EPSON

Industrial Robot: SCARA Robots
LA-A series Manual

Original instructions

Rev.2
ENM259R7821F

Table of Contents

1. FOREWORD

1.1 Introduction

Thank you for purchasing this Epson robot system. This manual provides the information necessary for correctly using the robot system.
Before using the system, please read this manual and related manuals to ensure correct use.
After reading this manual, store it in an easily accessible location for future reference.

Epson conducts rigorous testing and inspection to ensure that the performance of our robot systems meets our standards. Please note that if the Epson robot system is used outside the operating conditions described in the manual, the product will not perform up to its basic performance.

This manual describes potential hazards and problems that are foreseen. To use the Epson robot system safely and correctly, be sure to follow the safety information contained in this manual.

1.2 Trademarks

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Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.4 Manufacturer

SEIKO EPSON CORPORATION

1.5 Contact Information

Contact information details are listed in the "Supplier" section in the following manual.
Note that the contact information may vary depending on your region.
"Safety Manual - Contact Information"

The Safety Manual is also available at the following site.
URL: https://download.epson.biz/robots/

1.6 Disposal

When disposing of this product, please do so in accordance with the laws and regulations of your country.

1.7 Regarding battery disposal

The battery removal/replacement procedure is described in the following manual.

"Service Manual"

1.7.1 For Customers in the European Union

The crossed out wheeled bin label that can be found on your product indicates that this product and incorporated batteries should not be disposed of via the normal household waste stream.
To prevent adverse effects on the environment and human health, the product and its batteries should be separated from other waste and recycled in an environmentally responsible manner. Contact your local government or product distributor for information on collection facilities.
The Pb, Cd, or Hg symbol means that these metals are used in the battery.

KEY POINTS

This information only applies to customers in the European Union, according to Directive 2006/66/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC and legislation transposing and implementing it into the various national legal systems, and to customers in countries in Europe, Middle East and Africa (EMEA) where they have implemented equivalent regulations.

For information on recycling products in other countries, please contact your local government.

1.7.2 For Customers in the Taiwan Region

Used batteries should be separated from other waste and recycled in an environmentally responsible manner. Contact your local government or product distributor for information on collection facilities.

1.8 Before Reading this Manual

This section describes what you should know before reading this manual.

1.8.1 Structure of the Control System

The LA-A series Manipulator is made up of a combination of the following Controller and software.

- Controller: RC800L
- Software: EPSON RC+ 8.0 or later

1.8.2 Turning ON/OFF Controller

When you see the instruction “Turn ON/OFF the Controller” in this manual, be sure to turn ON/OFF all the hardware components of your Controller.

For the Controller composition, refer to the following.

Structure of the Control System

1.8.3 Setting by Using Software

This manual contains setup procedures using the software. They are indicated by the following symbol.

1.8.4 Pictures in this Manual

Pictures and illustrations of the manipulator in this manual may differ from the Manipulator you are using, depending on the shipment date and the specifications.

1.9 The Manuals of This Product

The following are typical manual types for this product and an outline of the descriptions.

Safety Manual

This manual contains safety information for all people who handle this product. The manual also describes the process from unpacking to operation and the manual you should look at next.

Read this manual first.

- Safety precautions regarding robot system and residual risk
- Declaration of conformity
- Training
- Flow from unpacking to operation

RC800L series Manual

This manual explains the installation of the entire robot system and the specifications and functions of the Controller. It is primarily intended for people who design robot systems.

- The installation procedure of the robot system (specific details from unpacking to operation)
- Daily inspection of the Controller
- Controller specifications and basic functions

LA-A series Manual

This manual describes the specifications and functions of the Manipulator. It is primarily intended for people who design robot systems.

- Technical information, functions, specifications, etc. required for the installation and design of the Manipulator.
- Daily inspection of the Manipulator

Status Code/Error Code List

This manual contains a list of code numbers displayed on the Controller and messages displayed in the software message area. The manual is primarily intended for people who design robot systems or do programming.

Epson RC+ 8.0 User's Guide

This manual describes general information about program development software.

Epson RC+ SPEL+ Language Reference

This manual describes the robot programming language "SPEL+".

Other Manual

Manuals for each option are available.

Maintenance and servicing manuals

Manuals for maintenance and servicing are not included with the product.

Maintenance should be performed by people who have received maintenance training provided by Epson and the suppliers. For more information, please contact the supplier.

2. LA3-A , LA6-A Manipulators

This volume contains information for setup and operation of the Manipulators.

Please read this volume thoroughly before setting up and operating the Manipulators.

2.1 Safety

The Manipulator and its related equipment should be unpacked and transported by people who have received installation training provided by Epson and the suppliers. Also, the laws and regulations of the installation country must be followed.

Before use, please read this manual and other related manuals to ensure correct use. After reading this manual, store it in an easily accessible location for future reference.

This product is intended for transporting and assembling parts in a safely isolated area.

2.1.1 Conventions

The following symbols are used in this manual to indicate important safety information. Be sure to read the descriptions shown with each symbol.

⚠ WARNING

This symbol indicates an imminently hazardous situation which, if operation is not performed properly, will result in death or serious injury.

⚠ WARNING

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, could result in an injury due to electric shock.

⚠ CAUTION

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, may result in a minor or moderate injury or in property damage only.

2.1.2 Design and Installation Safety

The robot system should be designed and installed by people who have received installation training provided by Epson and the suppliers.

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the following.

Safeguard (SG)

The following items are safety precautions for design personnel.

⚠ WARNING

- Personnel who design and/or construct the robot system with this product must read the “Safety Manual” to understand the safety requirements before designing and/or constructing the robot system. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, may result in serious bodily injury and/or severe equipment damage to the robot system, and may cause serious safety problems.

- The Manipulator and the Controller must be used within the environmental conditions described in their respective manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life cycle of the product but may also cause serious safety problems.
- The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems.
- When designing or installing a robot system, wear at least the following protective gear. Working without protective gear may cause serious safety problems.
  - Work clothes suitable for work
  - Helmet
  - Safety shoes
- There are no lights linked to Motor ON on the Manipulator. Use the Controller's output signal function to install the lights within the device.

  For details, refer to the following manual.

  "Robot Controller RC800L - Outputs"

Further precautions for installation are mentioned in the following.

Environment and Installation

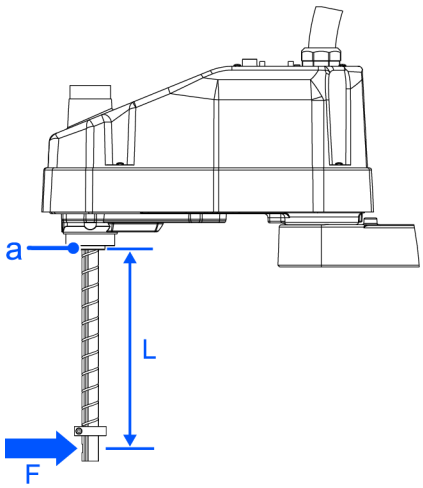
Please read this chapter carefully to understand safe installation procedures before installing the robots and robotic equipment.

2.1.2.1 Strength of the Ball Screw Spline

If a load exceeding the allowable value is applied to the ball screw spline, it may not work properly due to deformation or breakage of the shaft.

If a load exceeding the allowable value is applied to the ball screw spline, the ball screw spline unit must be replaced.

The allowable load varies depending on the distance over which the load is applied. For calculating the allowable load, see the calculation formula below.



Symbol	Description
a	End of the spline nut

Allowable bending moment

- LA3-A: M=13,000 N·mm
- LA6-A: M=27,000 N·mm

Moment

M=F·L＝100·100＝10,000 N·mm

Example:

If 100 N (10.2kgf) load is applied at 100 mm from the end of the spline nut

2.1.3 Operation Safety

The following items are safety precautions for qualified Operator personnel:

⚠ WARNING

- Please carefully read the Safety Requirements in the “Safety Manual” before operating the robot system. Operating the robot system without understanding the safety requirements is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.
- Do not enter the operating area of the Manipulator while the power to the robot system is turned ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even if it seems to be stopped.
- Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speed and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly.
- Immediately press the Emergency Stop switch whenever the Manipulator moves abnormally while the robot system is operated. Continuing the operation while the Manipulator moves abnormally is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system.

⚠ WARNING

- To shut off power to the robot system, disconnect the power plug from the power source or use a disconnector. Be sure to connect the AC power cable to either a power receptacle or a disconnector. DO NOT connect it directly to a factory power source.
- Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

- Do not connect or disconnect the motor connectors while the power to the robot system is turned ON. The Manipulator may move abnormally and be extremely hazardous Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.

⚠ CAUTION

- As a general rule, the robot system should be operated by only one person. If it is necessary to operate with more than one person, ensure that all personnel communicate with each other and take all necessary safety precautions.
- Joint #1, #2, and #4: If the Manipulator is operated repeatedly with an operating angle of 5° or less, the bearings used in the joints are likely to cause an oil film shortage. Repeated operation may cause premature damage. To prevent premature damage, operate the Manipulator to move each joint to an angle of 50° or more about once per hour.
  - Joint #3: If the up-and-down motion of the hand is less than 32 mm for LA3-A and less than 40 mm for LA6-A, move the joint a half or more of its maximum stroke for about once per hour.
- When the robot is operating at low speed (Speed: 5 to 20%), vibration (resonance) may occur continuously during operation depending on the combination of the arm orientation and hand load. Vibration occurs due to the natural vibration frequency of the Arm and can be controlled by taking the following measures:
  - Changing the Manipulator's speed
  - Changing the teach points
  - Changing the hand load

2.1.4 Emergency Stop

Each robot system needs equipment that will allow the operator to immediately stop the system's operation. Install an emergency stop device by using emergency stop input from the Controller or other equipment.

Before using the emergency stop switch, be aware of the following points.

- The emergency stop switch should be used to stop the Manipulator only in case of emergencies.
- Besides pressing the emergency stop switch when an emergency occurs, to stop the Manipulator during program operation, use the Pause or STOP (program stop) statements assigned to a standard I/O.
  The Pause and STOP statements do not turn off motor energization, and so the brake is not locked.

To place the robot system in emergency stop mode in a non-emergency (normal) situation, press the emergency stop switch while the Manipulator is not operating.

Do not press the emergency stop switch unnecessarily while the Manipulator is operating normally.

It could shorten the lifespan of the following components.

- Brakes
  The brakes will be locked, which will shorten the lifespan of the brakes due to worn brake friction plates.
  - Normal brake lifespan:
    About 2 years (when the brakes are used 100 times/day)
    or about 20,000 times
- Reduction gears
  An emergency stop applies an impact to the reduction gear, which can shorten its life.

If the Manipulator is stopped by turning off the Controller while it is operating, the following problems may occur.

- Reduced life and damage to reduction gear

- Position shift at the joints

If a power outage or other unavoidable Controller power-off occurs during Manipulator operation, check the following points after power is restored.

- Damage in reduction gear
- Shifting of the joints from their proper positions

If there was any shifting, maintenance is required. For more information, please contact the supplier.

Stopping distance of emergency stop

The Manipulator during operation cannot stop immediately after the emergency stop switch is pressed. Also, the stopping time and movement distance vary depending on the following factors.

- Hand weight, WEIGHT setting, ACCEL setting, workpiece weight, SPEED setting, movement posture, etc.

For the stopping time and movement distance of the Manipulator, refer to the following section.

Appendix C: Stopping Time and Stopping Distance When Safeguard is Open

2.1.5 Safeguard (SG)

The term "safeguard" as used in this manual refers to a safety device with an interlock that allows entry into the safety barriers.

Specifically, this includes safety door switches, safety barriers, light curtains, safety gates, safety floor mats, and so on.

The safeguard is an input that informs the Robot Controller that an operator may be inside the safeguard area.

You must assign at least one Safeguard (SG) in Safety Function Manager.

When the safeguard is opened, Protective Stop operates to change to the safeguard open state (display: SO).

- Safeguard open

  Operations are prohibited. Further robot operation is not possible until either the safeguard is closed, the latched state is released, and a command is executed, or the TEACH operation mode is turned on and the enable circuit is activated.

- Safeguard closed

  The robot can operate automatically in an unrestricted (high power) state.

⚠ WARNING

- If a third party accidentally releases the safeguard while an operator is working inside the safety barriers, this may result in a hazardous situation. To protect the operator working inside the safety barriers, implement measures to lock out or tag out the latch release switch.
- To protect operators working near the robot, be sure to connect a safeguard switch and make sure that it works properly.

Installing safety barriers

Carefully take into account the size of the hand and the workpieces to be held so that no interference occurs between the operating parts and the safety barriers.

Installing safeguards

Design the safeguards so that they satisfy the following requirements:

- When using a key switch type safety device, use a switch that forcibly opens the interlock contacts. Do not use switches that open their contacts using the spring force of the interlock.
- When using an interlock mechanism, do not disable the interlock mechanism.

Considering the stopping distance

During operation, the Manipulator cannot stop immediately even if the safeguard is opened. Also, the stopping time and movement distance vary depending on the following factors.

- Hand weight, WEIGHT setting, ACCEL setting, workpiece weight, SPEED setting, movement posture, etc.

For the stopping time and movement distance of the Manipulator, refer to the following section.

