia of the connector: J_{TW}



P.12 1. (3) formula used

$$J_{TW} = \frac{m_W(A^2+B^2)}{12}$$

$$= \frac{0.013\times(0.03^2+0.05^2)}{12}$$

$$= 3.68 \times 10^{-6}$$

m_W: Cuboid weight 0.013 [kg]
A: One side of cuboid 0.03 [m]
B: One side of cuboid 0.05 [m]

From the results of (1) and (2)

Moment of inertia of transported object around T-axis

$=J_{TT}+J_{TW}$

$=2.50\times10^{-7}+3.68\times10^{-6}$

$=3.9\times10^{-6}$ [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]

T-axis rotation speed: **600** [deg/s]
Acceleration: **0.3** [G]

■ **Allowable moment of inertia by speed/acceleration [kgm^2]**

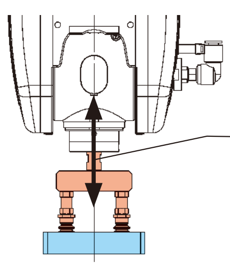
WU-S: Compact type

Speed	B-axis		T-axis	
	Acceleration/deceleration			
deg./s	0.3G	0.7G	0.3G	0.7G
0	0.0085	0.0065	0.0075	0.0035
150	0.0085	0.0065	0.0075	0.0035
300	0.0085	0.005	0.0065	0.0035
450	0.0085	0.005	0.0065	0.0025
600	0.0085	0.005	0.0065	0.0025
750		0.005	0.0065	0.0025
900			0.0065	0.0025
1050			0.0065	0.0025
1200			0.0065	0.0025

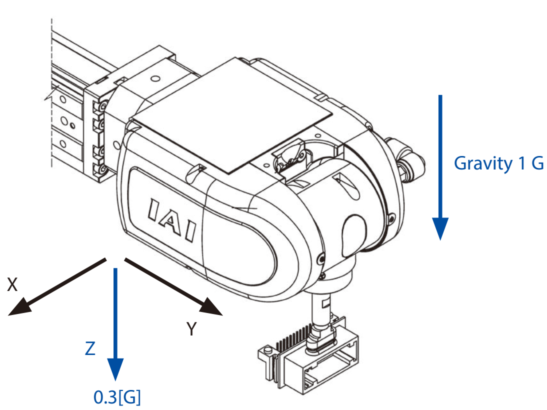
WU-M: Medium type

Speed	B-axis		T-axis	
	Acceleration/deceleration			
deg./s	0.3G	0.7G	0.3G	0.7G
0	0.0150	0.0145	0.0165	0.0126
150	0.0150	0.0145	0.0165	0.0126
300	0.0150	0.0127	0.0165	0.0090
450	0.0099	0.0045	0.0126	0.0063
600	0.0090	0.0036	0.0108	0.0054
750		0.0036	0.0099	0.0054
900		0.0036	0.0099	0.0045
1050			0.0081	0.0045
1200			0.0081	0.0045

Step 3 Check the allowable dynamic thrust load



Dynamic thrust load: F ≦ Allowable dynamic thrust load



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

m_T: Tool weight 0.02 [kg]
m_W: Workpiece weight 0.013 [kg]
g: Gravitational acceleration 1.0 [G]
a: Travel acceleration of Z-axis 0.3 [G]

$F=(0.02+0.13)\times(0.3+1.0)\times9.8$

$=0.033\times1.3\times9.8$

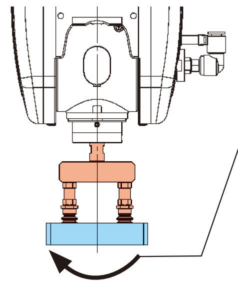
$=0.42$[N]

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

■ **Allowable dynamic thrust load**

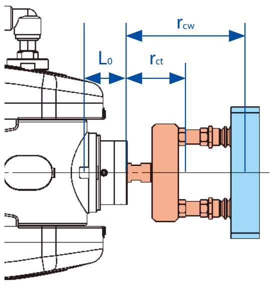
	Allowable thrust load
WU-S: Compact type	330N
WU-M: Medium type	450N

Step 4 Check the allowable dynamic load moment



Dynamic load moment: M ≦ Allowable dynamic load moment

$$M=m_T\cdot a\cdot 9.8(L_0+r_{CT})\times 10^{-3}+m_W\cdot a\cdot 9.8(L_0+r_{CW})\times 10^{-3}\ [\mathrm{Nm}]$$



m_T: Tool weight 0.02 [kg]
m_W: Workpiece weight 0.013 [kg]
a: Travel acceleration of X-axis 0.3 [G]
L_0: Load center of mass position
WU-S (Compact) 17.5 [mm]
WU-M (Medium) 21.5 [mm]
r_{CT}: Tool center mass location 25 [mm]
r_{CW}: Workpiece center mass location 60 [mm]

$$M=0.02\times 0.3\times 9.8\times(17.5+25)\times 10^{-3}$$
$$+0.013\times 0.3\times 9.8\times(17.5+60)\times 10^{-3}$$
$$=0.025+0.030$$
$$=0.055\ [\mathrm{Nm}]$$

