Keep this manual nearby for future reference.
General Descriptions

This manual describes the installation methods when the actuator is used as the single axis and is used in combination with other equipment. For the basic installation procedures, see Section 2. For the combined use, only the basic X–Y combination is explained in this manual.

Section 1  Explanation on Axis Configuration Parts

• For the axis configuration, the following parts are used in addition to the actuator.

1.1 Angle Bracket (Bracket)

This part is used to connect multiple actuators (axes). It is roughly classified into the angle type and plate type. Select either type according to the axis combination to be used.

1.2 Controller Cable

• This cable connects the axis (actuator) with the controller. One (1) set of two (2) cables for signal and power drive is provided.

• One (1) set of controller cables is required for each axis (actuator).

• As this controller cable is bending-resistant, it can be used as a movable cable.
1.3 CN Box

- This is the relay box for the controller cable, or the cables and air pipelines provided by the customer.

- The CN box is mounted on the axis (actuator), frame, etc. For details on the mounting procedures, see Para. 2.4.

**Note**

DO NOT mount the CN box in the working range of the slider or hand.

1.4 Flexible Tube

- This tube is used to protect the controller cable, or the cables and air pipelines provided by the customer. (In the case of BA10-FT-L only, in the tube, you can use through the controller cable.)

- The tube with oval cross-sectional profile (BA10–FT–M) can be used for the vertical or horizontal layout.

- The tube with round cross-sectional profile (BA10–FT–L) can be used for the vertical layout.

**Note**

When using the tube, the minimum radius of curvature should be considered. For details, see Para. 2.5.
1.5 Flexible Duct

- This duct is used to protect the controller cable, or the cables and air pipelines provided by the customer. (The cables, etc., run through the duct for use.)
Section 2 Installing Actuator (Axis)

• This section describes the basic installation of the actuator (axis) and basic mounting of the peripheral parts.

• Install the actuator, referring to this section. If the actuator is installed incorrectly, the robot cannot be operated to its full capacity and its service life will shorten drastically.

⚠️ CAUTION

Cautions on installation

• Environment of installation place

(1) The actuator should be installed under the following environment.
  • Ambient temperature
    - Working temperature:  0°C to 40°C
    - Transportation and storage temperature: -10°C to 50°C
  • Relative humidity: 30 to 90%RH without dew condensation
  • Altitude: 1000 m or less
  • Vibration 0.98 m/s²
  • Dust: Free from conductive dust or dirt
  • Gas: Free from flammable or corrosive gas
  • Magnetic field: Free from a nearby device that may generate magnetic field
  • Radiation: Not in the radiation controlled area
  • Others: Without greasy fume

(2) This actuator is not designed to be explosion-proof. Avoid using it at a heavily contaminated place. Take careful precautions on the operating environment.
• Cautions on installation

(1) DO NOT drop the actuator or hit it against any object during transport.

(2) Provide an ample space for the maintenance and inspection beforehand.

(3) Install the controller at a place where the standard cable can reach from the actuator.

(4) At the time of installation:
   • Install the actuator on a leveled set base.
   • The set base shall have such a length that allows mounting of the frame only.
   • The set base should be made of steel plate which is machined to 9 mm or over in thickness for BE10 and BE30, and 20 mm or over in thickness for BE50 and BE60, and 0.2 or less in flatness. Mount the actuator on this base, then correct a bend or twist of the actuator frame and reinforce the same frame.
   • The oval head bolts (i.e., set bolts) of the actuator should be mounted at pitches of about 150 mm.
2.1 Installing Actuator (Axis)

To install the actuator, observe the following procedures.

(1) Setting oval head bolts

Insert the oval head bolts into the T-slots on the actuator frame set surface.

Oval head bolt (M6 × 30): BE10, BE30
(M8 × 40): BE50, BE60

(2) Installing actuator on set base

BE10, BE30: 9 ~ 20
BE50, BE60: 20 ~ 30

Motor

• T-slots (for M4 nuts) on the lateral side and top of the frame are reserved for mounting the CN box and options. NEVER use these T-slots for mounting the actuator.

• For the nut clamping torque, see Para. 2.10.
2.2 Connecting Cable with Actuator End

- Cable connection (BE10)
  Make sure that the cable will not enter too far.