Appendix C: Stopping Time and Stopping Distance When Safeguard is Open

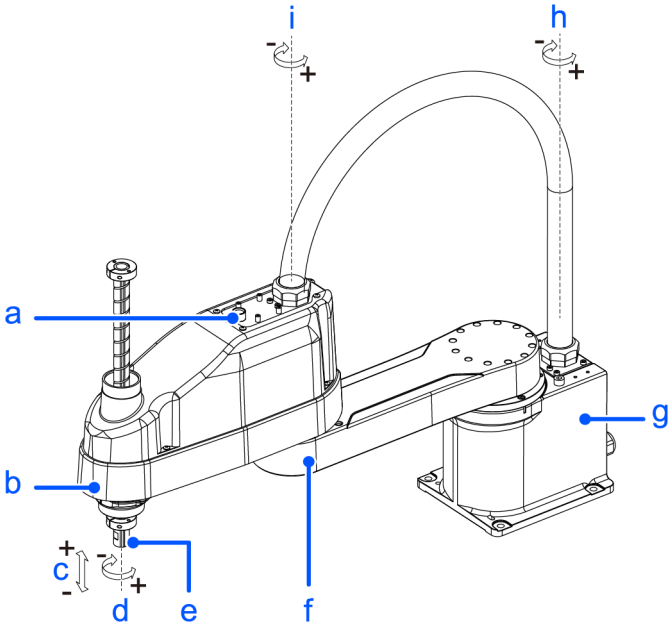
Precautions for safeguard operation

Do not open the safeguard unnecessarily while the motor is energized. Frequent safeguard inputs will reduce the life of the relay.

- Normal relay lifespan: Approximately 20,000 times

2.1.6 Arm Movement Method in the Emergency Stop State

When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:



(Figure: LA6-A602S)

Symbol	Description
a	Joint #3 brake release switch
b	Arm #2
c	Joint #3 (up and down)
d	Joint #4 (rotating)
e	Shaft

Symbol	Description
f	Arm #1
g	Base
h	Joint #1 (rotating)
i	Joint #2 (rotating)

- Arm #1: Push the arm by hand.
- Arm #2: Push the arm by hand.
- Joint #3: The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the Arm while pressing down the brake release switch.
- Joint #4: Rotate the shaft by hand.

KEY POINTS

When the brake release switch is pressed in emergency mode, the brake for Joint #3 is released. Be careful of the shaft falling and rotating while the brake release switch is pressed because the shaft and the support shaft may be lowered by the weight of an end effector.

2.1.7 ACCELS Setting for CP Motions

To make the Manipulator move in a CP motion, make the appropriate ACCELS settings in the SPEL program based on the tip load and Z-axis height.

KEY POINTS

If the ACCELS settings are not properly configured, the following problem occurs.

- Shortened lifespan and damage to the ball screw spline
- Stop with error (Error code: 4002)

Set ACCELS as shown below based on the Z-axis height.

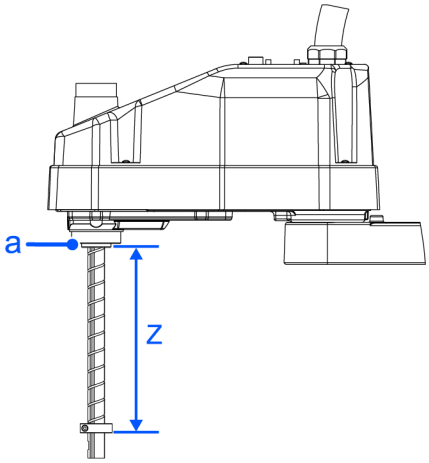
Maximum ACCELS correction values by Z-axis height and tip load

- LA3-A

Z-axis height (mm)	Tip load
	3kg or less
0>=Z >= - 150	25000 or less

- LA6-A

Z-axis height (mm)	Tip load	
	4kg or less	6kg or less
0>=Z >= - 150	25000 or less	25000 or less
- 150 > Z >= - 200		23000 or less



Symbol	Description
a	Z-axis height 0 (Origin position)

If the Manipulator is operated in CP motion with the wrong set values, make sure to check the following.

- No deformation or bending of the shaft of the ball screw spline

2.1.8 Warning Labels

The Manipulator has the following warning labels. Specific hazards exist in the vicinity of areas with the warning labels. Be thoroughly careful in handling. To ensure that the Manipulator is operated and maintained safely, be sure to follow the safety information and warnings indicated on the warning labels. Also, do not tear, damage, or remove these warning labels.

A

Touching any internal electrified parts while the power is turned on may cause electric shock.

****B**

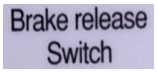
The surface of the Manipulator is very hot during and after operation which can cause for you to get burnt.

1

This indicates the product name, model name, serial number, information of supported laws and regulations, product specifications, manufacturer, importer, date of manufacture, country of manufacture, and the like.

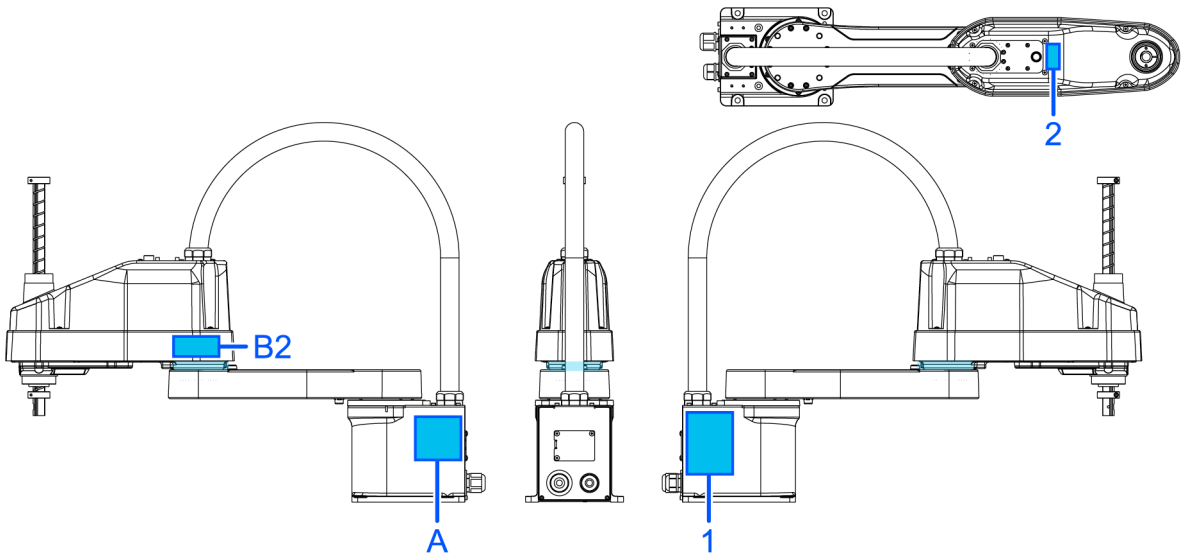
For details, see the label affixed to the product.

2



Indicates the position of the brake release switch

Labeled Locations



2.1.9 Responses for Emergencies or Malfunctions

2.1.9.1 Collision

If the Manipulator has collided with a mechanical stop, peripheral device, or other object, discontinue use and contact the supplier.

2.1.9.2 Getting body caught in Manipulator

When the operator is caught between the Manipulator and a mechanical part such as a base table, press the emergency stop switch to release the brake on the subject arm, and then move the arm by hand.

For details, refer to the following section.

Arm Movement Method in the Emergency Stop State

- Get body caught in the arms:

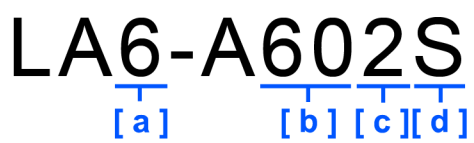
  The break is not working. Move the arms manually.

- Get body caught in the shafts:

  The break is working. Press the brake release switch and move the shafts.

2.2 Specifications

2.2.1 Model number



- a: Payload
  - 3: 3 kg
  - 6: 6 kg
- b: Arm length
  - 40: 400 mm
  - 50: 500 mm
  - 60: 600 mm
  - 70: 700 mm
- c: Joint #3 stroke
  - 1: 150 mm
  - 2: 200 mm
- D: Environment
  - S: Standard

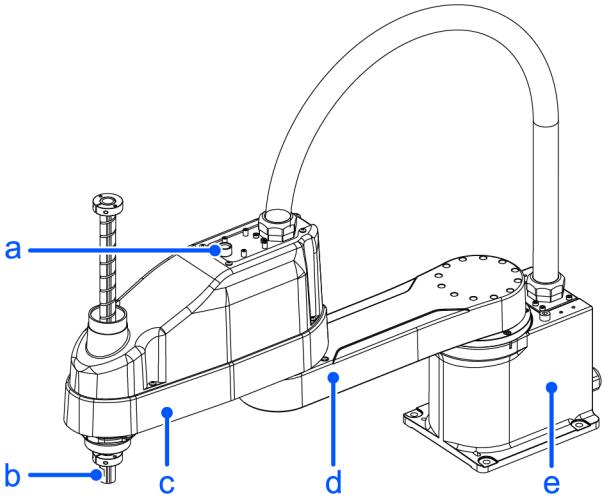
For details on the specifications, refer to the following.

Stopping time and Stopping distance in Emergency

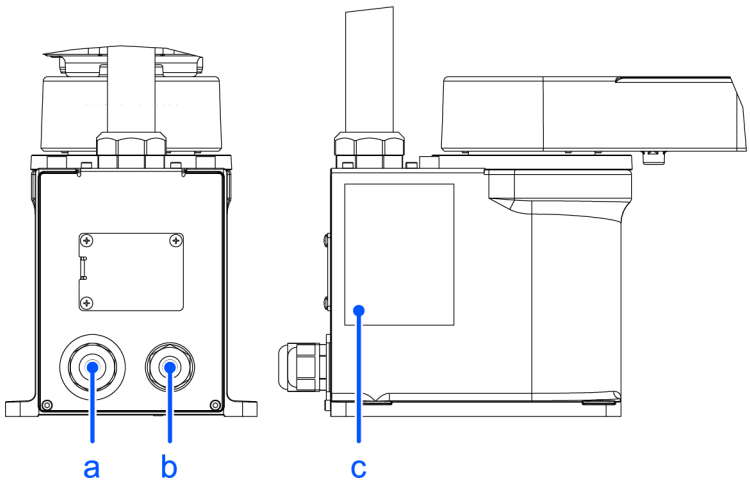
List of Models

Model number	Payload	Arm length	Joint #3 Stroke	Environment
LA3-A401S	3 kg	400 mm	150 mm	Standard
LA6-A502S	6 kg	500 mm	200 mm	
LA6-A602S		600 mm		
LA6-A702S		700 mm		

2.2.2 Part Names and Outer Dimensions



Symbol	Description
a	Joint #3 brake release switch
b	Shaft
c	Arm #2
d	Arm #1
e	Base



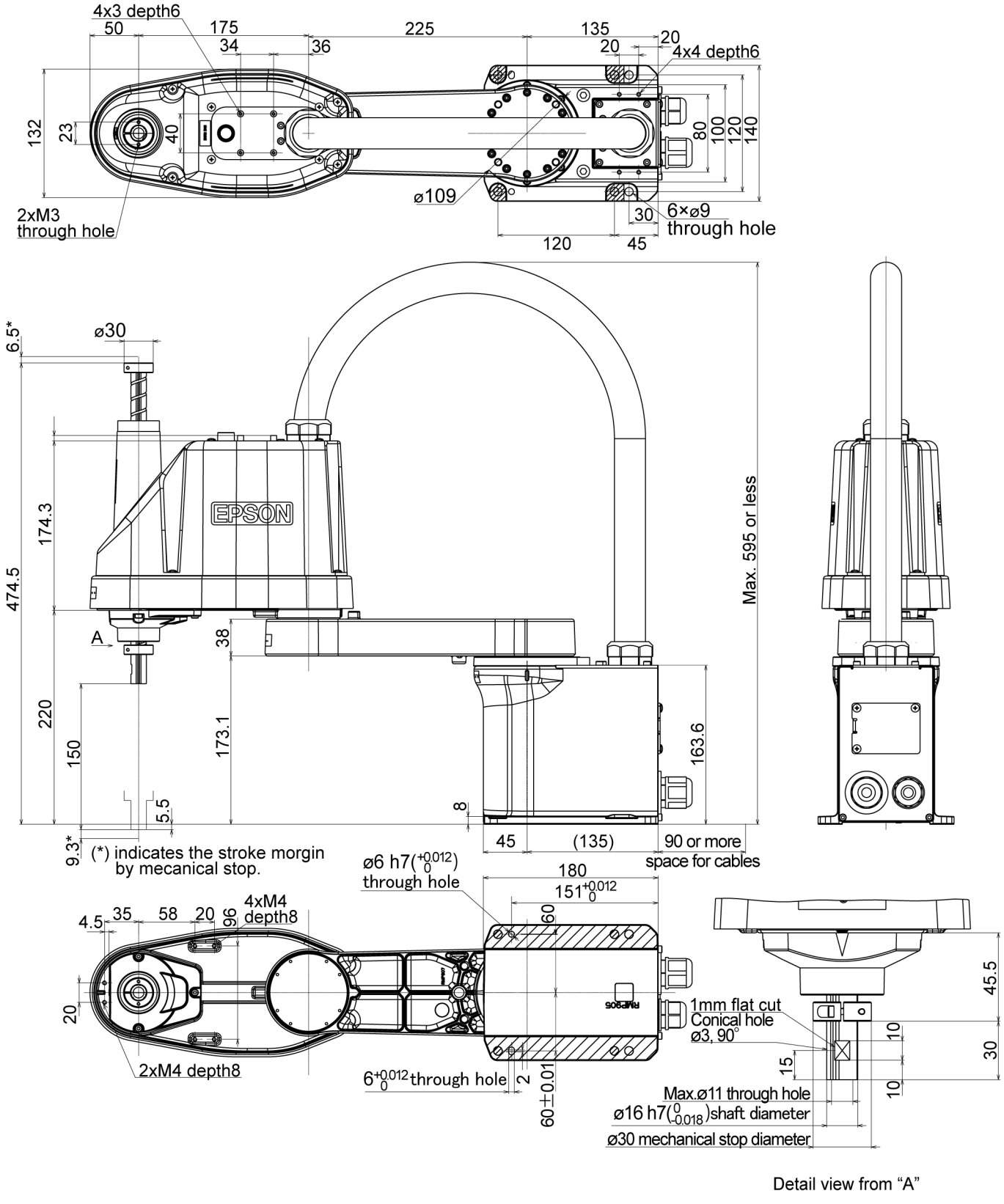
Symbol	Description
a	Signal cable

Symbol	Description
b	Power cable
c	Face plate (serial number of Manipulator)