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

■ Allowable dynamic load moment

	Allowable dynamic load moment
WU-S: Compact type	1.4Nm
WU-M: Medium type	4.2Nm

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

Formulae for calculating moment of inertia of typical shapes

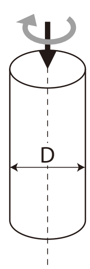
1. When the rotational axis passes through the center of the object

(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> $I = M \times D^2/8$

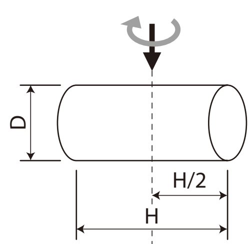
Moment of inertia of cylinder: I (kg·m²)
Cylinder weight: M (unit: kg)
Cylinder diameter: D (m)



(2) Moment of inertia of cylinder 2

<Formula> $I = M \times (D^2/4 + H^2/3) / 4$

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

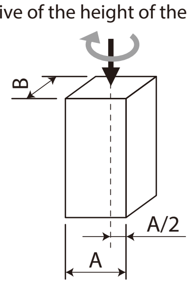


(3) Moment of inertia of prism 1

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

<Formula> $I = M \times (A^2 + B^2) / 12$

Moment of inertia of prism: I (kg·m²)
One side of prism: A (m)
One side of prism: B (m)



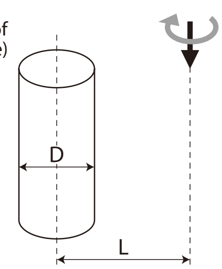
2. When the center of the object is offset from the rotational axis

(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> $I = M \times D^2/8 + M \times L^2$

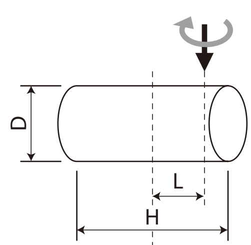
Moment of inertia of cylinder: I (kg·m²)
Cylinder weight: M (kg)
Cylinder diameter: D (m)
Distance from rotational axis to center: L (m)



(5) Moment of inertia of cylinder 4

<Formula> $I = M \times (D^2/4 + H^2/3) / 4 + M \times L^2$

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)

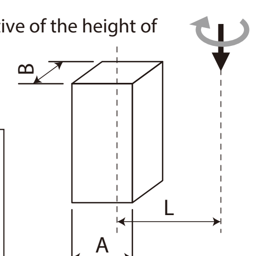


(6) Moment of inertia of prism 2

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

<Formula> $I = M \times (A^2 + B^2) / 12 + M \times L^2$

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



WU-S

Battery-less Absolute | Compact type | 24V Stepper Motor

■ Model Specification Items

WU	—	S	—	WA	—	PM1	—	☐	—	☐
Series		Type		Encoder Type		Applicable Controllers		Cable Length		Options
		S: Compact Type		WA: Battery-less Absolute		PM1: MSEL		N : None P : 1m S : 3m M : 5m X☐☐ : Specified Length R☐☐ : Robot Cable		Refer to Options table below.

* Does not include a controller
* Please refer to P.4 for more information about the model specification items.

* Please refer to P.6 for more information on the installation method and orientation.

POINT Selection Notes

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

Model	Axis configuration	Operation range (deg.)	Max. speed (Note 1) (deg/s)		Max. payload (kg)	Max. acceleration/deceleration (G)	
			Independent operation	Simultaneous operation of the B- and T-axes		Without load torque (Note 2)	With load torque (Note 2)
WU-S-WA-PM1-①-②	B-axis (wrist swing)	±100	750	600	1	0.7 G (6865 deg/s²)	0.3 G (2942 deg/s²)
	T-axis (wrist rotation)	±360	1200	600		0.7 G (6865 deg/s²)	0.3 G (2942 deg/s²)

Legend: ① Cable length ② Options

*1 G ≈ 9807 deg/s²

① Cable Length <per axis *1>

Type	Cable code
Standard type	**P**(1m)
	S(3m)
	M(5m)
Specified length	**X06**(6m) to **X10**(10m)
	X11(11m) to **X15**(15m)
	X16(16m) to **X20**(20m) *2
Robot cable	**R01**(1m) to **R03**(3m)
	R04(4m) to **R05**(5m)
	R06(6m) to **R10**(10m)
	R11(11m) to **R15**(15m)
	R16(16m) to **R20**(20m) *2

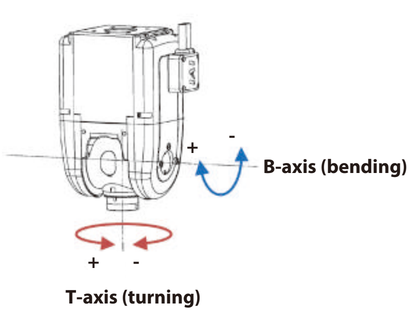
Cable between actuator and controller.
*1 Required for both B- and T-axes. Select the cable length in the model name to have 2 cables attached.
*2 When Actuator's pigtail cable length change "AC1.5" is selected as an option, 18 m (X18, R18) will be the maximum length.