Set the band in the groove on the cable grip.

Secure the cable with a band.

Assemble the cable grip.

Key wrench (option)

Clamp the resin nut.

Connecting cable with actuator end
• Cable connection (BE30, BE50)
  Make sure that the cable will not enter too far.

  Set the band in the groove on the cable grip.

  Secure the cable with a band.

  Assemble the cable grip.

  Key wrench (option)

  Clamp the resin nut. (Clamp both the end plate and end cover.)

  Connecting cable with actuator end
2.3 Mounting Angle Bracket

The following explanation is made, taking the X–Y combination for example. When using the actuator as the single axis, mount the hand provided by the customer.

CAUTION

For the bolt clamping torque, see Para. 2.10.

(1) Mounting Y-axis
Insert the oval head bolts into the Y-axis and mount the Y-axis as shown below.

• The Y-axis should be mounted so that it can make right angles with the X-axis and run parallel with the base.
For the nut clamping torque, see Para. 2.10.

If the sticker or warning label on the frame cover is upside down due to the axis combination, remove the frame cover, then reverse it left to right and mount it again.

For the BE30–BE10 (X–Y) combination, if the Y-axis is a straight axis, it is secured to the bracket with eight (8) oval head bolts. For the side mounted motor axis, insert the oval head bolts into the six (6) holes on the bracket in the direction of the axis (actuator) end.

**Points**

- The set base should be rigid enough with good flatness.
- Use the attached oval head bolts for the set bolts.
- The pitches for setting the oval head bolts should be 150 mm or less.
- T-slots on the lateral side and top of the frame are not intended for mounting the axis (actuator).
2.4 Mounting CN Box

- The CN box is used for the purposes of relay, branch and securing when wiring and piping to the robot and hand.

- The CN box can be mounted on the side of the actuator (axis), motor cover end, side of the motor cover, frame other than the actuator, etc.

<Example of main connection 1>
[BA10–BX–B10]
<Example of main connection 2>
[BA10–BX–B20]

Note
DO NOT mount the CN box in the movable range of the slider or hand.
<Example of securing CN box 1>

- Use of box metal fitting
  [BA10–BX–B10]

Mount the CN box so that it will not project the top of the axis (actuator) slider.
  Side of motor cover

Mount the CN box so that it will not collide with the axis slider.
  Top of motor cover
Mount the CN box so that it will not project the top of the actuator slider.

**Side of actuator**

![Side of actuator diagram]

**Other than actuator**

When mounting the CN box on other than the actuator, make sure that the set screws are positioned as shown below.

![Other than actuator diagram]
<Example of securing CN box 2>
[BA10–BX–B20]

Insert the hexagon nuts into the T-slot and mount the CN box so that it will not collide with the slider.
<Example of securing CN box 3 (Z-axis)>
[BA10–BX–B20]

Use of L-shaped metal fittings

- Insert the hexagon nuts into the T-slot, then secure the two (2) L-shaped metal fittings (large and small) to the side of the actuator.

- Mount the CN box on the L-shaped metal fittings so that it will not interfere with the slider.

Direct mounting

- Insert the hexagon nuts into the T-slot, then secure the CN box to the side of the actuator.
2.5 Connecting Flexible Tube and Cable

The flexible tube is used to protect the controller cable, and wiring and piping from the hand.
Cut the flexible tube to an appropriate length according to the application. (The tube can be cut easily with a knife, etc.)

- Cautions on use of flexible tube:
  When using the flexible tube, pass the controller cable, etc., through it before mounting the tube, as shown below.
The dimensions in the figure below refer to the BA10–FT–M. The same dimensions are also applicable for the BA10–FT–L.

**Vertical layout**

[Diagram showing vertical layout with dimensions and notes]

**Horizontal layout**

[Diagram showing horizontal layout with dimensions and notes]
• In the BA10-FT-M, the controller cable does not enter. If you are using the controller cable through the inside of the tube, please use the BA10-FT-L.

• When the cross-sectional profile is round (BA10–FT–L), only the vertical layout can be used.

• If used with dimensions other than those given above, the service life of the tube will reduce drastically.