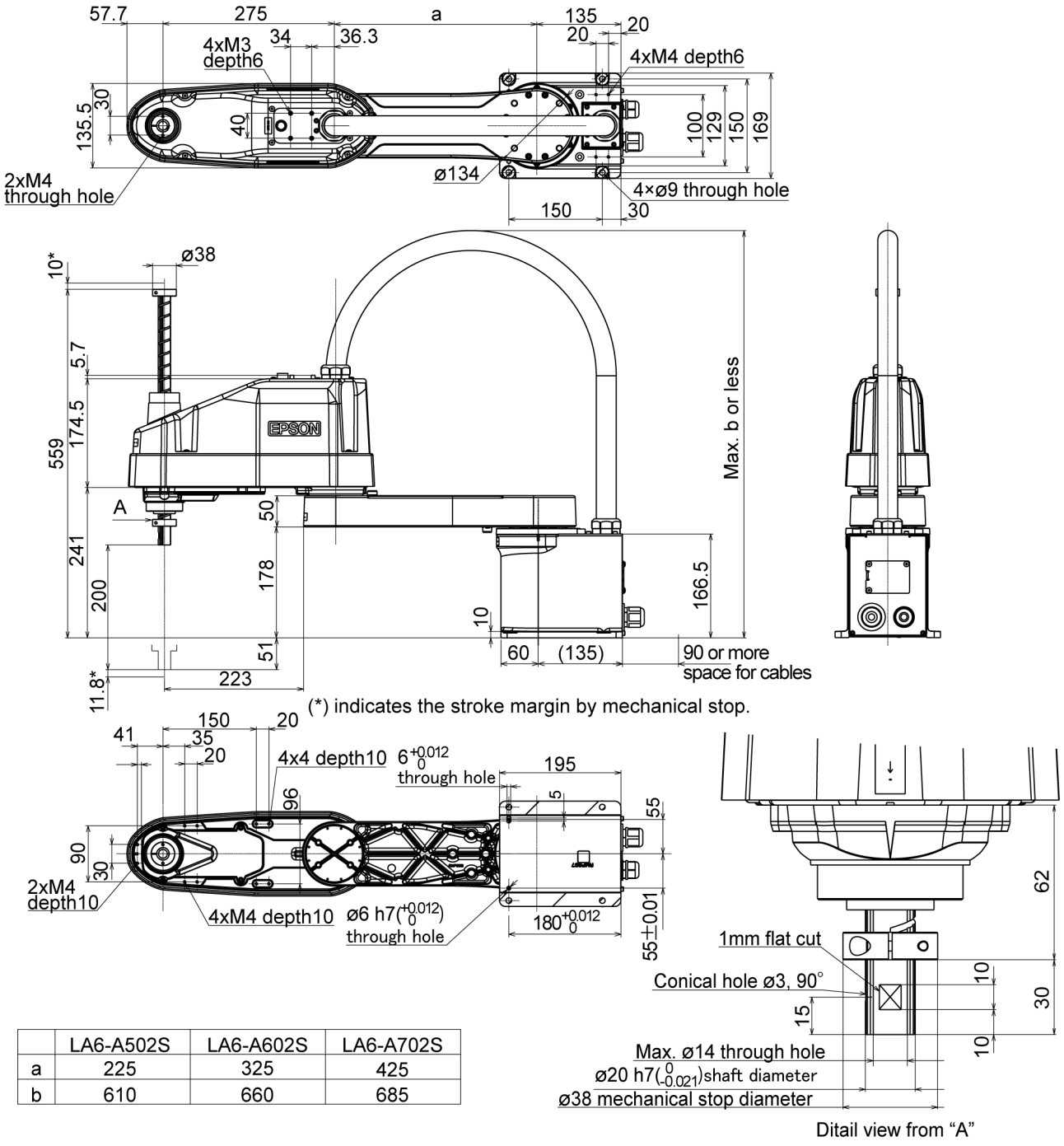
KEY POINTS

- When the brake release switch is pressed in emergency mode, the brake for Joint #3 is released.
- Performing any work with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. Make sure to turn OFF the controller power before maintenance work.

LA3-A


4x3 depth6
50
175
225
135
20
34
36
20
4x4 depth6
132
23
40
80
100
120
140
ø109
2xM3
through hole
30
6×ø9
through hole
120
45
6.5*
ø30
EPSON
474.5
174.3
220
150
A
38
173.1
163.6
8
5.5
9.3*
(*) indicates the stroke morgin
by mecanical stop.
Max. 595 or less
45
(135)
90 or more
space for cables
ø6 h7(+0.012 0)
through hole
180
151+0.012 0
60
4xM4
depth8
4.5
35
58
20
96
20
2xM4 depth8
6+0.012 0 through hole
2
60±0.01
1mm flat cut
Conical hole
ø3, 90°
45.5
30
10
15
10
Max.ø11 through hole
ø16 h7(0 -0.018)shaft diameter
ø30 mechanical stop diameter
Detail view from “A”

LA6-A



	LA6-A502S	LA6-A602S	LA6-A702S
a	225	325	425
b	610	660	685

2.2.3 Specification table

For details on the specifications of each model, refer to the following:

Appendix B: Stopping Time and Stopping Distance at Emergency Stop

2.2.4 How to Set the Model

The Manipulator model for your system has been set before shipment from the factory.

⚠ CAUTION

- If changing the setting of the Manipulator model, be responsible and absolutely certain that the wrong Manipulator model is not set. Incorrect setting of the Manipulator model may result in abnormal or no operation by the Manipulator and could even cause safety problems.

If a custom specifications number (MT***) or (X***) is written on the face plate (serial number label), the Manipulator has custom specifications.

Models with custom specifications may require a different setting procedure. Check the custom specifications number, and contact the supplier for more information.

The Manipulator model is set from software. For details, refer to the following manual.
"Epson RC+ User's Guide - Robot Configuration"

2.3 Environment and Installation

The robot system should be designed and installed by people who have received installation training provided by Epson and the suppliers. Also, the laws and regulations of the installation country must be followed.

2.3.1 Environment

A suitable environment is necessary for the robot system to function properly and safely. Be sure to install the robot system in an environment that meets the following conditions:

Item	Conditions
Ambient Temperature *	5 to 40°C
Ambient relative humidity	10 to 80 % (no condensation)
Fast transient burst noise	1 kV or less (Signal wire)
Electrostatic noise	4 kV or less
Altitude	1000 m or lower
Environment	■ Install indoors ■ Keep away from direct sunlight ■ Keep away from dust, oily smoke, salinity, metal powder and other contaminants ■ Keep away from flammable or corrosive solvents and gases ■ Keep away from water ■ Keep away from shock or vibration ■ Keep away from sources of electric noise ■ Keep away from explosive area ■ Keep away from large quantities of radiation.

* The ambient temperature conditions are for the Manipulator only. For the Controller the Manipulators are connected to, refer to the Controller Manual.

KEY POINTS

- Manipulators are not suitable for operation in harsh environments such as painting areas, etc. When using Manipulators in inadequate environments that do not meet the above conditions, please contact the supplier of your region.
- When the product is used in a low temperature environment around the minimum temperature of the product specification, or when the product is suspended for a long time on holidays or at night, a collision detection error may occur due to the large resistance of the drive unit immediately after the start of operation. In such cases, warm-up operation for about 10 minutes is recommended.

Special Environmental Conditions

Manipulator surfaces are generally oil-resistant, but if special oils are to be used, oil resistance should be checked before use. For more information, please contact the supplier.

Rapid change in temperature and humidity can cause condensation inside the Manipulator.

When handling food directly, it is necessary to make sure that the Manipulator is not likely to contaminate the food. For more information, please contact the supplier.

The Manipulator cannot be used in corrosive environments where acid or alkaline is used. In a salty environment where the rust is likely to gather, the Manipulator is susceptible to rust.

⚠ WARNING

- Always use a circuit breaker for the Controller's power supply. Failure to use a circuit breaker may result in an electrical shock hazard or malfunction due to an electrical leakage. Select the correct circuit breaker based on the Controller that you are using. For details, refer to the following manual.

  "Robot Controller Manual"

⚠ CAUTION

- When cleaning the Manipulator, do not rub it strongly with alcohol or benzene. Coated surfaces may lose their luster.

2.3.2 Base Table

Please make or obtain the base table to secure your Manipulator.

The shape and size of the base table differs depending on the use of the robot system. For your reference, we list some Manipulator table requirements here.

The base table must not only be able to bear the weight of the Manipulator but also be able to withstand the dynamic movement of the Manipulator when it operates at maximum acceleration/deceleration. Ensure that the base table has enough strength by using reinforcing materials such as crossbeams.

The torque and reaction force produced by the movement of the Manipulator are as follows:

	LA3-A	LA6-A
Max. reaction torque on the horizontal plate	250 N·m	350 N·m
Max. horizontal reaction force	1000 N	1700 N
Max. vertical reaction force	1000 N	1500 N

M8 threaded holes are used for mounting the Manipulator on the base table. Use mounting bolts with specifications conforming to ISO898-1 property class 10.9 or 12.9. For dimensions, refer to the following.

Manipulator Mounting Dimensions

The plate for the Manipulator mounting face should be 20 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 µm or less.

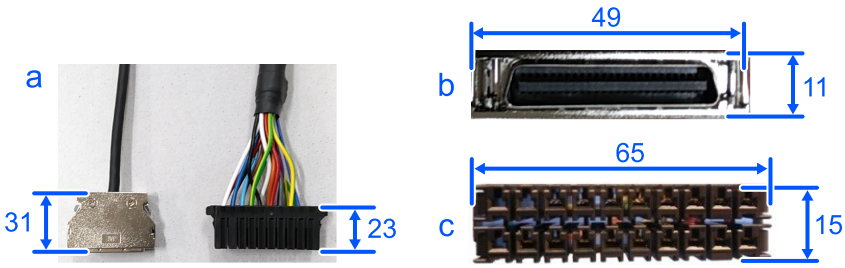
The table must be secured on the floor or wall to prevent it from moving.

The Manipulator installation surface should have a flatness of 0.5 mm or less and an inclination of 0.5° or less. If the flatness of the installation surface is improper, the base may be damaged, or the robot may not fully show its performance.

When using a leveler to adjust the height of the base table, use a screw with M16 diameter or more.

If you are passing cables through the holes on the base table, see the figures below.

(Unit : mm)



Symbol	Description
a	M/C Cables
b	Signal Cable Connector
c	Power Cable Connector

KEY POINTS

Do not remove the M/C cables from the Manipulator.

For environmental conditions regarding space when placing the Controller on the base table, refer to the Controller manual.

WARNING

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the Epson RC+ User's Guide.

2.3.3 Manipulator Mounting Dimensions

The maximum space (R) includes the radius of the end effector. If the radius of the hand exceeds 60 mm, define the radius as the distance to the outer edge of the maximum envelope. In addition to the hand, if a camera, solenoid valve, or other component attached to the arm is large, set the maximum envelope to include the range that the component may reach.

Also, besides the area required for installation of the Manipulator, Controller, peripheral equipment, and other devices, the following space should be provided at a minimum.

- Space for teaching
- Space for maintenance and inspection (Ensure some space to open the covers and plates for maintenance.)
- Space for cables

⚠ WARNING

Install the Manipulator in a location with enough space so that a tool or a workpiece tip does not reach a wall or safety barriers when the Manipulator extends its arm while holding a workpiece.

If the tool or the workpiece tip reaches a wall or safety barriers, it is extremely hazardous and may result in serious bodily injury to operators and/or severe equipment damage.

The distance between the safety barriers and the tool or workpiece should be set according to ISO 10218-2.

For the stopping time and stopping distance, refer to the following sections.

Appendix B: Stopping Time and Stopping Distance at Emergency Stop

Appendix C: Stopping Time and Stopping Distance When Safeguard is Open

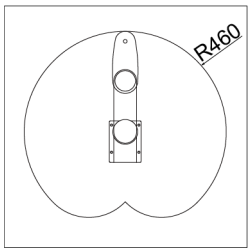
KEY POINTS

When installing the cable, be sure to maintain sufficient distance from obstacles.

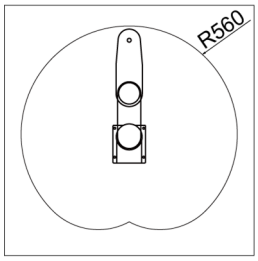
For the minimum bend radius of the MC cable, refer to the following.

Stopping time and Stopping distance in Emergency

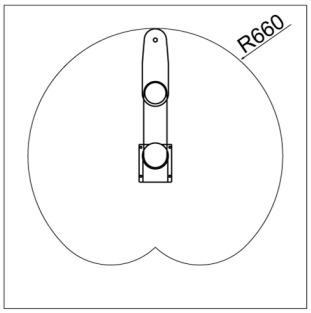
Ensure distance to the safeguard from the maximum motion range is more than 100 mm.