② Options

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

Name	Option code	Reference page
Cable exit direction (Right)	**A1**	See P.5, P.14
Cable exit direction (Bottom)	**A2**	See P.5, P.14
Cable exit direction (Left)	**A3**	See P.5, P.14
Actuator's pigtail cable length change	**AC1.5**	See P.5, P.14
Cable (air fitting) in opposite position	**CVR**	See P.5, P.14
With air fitting	**VC**	See P.5, P.14
With wiring collar	**WCS**	See P.5, P.14

Name and Coordinates of Each Axis



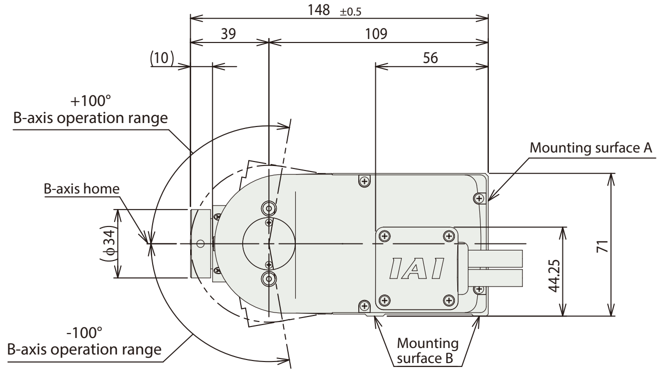
Actuator Specifications

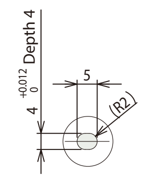
Item	Description	
	B-axis (wrist swing)	T-axis (wrist rotation)
Drive system	Stepper motor + timing belt	Stepper motor + timing belt + bevel gear
Positioning repeatability	±0.015 deg.	±0.15 deg.
Lost motion	0.06 degrees	0.4 degrees
Allowable dynamic thrust load *1	330N	
Allowable dynamic load moment *1	1.4N·m	
Unit weight	1.6kg	
Brake retaining torque *2	0.96N·m	0.96N·m
Ambient operating temperature, humidity	0~40°C, 85% RH or less (Non-condensing)	

*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.

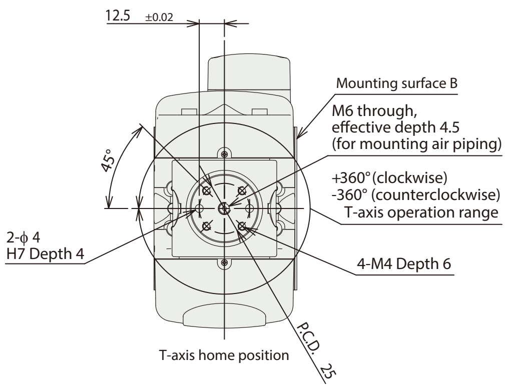
Dimensions

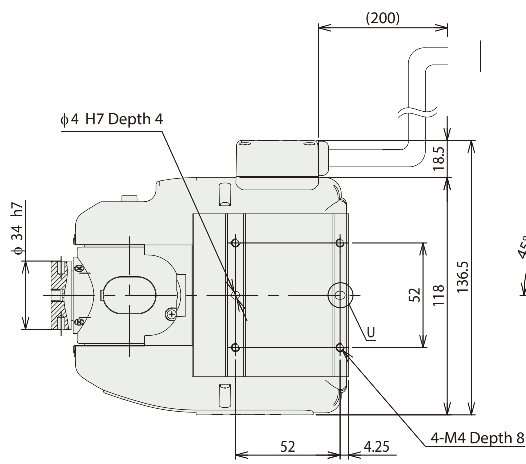
CAD drawings can be downloaded from our website.
www.intelligentactuator.com
2D CAD 3D CAD