• When the axis stroke is 600 mm or over (yardstick), use of the horizontal layout or use of a flexible duct is recommended. If the vertical layout is used, the flexible tube may not function.

• DO NOT place too many cables, etc., in the tube. Otherwise, the life of the cable will reduce sharply.
• Example of flexible tube connection (BA10–FT–M)

After inserting the clamp into the connector, mount the flexible tube on the connector.

CAUTION
When using the tube, the minimum radius of curvature should be considered. For details, see the descriptions above in this paragraph.
• Example of cable connection 1 (BA10–FT–M)

Pass all necessary parts through the cable beforehand.

Secure the cable with a band at either the cable inlet or outlet.

Connecting cable with CN box

<table>
<thead>
<tr>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To tighten the resin nut, you can use a wrench key (option).</td>
</tr>
<tr>
<td>• Pass all necessary parts through the cable beforehand.</td>
</tr>
<tr>
<td>• DO NOT bend the flexible tube too much.</td>
</tr>
<tr>
<td>• To secure the cable, use a band (Insulock; cable tie).</td>
</tr>
</tbody>
</table>
• Example of cable connection 2 (BA10–FT–M)

Pass all necessary parts through the cable beforehand.

Secure the cable with the resin nut from the rear side of the CN box.

Connecting cable with CN box

**Points**
- To tighten the resin nut, you can use a wrench key (option).
- Pass all necessary parts through the cable beforehand.
- DO NOT bend the flexible tube too much.
2.6 Connecting Flexible Duct and Cable

The flexible duct is used to protect the controller cable, and wiring and piping from the hand.
Cut the flexible duct to an appropriate length according to the application.
(The flexible duct link can be removed easily, using a screwdriver, etc.)
For the X–Y combination, the BA10–BX–F10 CN box is used for the X-axis, and the BA10–BX–F30 for the Y-axis.

• Cautions on use of flexible duct:
  When using the flexible duct, pass the controller cable, etc., through it before mounting the duct, as shown below.
  When the X-axis slider is located at the end of the actuator, the flexible duct should project by about 120 mm.

Notes

• If used with dimensions other than those given above, the service life of the duct will reduce drastically.
• DO NOT place too many cables, etc., in the flexible duct. Otherwise, the life of the cable will reduce sharply.
Example of connecting with X-axis (BE50)

(1) Insert the hexagon nuts into the T-slot on the frame cover and mount the CN box on top of the actuator.

(2) Mount the clamp plate on the CN box.

(3) Attach the flexible duct link set metal fitting to the clamp plate. Mount the clamp base on the clamp plate.

Points When connecting with the side of the actuator, mount the CN box on the side, then connect the flexible duct in the same manner as above.

For connecting the CN box on the side of the actuator, see Para. 2.4.
Example of connecting with Y-axis (BE50)

(1) Insert the hexagon nuts into the T-slot on the side of the actuator and mount the CN box on the actuator.

(2) Mount the clamp plate on the CN box.

(3) Attach the flexible duct link set metal fitting to the clamp plate. Mount the cable clamp base on the clamp plate.
Example of cable connection (X-axis)

Assemble the cable by passing it through the required parts and flexible duct ink, or pass the cable through the flexible duct after securing the duct to the X-axis.

Secure the flexible duct to the X-axis.

Pass the cable through the flexible duct.

Points

It is easy to pass the cable through the duct by bundling the cable connectors in a small vinyl bag, etc.
Example of cable connection (Y-axis)

Pass the cable through the CN box and resin nut, then connect it with the Y-axis.

After attaching the cable grip to the Y-axis, attach the CN box cable grip.

Adjust the length of the cable running from the Y-axis, then secure the cable with a band.
2.7 Mounting, Wiring and Piping of Hand

- After installing the robot, mount the hand provided by the customer. Make sure that the hand weight and moment load on the slider will not exceed the axis specifications.

- Use the CN box, flexible tube or flexible duct for wiring and piping to the hand.

*Example of wiring and piping*

*Example of using sleeve cone*
2.8 Mounting Tube Tray

- The tube tray is required when the flexible tube is arranged in the horizontal condition (⊂).
  Mount the tray so that excessive force is not exerted on the height direction and horizontal direction of the flexible tube.

- When mounting the tube tray on the axis (actuator), refer to the following photos.