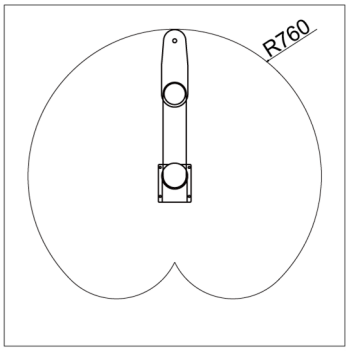
LA3-A401S



LA6-A502S



LA6-A602S



LA6-A702S

2.3.4 Unpacking and Transportation

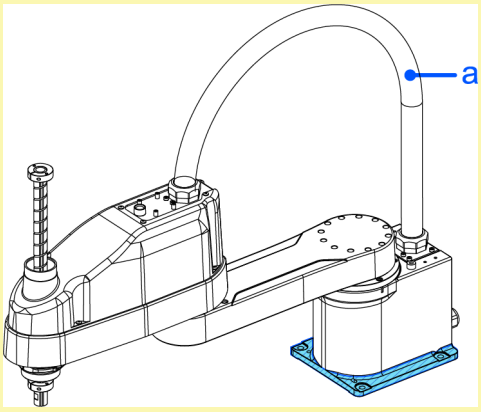
Transportation and installation of the Manipulator and related equipment should be performed by people who have received installation training provided by Epson and the suppliers. Also, the laws and regulations of the installation country must be followed.

⚠ WARNING

- Only qualified personnel should perform sling work and operate a crane or a forklift. When these operations are performed by unqualified personnel, it is extremely hazardous and may result in serious bodily injury to operators and/or severe equipment damage.
- Stabilize the Manipulator with your hands when hoisting it. If you lose balance, the Manipulator may fall which could result in serious bodily injury and/or severe equipment damage.

⚠ CAUTION

- Using a cart or similar equipment, transport the Manipulator in the same manner as it was delivered.
- After removing the fixing bolts securing the Manipulator to the transportation pallet, the Manipulator can fall. Be careful not to get your hands or feet caught in between the Manipulator.
- There are no brakes for Arm #1 and 2. Be careful not to get your hands or fingers caught.
- The Manipulator should be transported by two or more people, either secured to transporting equipment or carried by placing their hands under the shaded sections (the bottom of Arm #1 and bottom of the base). When holding the bottom of the base by hand, be extremely careful not to get your hands or fingers caught.
- Do not hold cable part (a) when transporting the Manipulator. Doing so may damage them.



(Figure: LA6-A602S)

- LA3-A401S: approx. 12 kg : 26.5 lbs. (pound)
- LA6-A502S, 602S: approx. 16 kg : 35.3 lbs. (pound)
- LA6-A702S: approx. 17 kg : 37.5 lbs. (pound)

KEY POINTS

When transporting the Manipulator for a long distance, secure it to the delivery equipment directly so that the Manipulator never falls over. If necessary, pack the Manipulator in the same style as it was delivered.

2.3.5 Installation Procedure

Installation of the Manipulator and robotic equipment shall be performed by personnel who has taken robot system training held by us and suppliers. Also, the laws and regulations of the installation country must be followed.

⚠ CAUTION

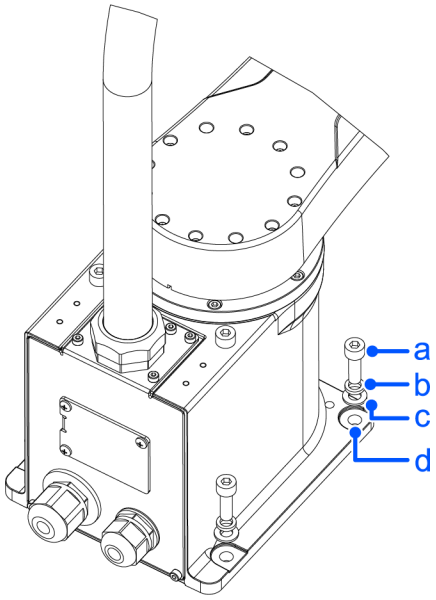
- The Manipulator must be installed in such a way that avoids interference with surrounding buildings, structures, and other machines and equipment. If not properly installed, it may collide with other machines or create a trapping hazard.
- Resonance (resonating sound or minute vibrations) may occur during Manipulator operation depending on the rigidity of the base table. If the resonance occurs, improve the rigidity of the base table or change the speed or acceleration and deceleration settings of the Manipulator.
- Install and move the Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands or feet caught or have equipment damaged due to dropping of the Manipulator.
  - LA3-A401S: approx. 12 kg : 26.5 lbs. (pound)
  - LA6-A502S, 602S: approx. 16 kg : 35.3 lbs. (pound)
  - LA6-A702S: approx. 17 kg : 37.5 lbs. (pound)

Secure the base to the base table with four bolts.

KEY POINTS

Use bolts with specifications conforming to ISO898-1 Property Class 10.9 or 12.9.

Tightening torque: 32.0 N·m (326 kgf·cm)



Symbol	Description
a	M8×25
b	Spring Washer
c	Plain Washer
d	Screw Hole

2.3.6 Connecting the Cables

⚠ WARNING

- To shut off power to the robot system, disconnect the power plug from the power source or use a disconnector. Be sure to connect the AC power cable to either a power receptacle or a disconnector. DO NOT connect it directly to a factory power source.
- Before performing any replacement procedure, turn OFF the Controller and related equipment, and then disconnect the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system.
- Be sure to connect the cables properly. Do not place heavy objects on the cables, bend them at extreme angles, pull them forcibly, or allow them to get pinched between objects. The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure.
- The Manipulator is grounded by connecting it to the Controller. Ensure that the Controller is grounded and the cables are correctly connected. If the ground wire is improperly connected to ground, it may result in the fire or electric shock.

⚠ CAUTION

- When connecting the Manipulator to the Controller, make sure that the serial numbers on each equipment match. Improper connection between the Manipulator and Controller may not only cause improper function of the robot system but also serious safety problems. The connection method between the Manipulator and the Controller varies depending on the Controller. For details on the specifications, refer to the Controller manual.
- Connecting cables to the Manipulator shall be performed by personnel who has taken robot system training held by us and suppliers. This should also be performed by qualified personnel with knowledge · skills in

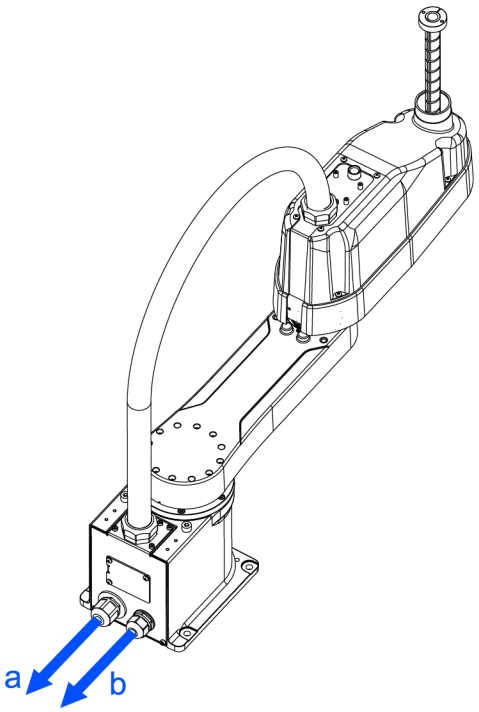
electricity. Cable connection performed by personnels without such knowledge · skill may result in injuries and malfunction.

2.3.6.1 Method to Connect the Manipulator and M/C Cable

1. To remove the back panel, remove six of the M4×10 hexagon socket head cap bolts
2. Pass the M/C cable through the back panel's hole (left) and secure it with a nut (Nut tightening torque: 8 N·m). Pay attention to the installation direction.
3. Pass the M/C cable through the back panel's hole (right) and secure it with a nut (Nut tightening torque: 8 N·m). Pay attention to the installation direction.
4. Secure three of the round terminals (PE7, FB1, FB2) to the M4×6 cross-head screw (Tightening torque: 0.9 N·m).
5. Connect the following connectors in the order shown below.
   i. CN111-1 and CN111-2
   ii. CN101-1 and CN101-2
   iii. CN201-1 and CN201-2
6. Mount a ferrite core between the cable tie of both the MC power cable (on the outside of the Manipulator) and the MC signal cable (on the inside of the Manipulator).
7. Secure the back panel with six of the M4×10 hexagon socket head cap bolts (Tightening torque: 4 N·m). Be careful not to pinch the cable.

2.3.6.2 Connecting M/C Cables and Controller

Connect the power connector and the signal connector of the M/C cable with the Controller.



Symbol	Description
a	Power Connector
b	Signal Connector

2.3.7 Relocation and Storage

2.3.7.1 Precautions for Relocation and Storage

For details on relocation, refer to the following.

Unpacking and Transportation

Transportation and installation of the Manipulator and robotic equipment shall be performed by personnel who has taken robot system training held by us and suppliers and should conform to all national and local codes. Also, the laws and regulations of the installation country must be followed.

As for transportation and storage, make sure to check the following:

- When the Manipulator is reassembled and used for a robot system again after an extended period of storage, perform a test run to verify that it works properly before starting the main operation.
- Transport and store the Manipulator in the range of Temperature: −20 to +60 °CC, Humidity: 10 to 90% (no condensation).
- If condensation has formed on the Manipulator during transportation or storage, do not turn on the power until the condensation is removed.
- Do not subject the Manipulator to excessive impacts or vibrations during the transportation process.

⚠ CAUTION

Store the Manipulator in an upright manner. When stored on its side, grease may leak.

2.3.7.2 Relocation

⚠ CAUTION

Install or relocate the Manipulator with two or more people. The Manipulator weights are as follows. Be careful not to get hands or feet caught or have equipment damaged due to dropping of the Manipulator.

- LA3-A401S: approx. 12 kg : 26.5 lbs. (pound)
- LA6-A502S, 602S: approx. 16 kg : 35.3 lbs. (pound)
- LA6-A702S: approx. 17 kg : 37.5 lbs. (pound)

1. Turn OFF the power on all devices and unplug the cables.

KEY POINTS

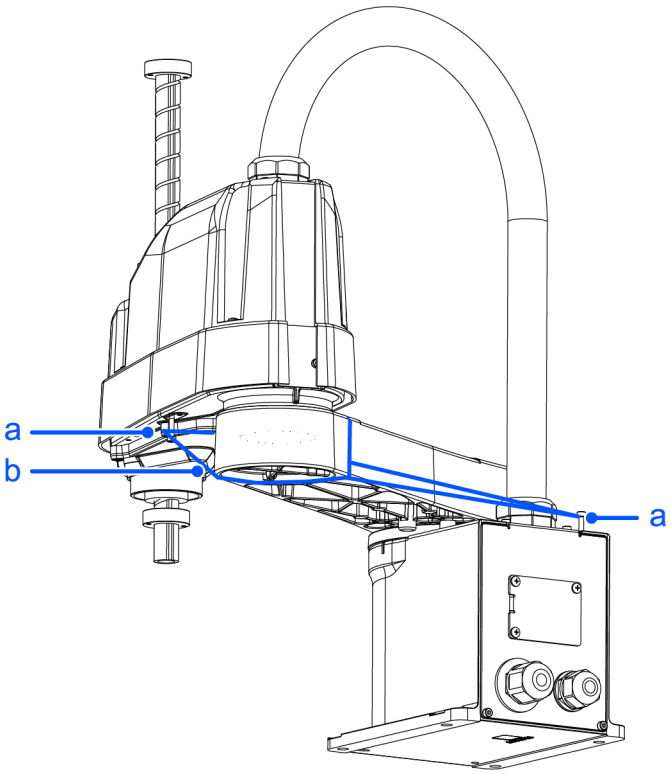
Remove the mechanical stops if using them to limit the motion range of Joints #1 and #2. For details on the motion range, refer to the following.

Motion Range Setting by Mechanical Stops

2. Cover the arm with a sheet so that the arm will not be damaged.
   Secure the arm while referring to the figure below. When fixing the arm using the shaft, fix it with adequate strength so as not to deform the spline. For details on the strength of the ball screw spline, refer to

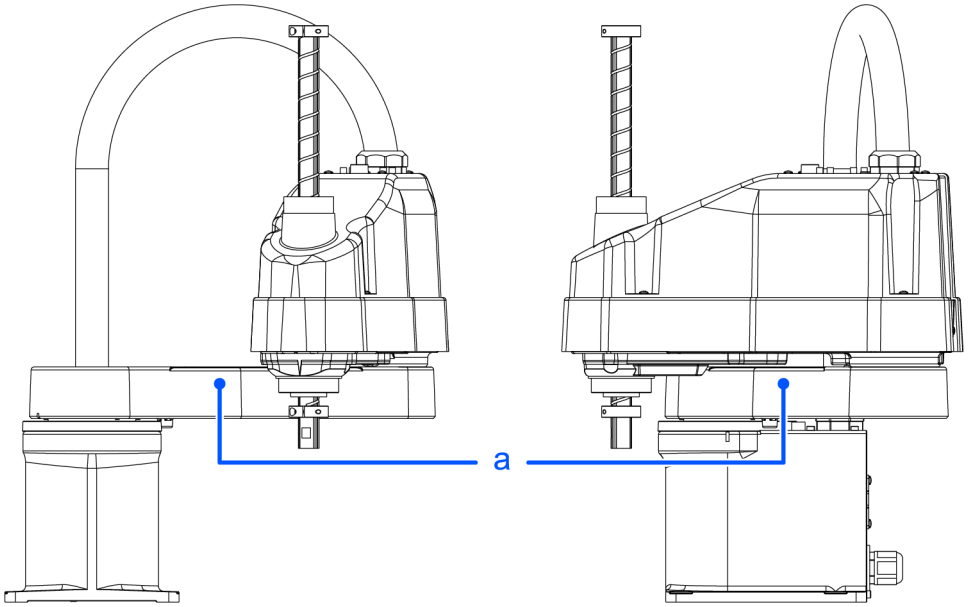
   Strength of the Ball Screw Spline

   Example of Securing the Arm



Symbol	Description
a	Bolt M4 × 20
b	Wire tie

3. Hold the bottom of Arm #1 by hand to unscrew the anchor bolts. Then, remove the Manipulator from the base table.



(Figure: LA6-A602S)

Symbol	Description
a	Center of gravity

2.4 Setting the Hand

2.4.1 Installing the Hand

Users are responsible for making their own end effector(s). Be careful of the following points when attaching an end effector. For details on attaching the hand, refer to the following manual.