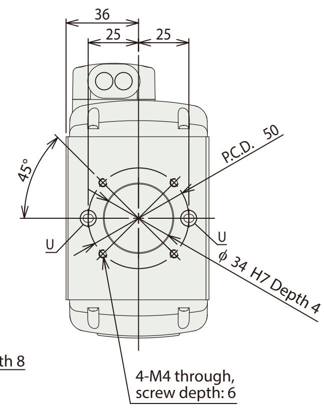




Detailed view U

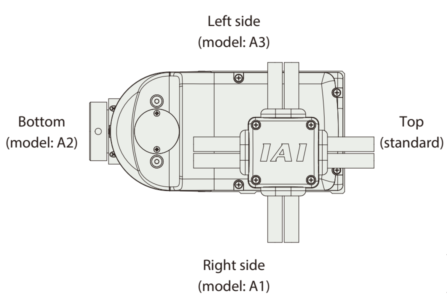




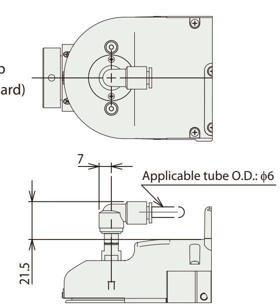


Options

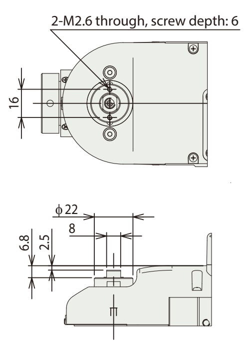
■ Cable exit direction



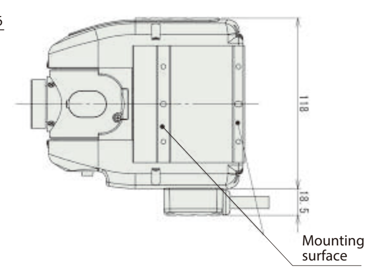
■ Air fitting (model: VC)



■ Wiring collar (model: WCS)



■ Cable (air fitting) opposite position (model: CVR)



Applicable Controllers

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 * selection		
MSEL-PC/PG		4	Single phase 100 to 230 V AC	–	–	●	DeviceNet, CC-Link, EtherCAT, EtherNet/IP, PROFIBUS, PROFINET	30000	See P.15

* Please contact our sales representative for control using expanded motion control with the XSEL-RA/SA controller. (See P. 19)

WU-M

Battery-less Absolute | Medium type | 24v Stepper Motor

■ Model Specification Items

WU	—	M	—	WA	—	PM1	—	☐	—	☐
Series	—	Type	—	Encoder Type	—	Applicable Controllers	—	Cable Length	—	Options
		M: Medium Type		WA: Battery-less Absolute		PM1:MSEL		N : None P : 1m S : 3m M : 5m X☐☐ : Specified Length R☐☐ : Robot Cable		Refer to Options table below.

* Does not include a controller

* Please refer to P.4 for more information about the model specification items.

CE RoHS

* Please refer to P.6 for more information on the installation method and orientation.

POINT Selection Notes

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

Model	Axis configuration	Operation range (deg.)	Max. speed (Note 1) (deg/s)		Max. payload (kg)	Max. acceleration/deceleration (G)	
			Independent operation	Simultaneous operation of the B- and T-axes		Without load torque (Note 2)	With load torque (Note 2)
WU-M-WA-PM1-①-②	B-axis (wrist swing)	±105	900	600	2	0.7 G (6865 deg/s²)	0.3 G (2942 deg/s²)
	T-axis (wrist rotation)	±360	1200	600		0.7 G (6865 deg/s²)	0.3 G (2942 deg/s²)

Legend: ① Cable length ② Options

*1 G = 9800 deg/s²

① Cable Length <per axis *1>

Type	Cable code
Standard type	**P**(1m)
	S(3m)
	M(5m)
Specified length	**X06**(6m) to **X10**(10m)
	X11(11m) to **X15**(15m)
	X16(16m) to **X20**(20m) *2
Robot cable	**R01**(1m) to **R03**(3m)
	R04(4m) to **R05**(5m)
	R06(6m) to **R10**(10m)
	R11(11m) to **R15**(15m)
	R16(16m) to **R20**(20m) *2

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.

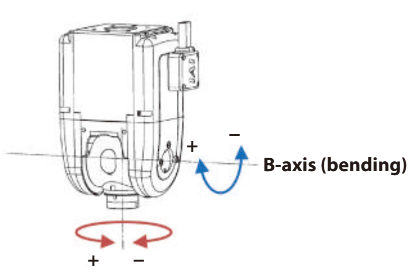
*2 When Actuator's pigtail cable length change "AC1.5" is selected as an option, 18 m (X18, R18) will be the maximum length.