  Mounting tube tray on the side of actuator (using L-shaped metal fitting)

  Mounting tube tray directly on the side of actuator
Mounting tube tray on the lower side of actuator
2.9 Mounting Duct Tray

- The duct tray is required when the flexible duct is used on the side of the axis (actuator).

- Mount the tray so that excessive force is not exerted on the height direction and horizontal direction of the flexible duct.

- To mount the tray on the actuator, pass the hexagon nuts through the T-slot on the actuator, then secure it. See the photos below.

Mounting duct tray directly on the side of actuator
## 2.10 Bolt and Nut Clamping Torque Table

<table>
<thead>
<tr>
<th>Part name</th>
<th>Nominal screw size</th>
<th>Clamping torque (N·m)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexagon socket head cap screw</td>
<td>M4</td>
<td>2.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5</td>
<td>5.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M6</td>
<td>8.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M8</td>
<td>21.6</td>
<td></td>
</tr>
<tr>
<td>Pan head screw</td>
<td>M3</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Hexagon socket head button screw</td>
<td>M4</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5</td>
<td>2.84</td>
<td></td>
</tr>
<tr>
<td>Hexagon nut</td>
<td>M4</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5</td>
<td>2.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M6</td>
<td>5.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M8</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Resin nut</td>
<td>G1</td>
<td>2.94</td>
<td></td>
</tr>
</tbody>
</table>
Section 3 Installing X–Y Combination Axes

3.1 BE10-BE10, BE30–BE10 (X–Y) Combination

Installation procedures (when the flexible duct is used)

(1) Install the 1st axis (actuator).
(2) Mount the angle bracket.
(3) Mount the 2nd axis (actuator).
(4) Mount the CN box.
(5) Prepare the flexible duct of an appropriate length. Pass the required parts through the cables, then pass the cables through the duct.
(6) Secure the cables in turn, starting from the Y-axis (2nd axis) motor side.
(7) Secure the cables with band (Insulock).
(8) Mount the CN box cover.

Point For details, see Section 2.

(1), (2) (3)

(4) (5)–1

(5)–2 (5)–3
3.1.1 Example of Basic Combination

**Straight axis**

Example of laterally arranged flexible duct (between X- and Y-axes)

**Point** For the precautions on flexible duct connection, see Para. 2.6.
3.2 BE50–BE30 (X–Y) Combination

Installation procedures (when the flexible duct is used)

(1) Install the 1st axis (actuator).
(2) Mount the angle bracket.
(3) Mount the 2nd axis (actuator).
(4) Mount the CN box.
(5) Prepare the flexible duct of an appropriate length. Pass the required parts through the cables, then pass the cables through the duct.
(6) Secure the cables in turn, starting from the Y-axis (2nd axis) motor side.
(7) Secure the cables with band (Insulock).
(8) Mount the CN box cover.

Point For details, see Section 2.
Installation procedures (when the flexible tube is used)

(1) Install the 1st axis (actuator).
(2) Mount the angle bracket.
(3) Mount the 2nd axis (actuator).
(4) Mount the CN box.
(5) Cut the flexible tube to an appropriate length. Pass the required parts through the cables, then pass the cables through the tube.
(6) Secure the cables in turn, starting from the Y-axis (2nd axis) motor side.
(7) Secure the cables with band (Insulock).
(8) Mount the CN box cover.

Point For details, see Section 2.
3.2.1 Example of Basic Combination

**Straight axis**

Example of laterally arranged flexible duct (between X- and Y-axes)

**Example of horizontally arranged flexible tube**

**Points**

- For the precautions on flexible duct connection, see Para. 2.6.
- For the precautions on flexible tube connection, see Para. 2.5.
Section 4  Maintenance and Inspection

4.1  Cautions on Maintenance and Inspection

(1)  Cautions on maintenance and inspection
When performing inspection and maintenance, observe the following matters.

1.  Maintenance and inspection of the robot should be performed only by a qualified person well versed in the knowledge and having experiences. Unless such a person is present, consult with the manufacturer to take necessary measures such as having the relevant work done by the manufacturer or having the customer's responsible persons trained for the work by the manufacturer.