"Hand Function Manual"

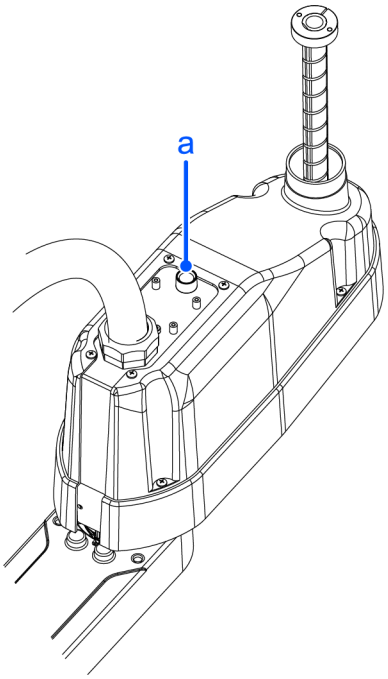
⚠ CAUTION

- If you use an end effector equipped with a gripper or chuck, connect wires and/or pneumatic tubes properly so that the gripper does not release the workpiece when the power to the robot system is turned OFF. Improper connection of the wires and/or pneumatic tubes may damage the robot system and/or work piece as the work piece is released when the Emergency Stop switch is pressed.
- I/O outputs are configured at the factory so that they are automatically shut off (0) by power disconnection, the Emergency Stop switch, or the safety features of the robot system. However, the I/O set in the hand function does not turn off (0) when the Reset command is executed or in emergency stop.

Shaft

- Attach an end effector to the lower end of the shaft. For the shaft dimensions, and the overall dimensions of the Manipulator, refer to the following.
  Specifications
- Do not move the upper limit mechanical stop on the lower side of the shaft. Otherwise, when “Jump motion” is performed, the upper limit mechanical stop may hit the Manipulator, and the robot system may not function properly.
- When attaching the hand to the shaft, have the hand hold the shaft using a split muff coupling with an M4 bolt or larger screws.

Brake release switch



Symbol	Description
a	Brake release switch

Shaft may be lowered by the weight of the end effector.

- Joint #3 cannot be moved up/down by hand because the electromagnetic brake is applied to the joint while power to the robot system is turned OFF. This prevents the shaft from hitting peripheral equipment in the case that the shaft is lowered by the weight of the end effector when the power is disconnected during operation, or when the motor is turned OFF even though the power is turned ON.

  To rotate Joint #3 up/down while attaching an end effector, turn ON the Controller and press the brake release switch. This button switch is a momentary-type; the brake is released only while the button switch is being pressed

- Be careful of the shaft falling and rotating while the brake release switch is pressed because the shaft may be lowered by the weight of the hand.

Layout

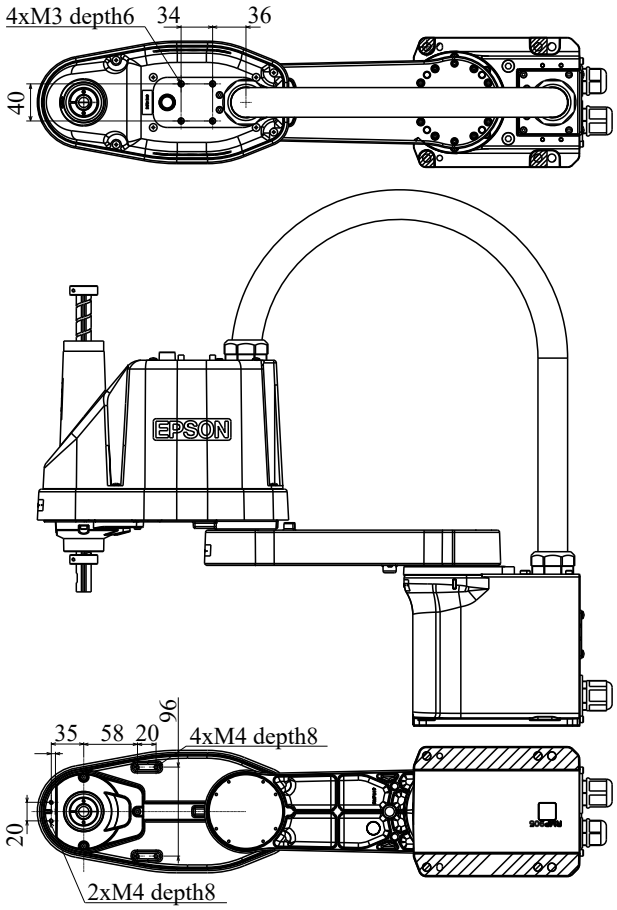
- When attaching and operating a hand, the hand may come into contact with the Manipulator body due to the outer diameter of the hand, the size of the workpiece, or the position of the arm. Carefully consider the interference area of the hand when designing the system layout.

2.4.2 Attaching Cameras and Valves

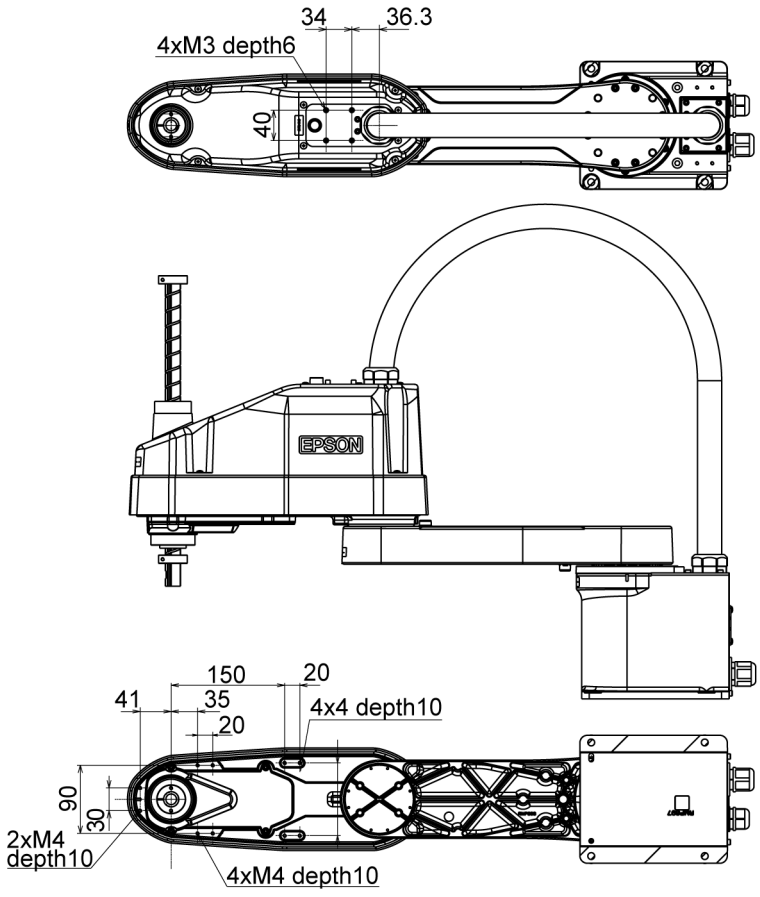
Arm #2 has threaded holes as shown in the figure below. When attaching cameras and valves, attach them to the mounting hole with a bracket as shown in the figure below.

(Unit : mm)

LA3-A


4xM3 depth6
34
36
40
EPSON
96
35
58
20
4xM4 depth8
20
2xM4 depth8

LA6-A


34
36.3
4xM3 depth6
40
EPSON
150
20
41
35
20
4x4 depth10
90
30
2xM4
depth10
4xM4 depth10

2.4.3 Weight and Inertia Settings

To ensure optimum Manipulator performance, it is important to make sure that the load (weight of the end effector and workpiece) and moment of inertia of the load are within the maximum rating for the Manipulator, and that Joint #4 does not become eccentric. If the load or moment of inertia exceeds the rating or if the load becomes eccentric, follow the steps below to set parameters.

- **Weight Setting**
- **Inertia Setting**

Setting parameters makes the PTP motion of the Manipulator optimal, reduces vibration to shorten the operating time, and improves the capacity for larger loads. In addition, it reduces persistent vibration produced when the moment of inertia of the end effector and work piece is larger than the default setting.

It can also be set from “Weight, Inertia, and Eccentricity/Offset Measurement”. For details, refer to the following manual.

“Epson RC+ User’s Guide - Weight, Inertia, and Eccentricity/Offset Measurement Utility”

2.4.3.1 Weight Setting

⚠ CAUTION

The total weight of the hand and the workpiece must not exceed 3 kg for LA3-A and 6 kg for LA6-A. The LA-A series is not designed to work with loads exceeding the weight mentioned. Always set the value according to the load. Setting a value that is smaller than the actual load may cause errors, shock and insufficient function of the Manipulator. Also, the life cycle of parts will shorten and belt tooth jumping will occur which will lead to position shift.

The acceptable weight capacity (hand weight and workpiece weight)

- LA3-A: Max.3 kg
- LA6-A: Max.6 kg

If the load weight exceeds the rated weight, change the setting for the hand weight parameter in the Weight command. After the setting is changed, the maximum speed and acceleration/deceleration of the Manipulator during PTP motion that correspond to the "Hand Weight" are corrected automatically.

2.4.3.2 Load on the Shaft

The weight of the load (hand + workpiece) attached to the shaft can be set by the "Hand Weight" parameter in the Weight statement.

Epson RC+

Enter a value into the [Weight:] text box on the [Weight] panel ([Tools]-[Robot Manager]). (You may also execute the Weight command from the [Command Window].)

2.4.3.3 Load on the Arm

When a camera, valve, or other object is attached to the arm, its weight is converted to the equivalent weight of the shaft and added to the weight of the load attached to shaft to set the "Hand Weight" parameter.

Equivalent Weight Formula

When attaching to the root of Arm #2: $W_M=M\times(L_M+L_1)^2/(L_1+L_2)^2$

When attaching to the end of Arm #2: $W_M=M\times(L_M)^2/(L_2)^2$

- W_M: equivalent weight
- M: Weight of camera etc.
- L_1: length of Arm #1
- L_2: length of Arm #2
- L_M: distance from rotation center of Joint #2 to center of gravity of the camera etc.

Calculates [Weight] parameter when a “1 kg” camera is attached to the end of the LA6-A arm (375 mm away from the rotation center of Joint #2) with a load weight of “1 kg”.

$M=1$

$L_1=325$

$L_2=275$

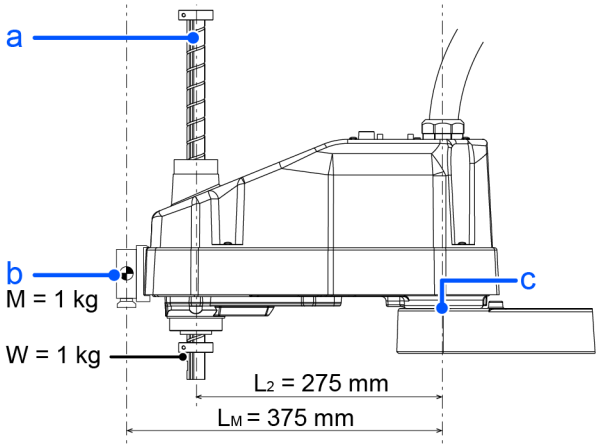
$L_M=375$

$W_M=1\times(375+325)^2/(325+275)^2=1.36$

(Round up to two decimal places)

$W+W_M=1+1.36=2.36$

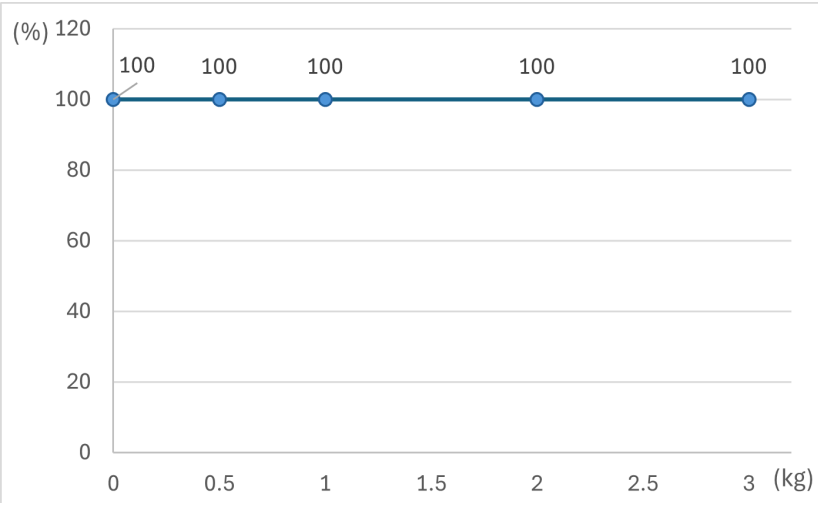
Enter “2.36” for the Weight Parameter.