② Options

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

Name	Option Code	Reference page
Cable exit direction (Right)	**A1**	See P.5, P.14
Cable exit direction (Bottom)	**A2**	See P.5, P.14
Cable exit direction (Left)	**A3**	See P.5, P.14
Actuator's pigtail cable length change	**AC1.5**	See P.5, P.14
Cable (air fitting) in opposite position	**CVR**	See P.5, P.14
With air fitting	**VC**	See P.5, P.14
With wiring collar	**WCS**	See P.5, P.14

Name and Coordinates of Each Axis



Actuator Specifications

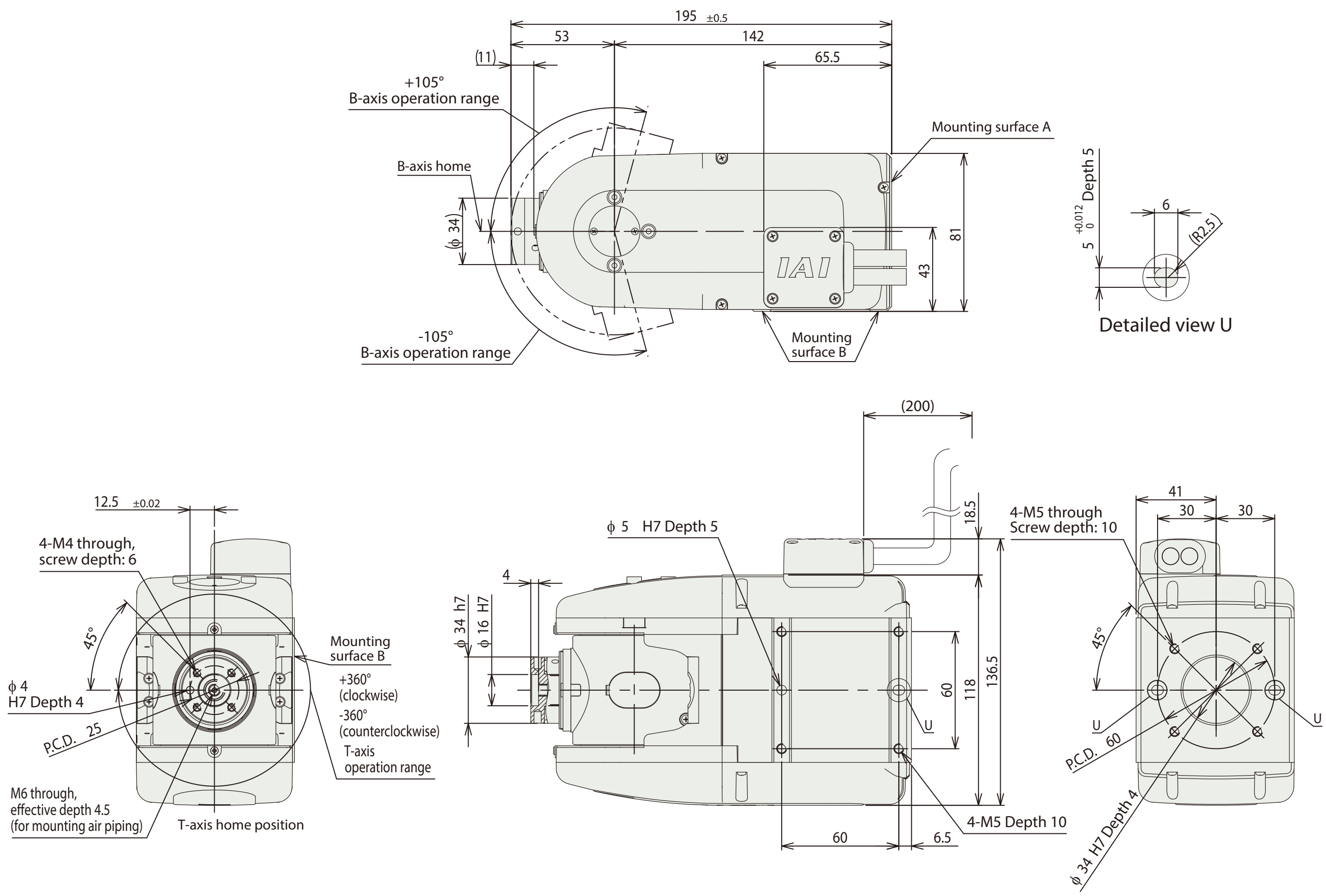
Item	Description	
	B-axis (wrist swing)	T-axis (wrist rotation)
Drive system	Stepper motor + timing belt	Stepper motor + timing belt + bevel gear
Positioning repeatability	±0.015 deg.	±0.15 deg.
Lost motion	0.06 degrees	0.4 degrees
Allowable dynamic thrust load *1	450N	
Allowable dynamic load moment *1	4.2N·m	
Unit weight	2.8kg	
Brake retaining torque *2	2.8N·m	2.8N·m
Ambient operating temperature/humidity	0~40°C, 85% RH or less (Non-condensing)	

*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.