2.  Use an appropriate illumination.

3.  Put a tag showing "Under inspection (or maintenance)" on the start switch, etc., equipped on the stationary operation panel. When entering the fence or premises, lock the power switch which is turned off to completely cut off the power. If the safety plug is attached to the entry of the fence or premises, carry it with you.

4.  When you have to enter the fence or premises for inspection or maintenance of the control circuit, be sure to shut off the drive power source beforehand.

5.  When you have to operate the industrial robot for inspection or maintenance inside the fence or premises, it is recommended to take the measures prescribed below.
   •  The work should be performed by two (2) persons. That is, when one person executes the work, the other person keeps a watch.
   •  The robot speed is desirably such that can avoid contact with the worker should the robot move unexpectedly. Determine the appropriate speed according to the work to be done.
   •  During the work, take careful precautions on the robot motions. If the robot has not moved just as you intended, immediately press the EMERGENCY STOP pushbutton switch.
6. Before disassembling the air pressure gage, etc., or replacing the part, release the residual pressure from the cylinder.

7. When disassembling the hydraulic or pneumatic circuit or replacing the part, take utmost care not to allow adhesion or entry of contaminant.

(2) Measures to be taken at the end of inspection and maintenance

1. Persons in charge of inspection and maintenance should return all tools to the predetermined place after the work has finished.

2. After the maintenance, be sure to test-run the equipment for confirmation. In principle, the test-run for confirmation should be performed from outside the fence or premises.

3. After the work in Item 2 above has been performed, persons responsible for inspection and maintenance should report their manager that the inspection or maintenance has completed.

4.2 Inspection before Starting Operation

(1) Before starting the robot operation, perform check on the following matters.

1. Function of control unit.

2. Function of emergency stop switch.

3. Function of robot interlock with equipment for preventing contact.

4. Function of robot interlock with related equipment.

5. Damage of external power supply, piping, etc.

6. Abnormality of supply voltage, supply hydraulic pressure and supply pressure.

7. Nonconformity of operation.

8. Abnormal noise and abnormal vibration.

9. Condition of equipment for preventing contact.

(2) Execute the inspection outside the working envelope, where possible.
4.3 Regular Inspection

Determine the inspection standard including the check items, method, criteria for evaluation and time of execution for the following items, considering the robot installation place, frequency of use and durability of parts, then execute the inspection according to the same standard.

1. Looseness of main parts.
2. Lubrication state of movable parts and other abnormality of movable parts.
3. Abnormality of power transmission parts.
4. Abnormality of hydraulic and pneumatic circuits.
5. Abnormality of electric circuit.
6. Abnormality of function detecting a motion error.
7. Abnormality of encoder.
8. Abnormality of servo system.

[Check points of controller]
9. Make sure that the supply voltage to the controller falls under the predetermined range (i.e., rated voltage ±10%).
10. Check for the air vent holes on the controller, and remove contaminant if any left on them.
11. Check for the controller cable (running from the controller to the actuator) and make sure that all screws, etc., are tightened completely.
12. Make sure that the controller set screws, etc., are tightened completely.
13. Check for each connector (motor output connector, encoder input connector, teach pendant connector) and make sure that they are tightened completely, not causing gap.
4.3.1 Inspection of Timing Belt

The timing belt should be inspected every 500 hours of operation.

- Check the belt for deterioration, fatigue, scratch, etc., and replace it immediately if any abnormality is found, referring to Para. 4.4 of the appropriate actuator instruction manual provided separately.

- When using the side mounted motor axis with brake for vertical use (as the Z-axis), strictly observe the following matters.

  1. **Be sure to replace the belt on a regular basis within 3,000 hours of operation.**

  2. The service life of the belt is largely affected by the working environment and conditions. If any abnormality is found during inspection, replace the belt immediately.

⚠️ **CAUTION**

If the belt has snapped while it was used vertically, it is very dangerous. To avoid this, replace the belt at an early stage.
4.4 Lubricating Each Part

For lubrication method, please refer to each actuator instruction manual.

4.5 Cleaning

For cleaning of each part, please refer to each actuator instruction manual.

4.6 Spare Parts

For spare parts of the actuator, please refer to each actuator instruction manual.
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      http://www.tmrobotics.com
      http://www.tmrobotics.co.uk

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