Symbol	Description
a	Shaft
b	Weight of the entire camera
c	Joint #2

2.4.3.4 Automatic speed setting by Weight

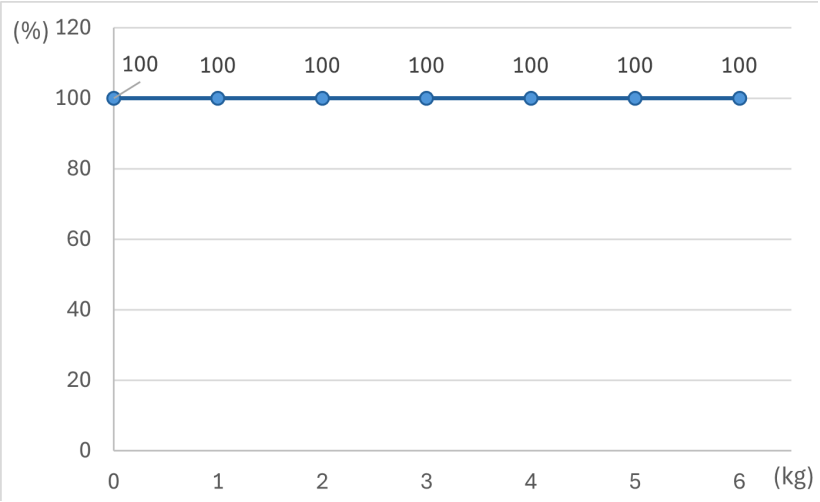
LA3-A



* The percentage in the graph is based on the speed at rated weight (1 kg) as 100%.

End effector weight (kg)	Automatic speed setting by Weight (%)
0	100
0.5	100
1	100
2	100
3	100

LA6-A



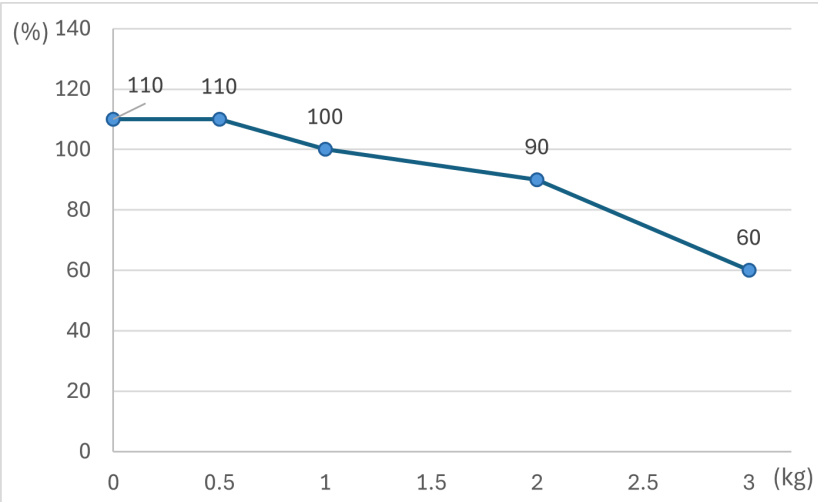
* The percentage in the graph is based on the speed at rated weight (2 kg) as 100%.

End effector weight (kg)	Automatic speed setting by Weight (%)
0	100
1	100
2	100
3	100
4	100

End effector weight (kg)	Automatic speed setting by Weight (%)
5	100
6	100

2.4.3.5 Automatic acceleration/deceleration setting by Weight

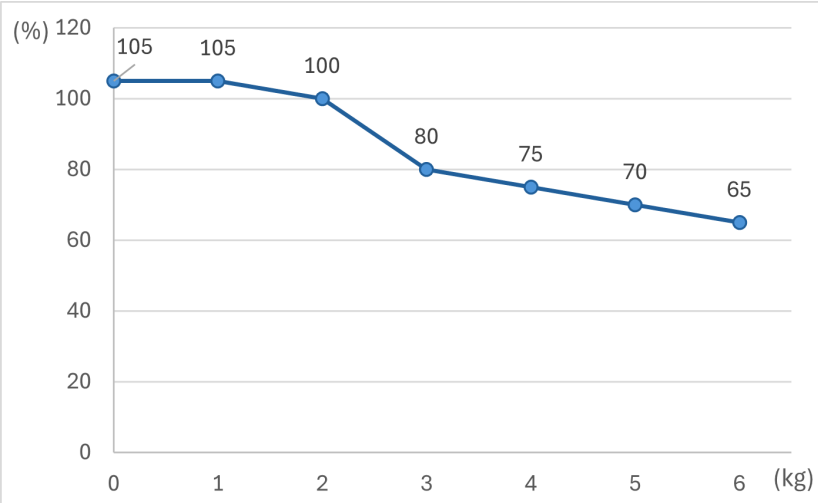
LA3-A



* The percentage in the graph is based on the acceleration/ deceleration at LA3-A: rated weight (1 kg) as 100%.

End effector weight (kg)	Automatic acceleration/deceleration setting by Weight
0	110
0.5	110
1	100
2	90
3	60

LA6-A



* The percentage in the graph is based on the acceleration/ deceleration at LA6-A: rated weight (2 kg) as 100%.

End effector weight (kg)	Automatic acceleration/deceleration setting by Weight
0	105
1	105
2	100
3	80
4	75
5	70
6	65

2.4.3.6 Inertia Setting

2.4.3.6.1 Moment of Inertia and the Inertia Setting

The moment of inertia is defined as “the ratio of the torque applied to a rigid body and its resistance to motion”. This value is typically referred to as “the moment of inertia”, “inertia”, or “GD2”. When the Manipulator operates with additional objects (such as an end effector) attached to the shaft, the moment of inertia of load must be considered.

⚠ CAUTION

The moment of inertia of the load (weight of the hand and workpiece) must be 0.05 kg·m^2 or less for LA3-A and 0.12 kg m^2 for LA6-A. The LA-A series Manipulators are not designed to work with a moment of inertia exceeding 0.05 kg·m^2 for LA3-A and 0.12 kg m ^{2} for LA6-A. Always set the value corresponding to the moment of inertia. Setting a value that is smaller than the actual moment of inertia may cause errors, shock and insufficient function of the Manipulator. Also, the life cycle of parts may be shortened and positional gap due to belt tooth bumping may occur.

The acceptable moment of inertia of load

- LA3-A
  - Rated weight: 0.005 kg·m^2
  - Max.: 0.05 kg·m^2
- LA6-A
  - Rated weight: 0.01 kg·m^2
  - Max.: 0.12 kg·m^2

If the moment of inertia of the load exceeds the rated weight, change the setting of the moment of inertia parameter of the Inertia command. After the setting is changed, the maximum acceleration/deceleration of Joint #4 during PTP motion that corresponds to the "Inertia" value is corrected automatically.

2.4.3.6.2 Moment of inertia of load on the shaft

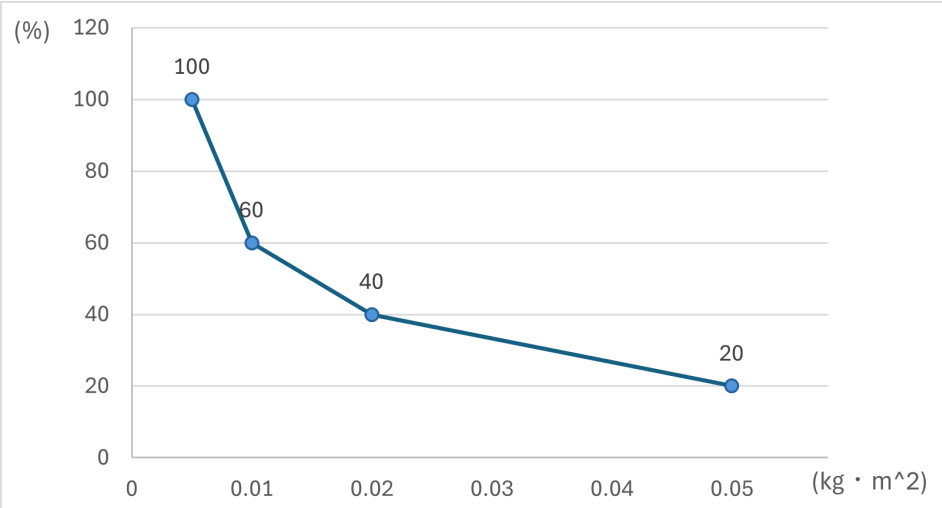
The moment of inertia of load (weight of the end effector and workpiece) on the shaft can be set by the “moment of inertia” parameter of the Inertia command.

Epson RC+

Enter a value into the [Moment of inertia] text box on the [Weight] panel ([Tools]-[Robot Manager]). (You may also execute the Inertia command from the [Command Window].)

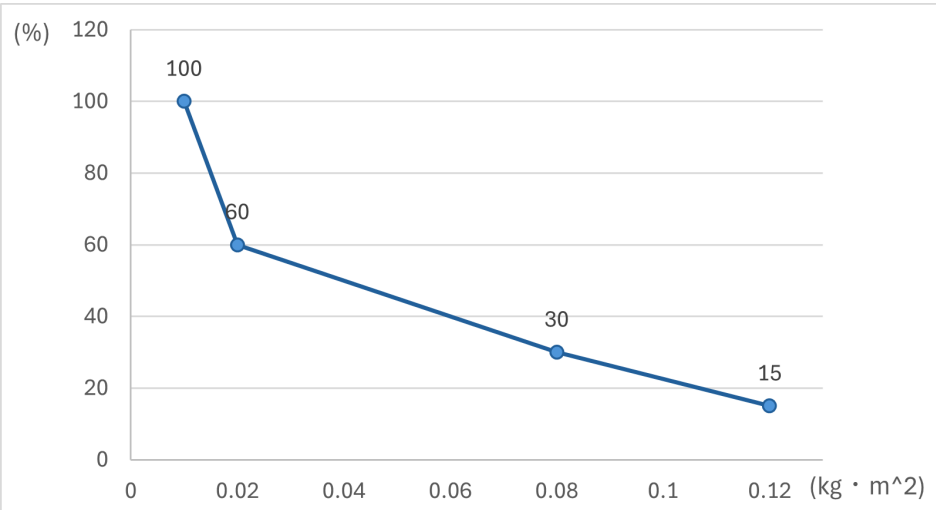
2.4.3.6.3 Automatic acceleration/deceleration setting of Joint #4 by Inertia (moment of inertia)

LA3-A



Moment of inertia parameter ($kg \cdot m^2$)	Automatic acceleration/deceleration (%) setting of Joint #4 by Inertia (moment of inertia)
0.005	100
0.01	60
0.02	40
0.05	20

LA6-A



Moment of inertia parameter ($kg \cdot m^2$)	Automatic acceleration/deceleration (%) setting of Joint #4 by Inertia (moment of inertia)
0.01	100
0.02	60
0.08	30
0.12	15

2.4.3.6.4 Eccentric Quantity and the Inertia Setting

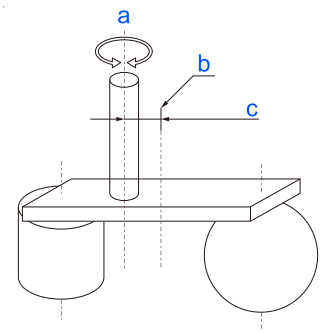
⚠ CAUTION

The eccentricity of the load (hand and workpiece) must be 100 mm or less for LA3-A and 150 mm or less for LA6-A. The LA-A series Manipulators are not designed to work with eccentricities exceeding 100 mm for LA3-A and 150 mm for LA6-A. Always set the value according to the eccentricity. Setting a value that is smaller than the actual load may cause errors, excessive shock and insufficient function of the Manipulator. Also, the life cycle of parts may be shortened and positional gap due to belt tooth bumping may occur.

The allowable eccentricity of load for LA-A series

- LA3-A
  - Rated weight: 0 mm
  - Maximum: 100 mm
- LA6-A
  - Rated weight: 0 mm
  - Maximum: 150 mm

If the moment of inertia of the load exceeds the rating, change the setting of the eccentric quantity parameter of the Inertia command. After the setting is changed, the maximum acceleration/deceleration of the Manipulator during PTP motion that corresponds to the "Eccentricity" is corrected automatically.



Symbol	Description
a	Rotation center
b	Position of load’s center of gravity
c	Eccentric quantity

2.4.3.6.5 Eccentric quantity of load on the shaft

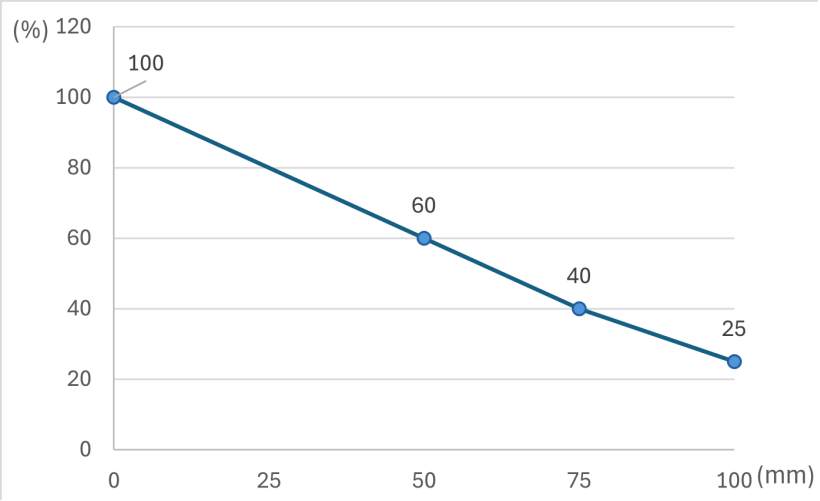
The eccentric quantity of load (weight of the end effector and workpiece) on the shaft can be set by “eccentric quantity” parameter of Inertia command.

Epson RC+

Enter a value into the [Eccentricity:] text box on the [Inertia] panel ([Tools]-[Robot Manager]). (You may also execute the Inertia command from the [Command Window].)