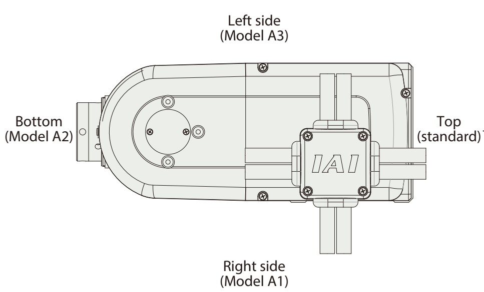
Dimensions

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

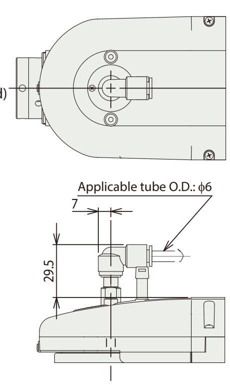


Options

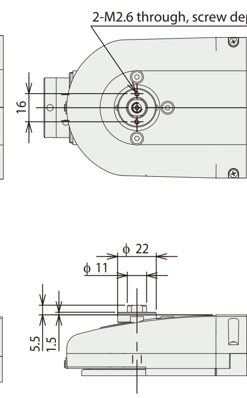
■ Cable exit direction



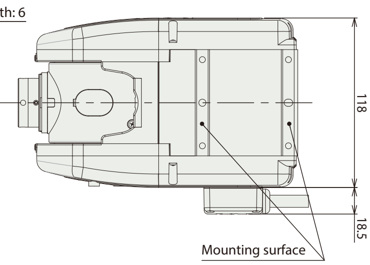
■ Air fitting (model: VC)



■ Wiring collar (model: WCS)



■ Cable (air fitting) in opposite position Model: CVR



Applicable Controllers

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 * selection		
MSEL-PC/PG		4	Single phase 100 to 230 V AC	–	–	●	DeviceNet, CC-Link, EtherCAT, EtherNet/IP, PROFIBUS, PROFINET	30000	See P.15

* Please contact our sales representative for control using expanded motion control with the XSEL-RA/SA controller. (See P. 19)

MSEL

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

List of Models

Program controller enabling operation of RCP6/RCP5/RCP4/RCP3/RCP2 Series actuators. One MSEL controller can handle various forms of control with up tp 4-axis.

Type name			PC	PG
Name			Standard type	Safety category type
Max. number of controlled axes			4	
No. of positions			30,000 points	
Power			Single phase 100 to 230V AC	
Safety category			B	3 *1
Standard price	Battery-less Absolute Incremental	1-axis	–	
		2-axis	–	
		3-axis	–	
		4-axis	–	
	Simple absolute	1-axis	–	
		2-axis	–	
		3-axis	–	
		4-axis	–	

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

Model Specification Items

MSEL – [Type] – [Number of Connectable Axes] – [Motor Type] [Encoder Type] [Options] (Within the 1st axis) – [Motor Type] [Encoder Type] [Options] (Details of the 2nd~4th axes) – [Standard I/O Type] – [Expansion I/OType] – [I/O Cable Length] – 4 (Power Supply Voltage) – [Simple Absolute Unit] – [Controller Mounting Specification]

Series / Type / Number of Connectable Axes / Motor Type / Encoder Type / Options / Motor Type / Encoder Type / Options / Standard I/O Type / Expansion I/OType / I/O Cable Length / Power Supply Voltage / Simple Absolute Unit / Controller Mounting Specification

Type

PC	Standard type
PG	Safety category type

Number of Connectable Axes

1	1-axis specification
2	2-axis specification
3	3-axis specification
4	4-axis specification

Motor Type (Within the 1st axis)

20P	20□
20SP	20□
28P	28□
28SP	28□
35P	35□
42P	42□
42SP	42□
56P	56□
WUS	For WU-S
WUM	For WU-M

(Example) 20P: Supports 20□ stepper motor
* WUS and WUM use 2 axes.
Encoder type and options can be omitted.

Encoder Type (Within the 1st axis)

WAI	Battery-less absolute specification Incremental specification
SA	Simple absolute specification

* Battery-less absolute and simple absolute cannot be used together. When using simple absolute, all axes must be simple absolutes.

Options (Within the 1st axis)

B	Brake

Motor Type (Details of the 2nd~4th axes)

20P	20□
20SP	20□
28P	28□
28SP	28□
35P	35□
42P	42□
42SP	42□
56P	56□
WUS	For WU-S
WUM	For WU-M

(Example) 20P: Supports 20□ stepper motor
* WUS and WUM use 2 axes.
Encoder type and options can be omitted.

Encoder Type (Details of the 2nd~4th axes)

WAI	Battery-less absolute specification Incremental specification
SA	Simple absolute specification

* Battery-less absolute and simple absolute cannot be used together. When using simple absolute, all axes must be simple absolutes.