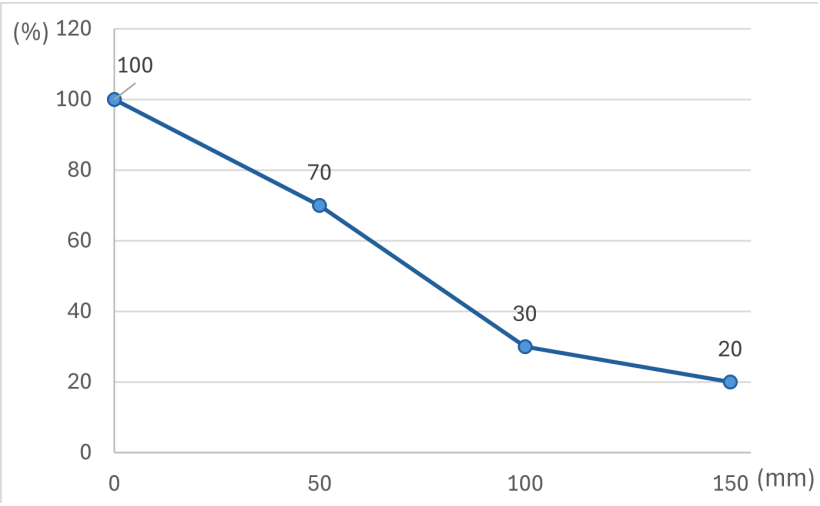
2.4.3.6.6 Automatic acceleration/deceleration setting by Inertia (eccentric quantity)

LA3-A



Eccentric quantity parameter (mm)	Automatic acceleration/deceleration setting by Inertia (eccentric quantity) (%)
0	100
50	60
75	40
100	25

LA6-A

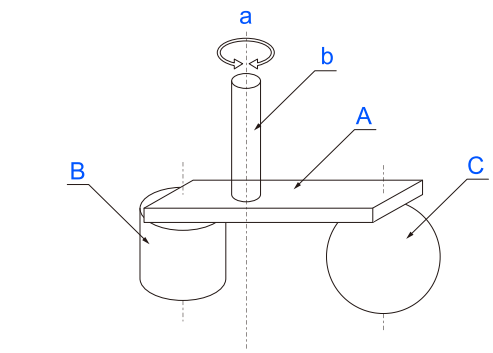


Eccentric quantity parameter (mm)	Automatic acceleration/deceleration setting by Inertia (eccentric quantity) (%)
0	100
50	70
100	30
150	20

2.4.3.6.7 Calculating the Moment of Inertia

Refer to the following examples of formulas to calculate the moment of inertia of load (end effector with workpiece).

The moment of inertia of the entire load is calculated by the sum of each part (a), (b), and (c).

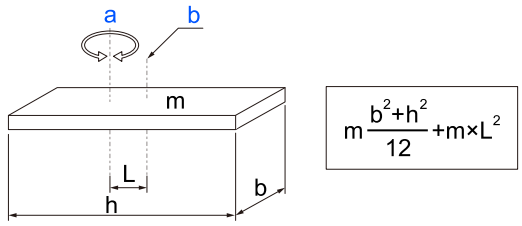


Whole moment of inertia = Moment of inertia of end effector (A) + Moment of inertia of work piece (B) + Moment of inertia of work piece (C)

Symbol	Description
a	Rotation center
b	Shaft
A	End effector
B	Workpiece
C	Workpiece

The methods for calculating the moment of inertia for (a), (b), and (c) are shown below. Calculate the total moment of inertia using the basic formulas.

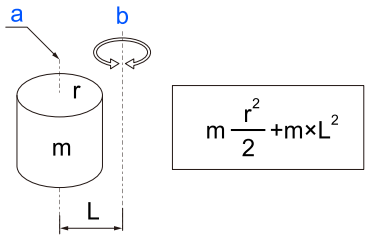
(A) Moment of inertia of a rectangular parallelepiped



$$m\frac{b^2+h^2}{12}+m\times L^2$$

Symbol	Description
a	Rotation center
c	Rectangular parallelepiped's center of gravity

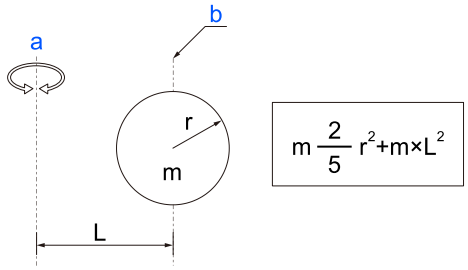
(b) Moment of inertia of a cylinder



$$m\frac{r^2}{2}+m\times L^2$$

Symbol	Description
a	Cylinder's center of gravity
b	Rotation center

(C) Moment of inertia of a sphere



$$m\frac{2}{5}r^2+m\times L^2$$

Symbol	Description
a	Rotation center
b	Sphere's center of gravity

2.4.4 Precautions for Auto Acceleration/Deceleration of Joint #3

When you move the Manipulator in horizontal PTP motion with Joint #3 (Z) at a high position, the motion time will be faster.

If the shaft height is less than a certain value while performing horizontal movement in PTP motion, the auto acceleration function is activated, and the acceleration/deceleration of the movement is set slower for lower shaft heights (Refer to the table below). The higher the position of the shaft is, the faster the motion acceleration/deceleration is. However, the up movement

time and down movement time of the shaft are also required. Adjust the position of Joint #3 for the Manipulator motion after considering the relation between the current position and the destination position.

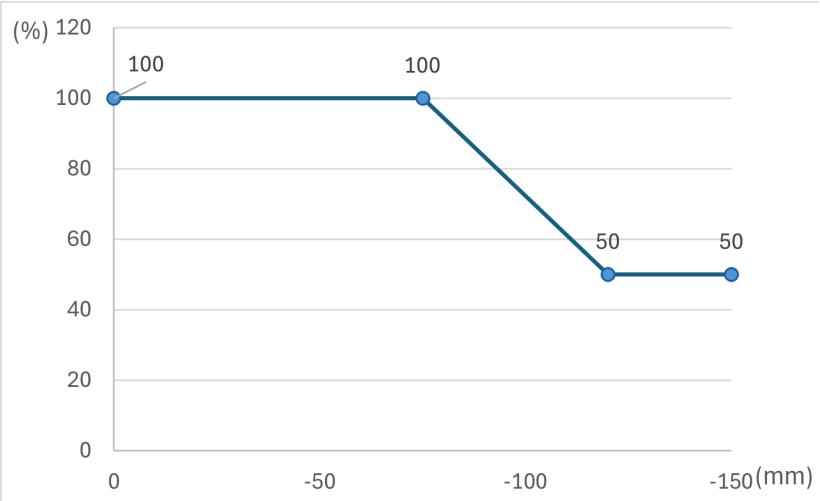
The upper limit of Joint #3 during horizontal motion using Jump command can be set by the LimZ command.

2.4.4.1 Automatic acceleration/deceleration vs. Joint #3 position

KEY POINTS

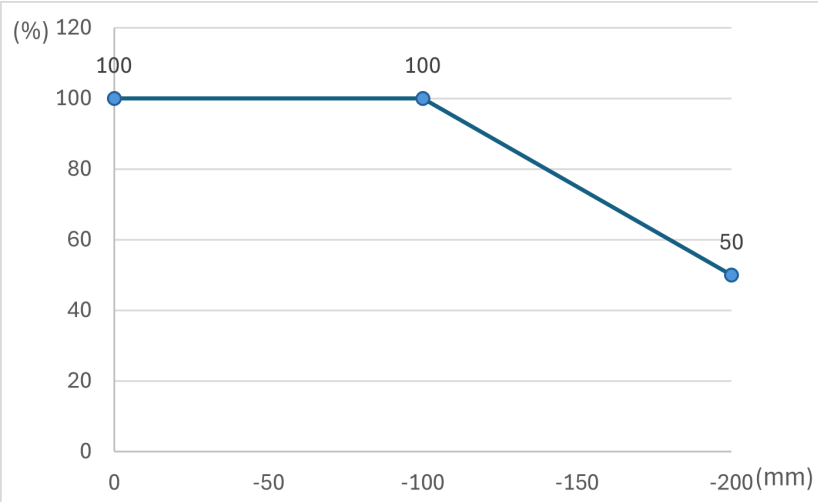
When moving the Manipulator horizontally while the shaft is being lowered, it may cause over-shoot at the time of final positioning.

LA3-A



Shaft height (mm)	Acceleration/Deceleration (%)
0	100
-75	100
-120	50
-150	50

LA6-A



Shaft height (mm)	Acceleration/Deceleration (%)
0	100
-100	100
-200	50

2.5 Motion Range

> ⚠ CAUTION
>
> When setting up the motion range for safety, both the pulse range and mechanical stop must always be set at the same time.

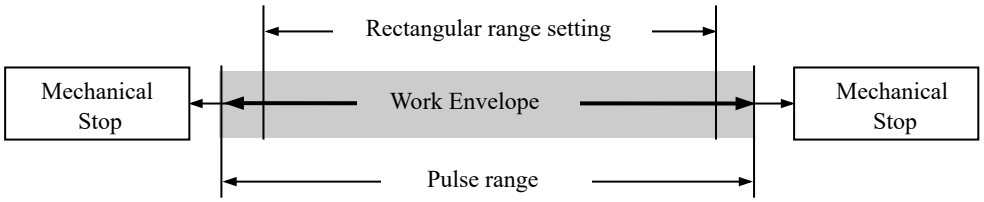
The motion range is preset at the factory as explained in the following section.

Standard Motion Range

This is the maximum motion range of the Manipulator.

The motion range can be set by one of the following three methods.

1. Setting by pulse range (for all joints)
2. Setting by mechanical stops (for Joints #1 to #3)
3. Setting the rectangular range in the XY coordinate system of the Manipulator (for Joints #1 and #2)



When the motion range is changed due to layout efficiency or safety, follow the descriptions below.

- **Motion Range Setting by Pulse Range**
- **Motion Range Setting by Mechanical Stops**
- **Setting the Cartesian (Rectangular) Range in the XY Coordinate System of the**

2.5.1 Motion Range Setting by Pulse Range

Pulses are the basic unit of Manipulator motion. The motion range of the Manipulator is controlled by the pulse range between the pulse lower limit and upper limit of each joint. Pulse values are read from the encoder output of the servo motor.

For the maximum pulse range, refer to the following sections. The pulse range must be set inside of the mechanical stop settings.

- **Max. Pulse Range of Joint #1**
- **Max. Pulse Range of Joint #2**
- **Max. Pulse Range of Joint #3**
- **Max. Pulse Range of Joint #4**

KEY POINTS

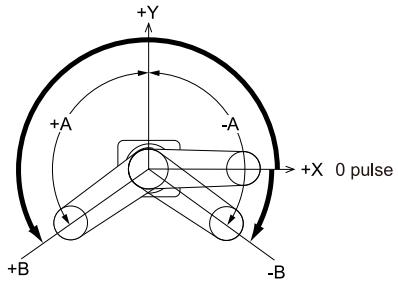
Once the Manipulator receives an operating command, it checks whether the target position specified by the command is within the pulse range before operating. If the target position is outside of the pulse range that was set, an error occurs and the Manipulator does not move.

Epson RC+

The pulse range can be set on the [Range] panel shown by selecting [Tools]-[Robot Manager]. (You may also execute the Range command from the [Command Window].)

2.5.1.1 Max. Pulse Range of Joint #1

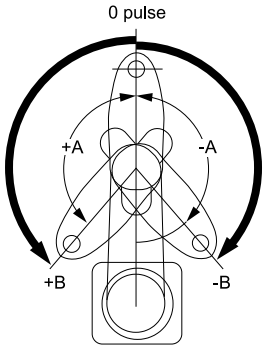
The 0 (zero) pulse position of Joint #1 is the position where Arm #1 faces toward the positive (+) direction on the X-coordinate axis. With the 0 pulse as a starting point, the counterclockwise pulse value is defined as positive (+), and the clockwise pulse value is defined as negative (-).



	A: Max. Motion Range	B: Max. Pulse Range
LA3-A	±132°	- 95574 to 505174 pulse
LA6-A		- 152918 to 808278 pulse

2.5.1.2 Max. Pulse Range of Joint #2

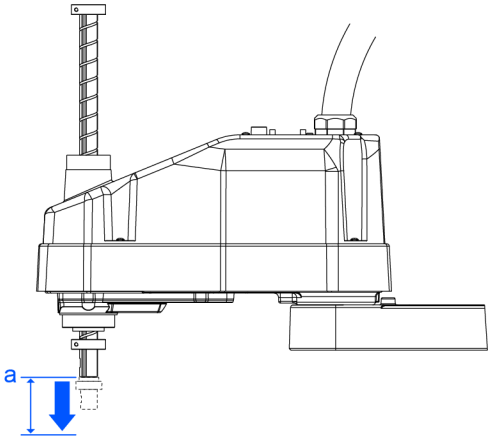
The 0 (zero) pulse position of Joint #2 is the position where Arm #2 is in-line with Arm #1. (Same for all direction of Arm #1) With the 0 pulse as a starting point, the counterclockwise pulse value is defined as the positive (+) and the clockwise pulse value is defined as the negative (-).



	A: Max. Motion Range	B: Max. Pulse Range
LA3-A	±141°	± 320854 pulse
LA6-A	±150°	± 341334 pulse

2.5.1.3 Max. Pulse Range of Joint #3

The 0 (zero) pulse position of Joint #3 is the position where the shaft is at its upper limit. The pulse value is always negative because Joint #3 moves down from the 0 pulse position.

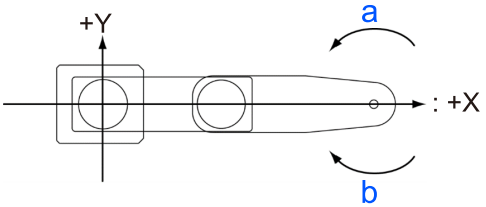


Symbol	Description
a	Upper limit: 0 pulse

	Joint #3 Stroke	Lower Limit Pulse
LA3-A	150 mm	- 187734 pulse
LA6-A	200 mm	- 245761 pulse

2.5.1.4 Max. Pulse Range of Joint #4

The 0 (zero) pulse position of Joint #4 is the position where the flat near the end of the shaft faces toward the end of Arm #2. (Same for all directions of Arm #2) With the 0 pulse as a starting point, the counterclockwise pulse value is defined as positive (+), and the clockwise pulse value is defined as negative (-).