Options (Details of the 2nd~4th axes)

B	Brake

Standard I/O Type

NP	NPN specification
PN	PNP specification

Expansion I/OType

E	Not used
NP	Expansion PIO board (NPN spec.)
PN	Expansion PIO board (PNP spec.)
DV	DeviceNet board
DV2	DeviceNet board (bifurcated connector included)
CC	CC-Link board
CC2	CC-Link board (bifurcated connector included)
PR	PROFIBUS-DP board
EP	EtherNet/IP board
EC	EtherCAT connection specification
PRT	PROFINET IO connection specification
SE1	RS232C connection board
SE2	RS485 connection board
IA	IA Net connection board

* When selecting DV2 and CC2, a bifurcated connector for branch wiring is included.
* When using EIOU, an IA Net connection board is required.

I/O Cable Length

0	No cable
2	2m (Standard)
3	3m
5	5m

Power Supply Voltage

4	AC100~230

Simple Absolute Unit

ABB	With absolute data backup battery box
ABBN	Without absolute data backup battery box
(Blank)	Battery-less absolute or incremental

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

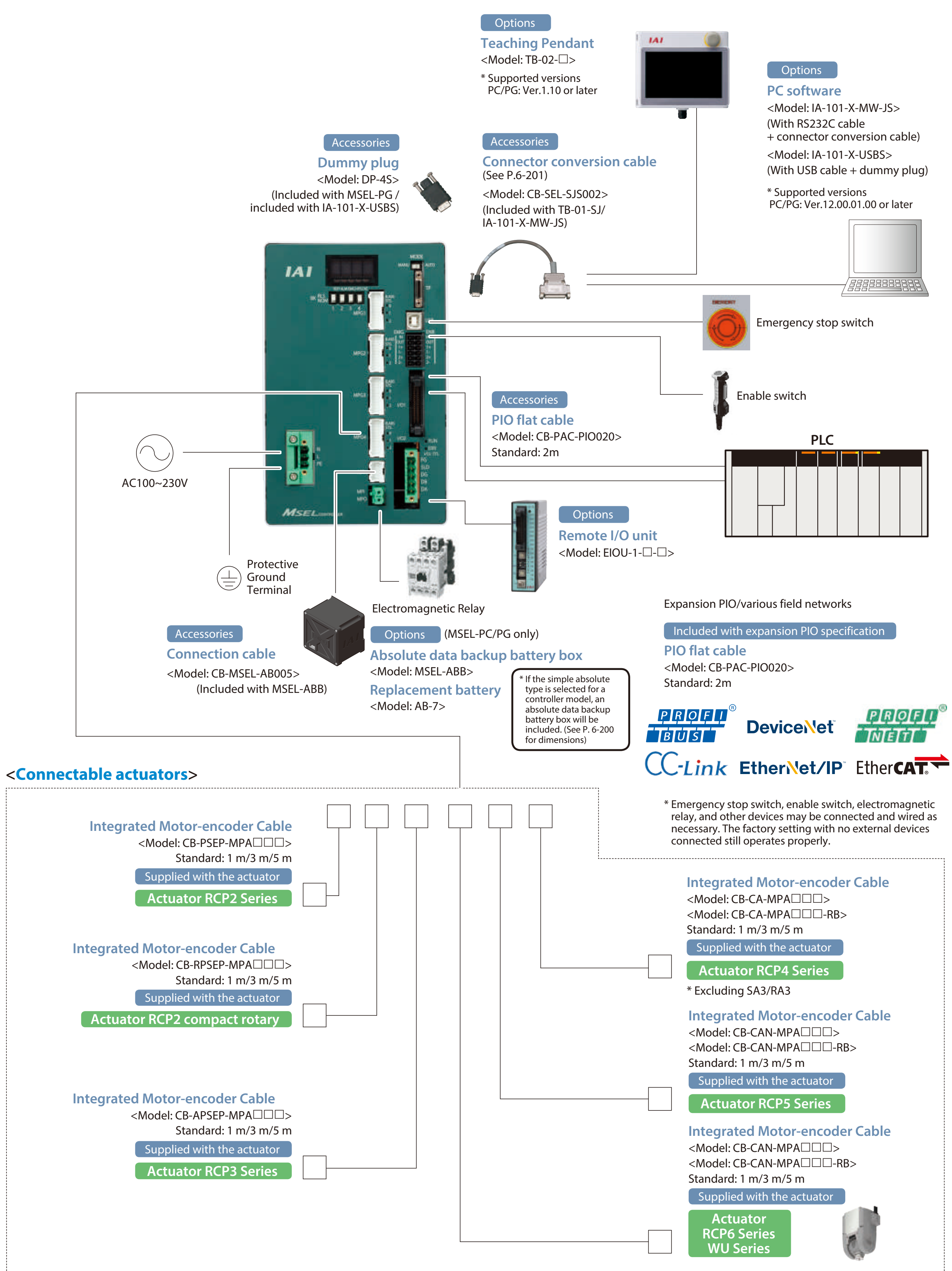
Controller Mounting Specification

(Blank)	Screw mounting specification
DN	DIN rail mounting specification

Notes

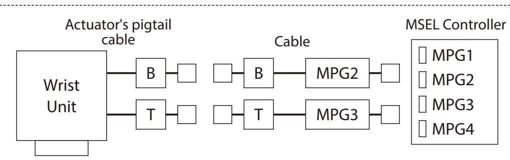
The motor type symbol is normally the same as that of the actuator to be connected, but there are some models for which motor types of the controller and actuator do not match.
Be sure to check the corresponding models listed below during selection.
<28SP target actuator>
● Controller motor type [28SP]
…RCP2-RA3C

System Configuration



Notes

When using the Wrist Unit, connect so that the combination of symbols in "Actuator's pigtail cable", "Cable" and "Controller" will match.
The figure on the right is an example when connecting the Wrist Unit to the second and third axes of the MSEL controller.



X-SEL

XSEL-RA/SA expanded motion control function (equipped as standard)

1. Interpolation command of Cartesian Robot + Wrist Unit possible
   (Note) It is not possible to interpolate between an actuator directly connected to XSEL and an actuator connected to the controller on the network.
2. What to prepare
   (1) XSEL-RA/SA controller (equipped with expanded motion function as standard)
   (2) MECHATROLINK-III dedicated cable (to be prepared by the customer)
   (3) MCON-C, P/A/D/SCON-CB as needed (MECHATROLINK-III option selected)

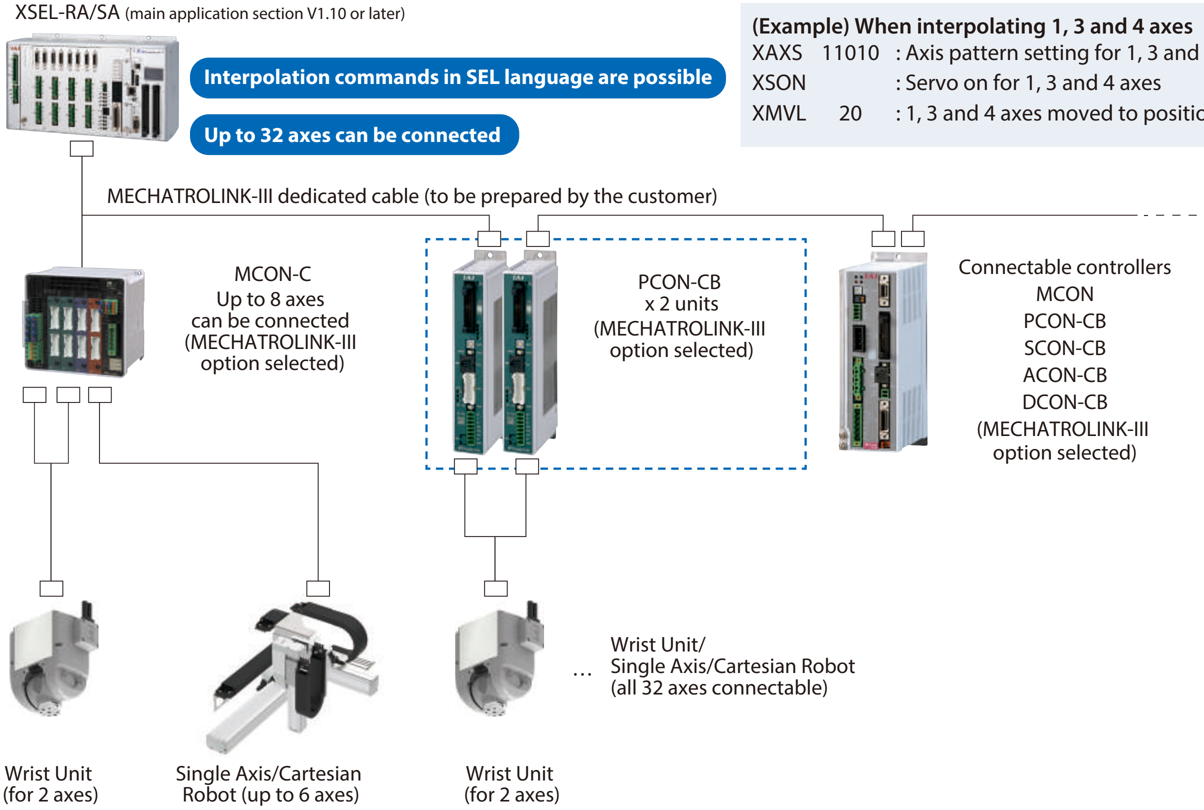
* Please contact our sales representative for Wrist Unit control using expanded motion control with the XSEL-RA/SA controller.

Program example

(XSEL PC software supported version: V13.02.04.00)

(Example) When interpolating 1, 3 and 4 axes

XAXS	11010	: Axis pattern setting for 1, 3 and 4 axes
XSON		: Servo on for 1, 3 and 4 axes
XMVL	20	: 1, 3 and 4 axes moved to position No. 20



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