Symbol	Description
a	+ direction
b	- direction

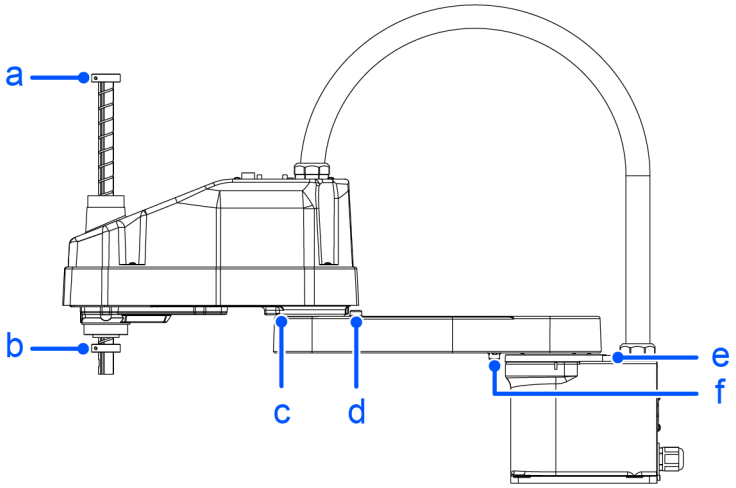
	A: Max. Motion Range	B: Max. Pulse Range
LA3-A	±360°	0 ± 186778 pulse
LA6-A		0 ± 245761 pulse

2.5.2 Motion Range Setting by Mechanical Stops

Mechanical stops set the absolute motion range that physically limits where the Manipulator can move.

Joints #1 have threaded holes in the positions corresponding to the angle for the mechanical stop settings. Set the motion range depending on the position of the mechanical stop (adjustable) Install the bolts in the threaded holes corresponding to the angles to be set.

Joints #3 can be set to any length less than the maximum stroke.



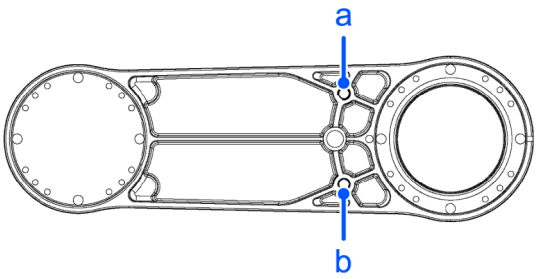
Symbol	Description
a	Mechanical stop of Joint #3 (Lower limit mechanical stop)
b	Joint #3 mechanical stop (upper limit mechanical stop) Do not move the position.
c	Mechanical stop of Joint #2 (Fixed)
d	Mechanical stop of Joint #2 (Adjustable)
e	Mechanical stop of Joint #1 (Fixed)
f	Mechanical stop of Joint #1 (Adjustable)

2.5.2.1 Setting the Mechanical Stops of Joints #1 and #2

Joints #1 have threaded holes in the positions corresponding to the angle for the mechanical stop settings. Set the motion range depending on the position of the mechanical stop (adjustable) Install the bolts in the threaded holes corresponding to the angles to be set.

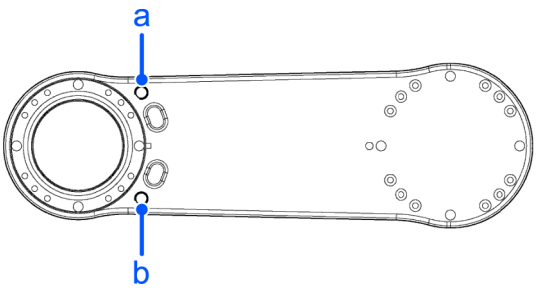
Install the bolts for the mechanical stop to the following position.

Joint #1 Mechanical Stops



		a	b
LA3-A	Setting Angle	110°	-110°
	Pulse Value	455111 pulse	-45511 pulse
LA6-A	Setting Angle	115°	-115°
	Pulse Value	746382 pulse	-91022 pulse

****Joint #2 Mechanical Stops**



		a	b
LA3-A LA6-A	Setting Angle	110°	-110°
	Pulse Value	455111 pulse	-45511 pulse

1. Turn off the Controller.
2. Install a hexagon socket head cap bolt into the hole corresponding to the setting angle and tighten it.

Joint	Hexagon socket head cap bolt	The number of bolts	Recommended tightening torque	Strength
1	M8×10 full thread	1 for each side	12.3 N·m (125 kgf·cm)	ISO898-1 property class 10.9 or 12.9 equivalent

3. Turn ON the Controller.
4. Set the pulse range corresponding to the new positions of the mechanical stops.

KEY POINTS

Be sure to set the pulse range inside the positions of the mechanical stop range.

Example: Setting Joint #1 to -110 to +110° and Joint #2 to -110 to +110° for LA6-A602S

Epson RC+

Execute the following commands from the [Command Window].

```
>JRANGE 1, -72817, 728177   ' Sets the pulse range of Joint #1
>JRANGE 2, -250311, 250311  Sets the pulse range of Joint #2
>RANGE                      ' Checks the set value using Range command
-72817, 728177, -250311, 250311, -245760, 0,  -245760, 245760
```

5. Move the arm by hand until it touches the mechanical stops, and make sure that the arm does not hit any peripheral equipment during operation.

6. Operate the joint changed at low speeds until it reaches the positions of the minimum and maximum pulse range. Make sure that the arm does not hit the mechanical stops.

   (Check the position of the mechanical stop and the motion range that were set.)

   Example: Setting Joint #1 to -110 to +110° and Joint #2 to -110 to +110° for LA6-A602S

   Epson RC+

   Execute the following commands from the [Command Window].

```
>MOTOR ON   ' Turns On the motor
>POWER LOW  ' Enters low-power mode
>SPEED 5    ‘ Sets at low speed
>PULSE 1, -72817.0, 0.0      '       Moves to the min. pulse position of Joint #1
>PULSE 72817,0,0,0   '       Moves to the max. pulse position of Joint #1
>PULSE 327680,-250311,0,0    ‘       Moves to the minimum pulse position of Joint
#2
>PULSE 327680,250311,0,0     '       Moves to the max. pulse position of Joint #2
```

   The Pulse command (Go Pulse command) moves all joints to the specified positions at the same time. Specify safe positions after considering motion of not only the joints whose pulse range have been changed, but also other joints.

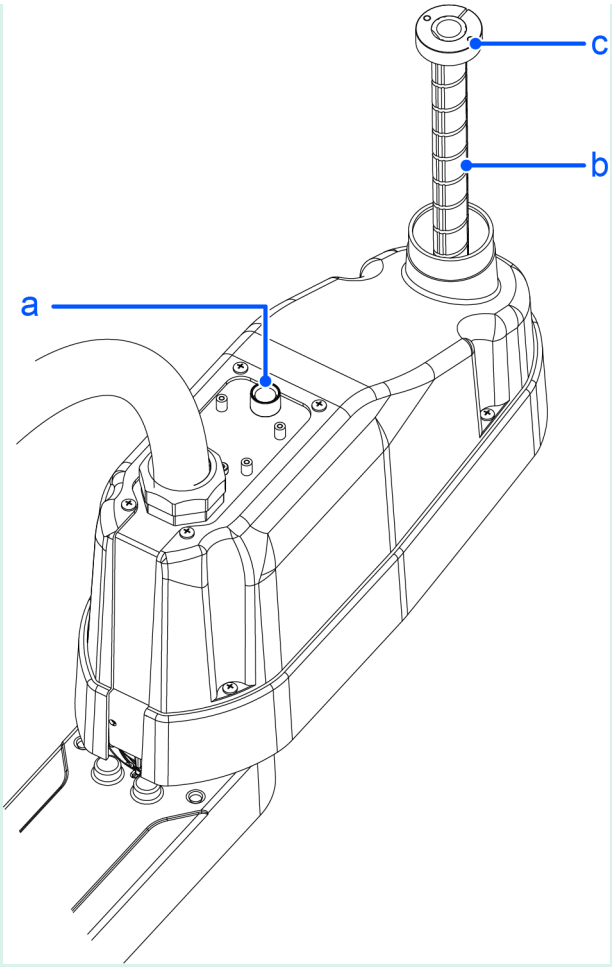
   If the arm is hitting the mechanical stops or if an error occurs after the arm hits the mechanical stops, either reset the pulse range to a narrower setting or extend the positions of the mechanical stops within the limit.

2.5.2.2 Setting the Mechanical Stops of Joints #3

1. Turn ON the Controller and turn OFF the motors using the Motor OFF command.

2. Push up the shaft while pressing the brake release switch.

> **KEY POINTS**
>
> Do not push the shaft up to its upper limit or it will be difficult for the arm top cover to be removed. Push the shaft up to a position where the Joint #3 mechanical stop can be changed.



Symbol	Description
a	Brake release switch
b	Shaft
c	Lower limit mechanical stop mounting screw M4 × 15

When you press the brake release switch, the shaft may lower or rotate due to the weight of the hand. Be sure to hold the shaft by hand while pressing the switch.

3. Turn off the Controller.

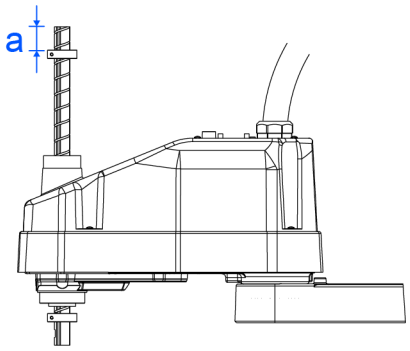
4. Loosen the lower limit mechanical stop screw (M4 × 15).

KEY POINTS

A mechanical stop is mounted on both the top and bottom of Joint #3. However, only the position of the lower limit mechanical stop on the top can be changed. Do not remove the upper limit mechanical stop on the bottom because the origin point of Joint #3 is determined by the stop.

5. The upper end of the shaft defines the position of the maximum stroke. Move the lower limit mechanical stop down by the length that you want to limit the stroke.

For example, when the lower limit mechanical stop is set at the "200 mm" stroke, the lower limit Z coordinate value is "-200". To change this value to "-180", move the lower limit mechanical stop down by "20 mm". Use calipers to measure the distance when adjusting the mechanical stop.



6. Tighten the lower limit mechanical stop screw (M4 × 15).

   Recommended tightening torque: 5.4 N m (55 kgf cm)

7. Turn ON the Controller.

8. Press down Joint #3 while pressing the brake release switch, and then check the lower limit position.
   Do not lower the mechanical stop too far. Otherwise, the joint may not reach a target position.

9. Calculate the lower limit pulse value of the pulse range using the formula shown below and set the value.
   The result of the calculation is always negative because the lower limit Z coordinate value is negative.
   Lower limit of pulse (pulse) = lower limit Z coordinate value (mm) / Joint #3 Resolution* (mm/pulse)
   * For Joint #3 resolution, refer to the following.
   Stopping time and Stopping distance in Emergency

   Epson RC+

   Execute the following commands from the [Command Window]. Enter the calculated value in X.

```
>JRANGE 3,X,0      '       Sets the pulse range of Joint #3
```

10. Using the Pulse command (Go Pulse command), move Joint #3 to the lower limit position of the pulse range at low speed.

    If the mechanical stop range is less than the pulse range, Joint #3 will hit the mechanical stop and an error will occur. When an error occurs, either change the pulse range to a narrower setting or extend the position of the mechanical stop within the limit.

KEY POINTS

If it is difficult to check whether Joint #3 hits a mechanical stop, turn OFF the Controller and lift the arm top cover to check the condition causing the problem from the side.

Epson RC+

Execute the following commands from the [Command Window]. Enter the value calculated in Step (9) in X.

```
>MOTOR ON      '   Turns On the motor
>SPEED 5          '   Sets at low speed
```

```
>PULSE 0,0,X,0       '       Moves to the lower limit-pulse position of Joint #3
(In this example, all pulses except those for Joint #3 are “0”. Substitute these
“0s” with the other pulse values specifying a position where there is no
interference even when lowering Joint #3.)
```

2.5.3 Setting the Cartesian (Rectangular) Range in the XY Coordinate System of the

Manipulator (for Joints #1 and #2)

Use this method to set the upper and lower limits of the X and Y coordinates.

This setting is only enforced by software. Therefore, it does not change the physical range. The maximum physical range is based on the position of the mechanical stops.

Epson RC+

Set the XYLim setting on the [XYZ Limits] panel shown by selecting [Tools]-[Robot Manager]. (You may also execute the XYLim command from the [Command Window].)

2.5.4 Standard Motion Range

Motion Range

The following “motion range” diagrams show the standard (maximum) specification. When each Joint motor is under servo control, the center of Joint #3’s (shaft’s) lowest point moves in the areas shown in the figure.

Range to mechanical stop

The area where the center of Joint #3’s lowest point can be moved when each joint motor is not under servo control.

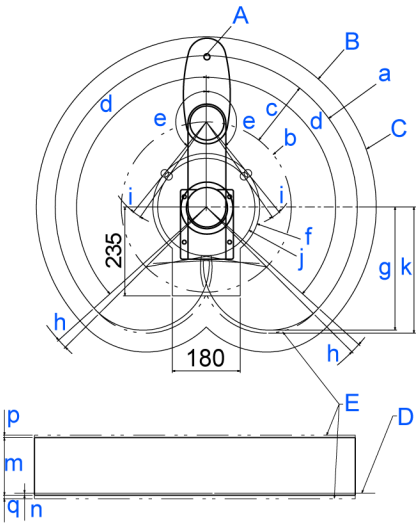
Mechanical stop

This is the stop that sets the absolute motion range where the Manipulator cannot move beyond mechanically.

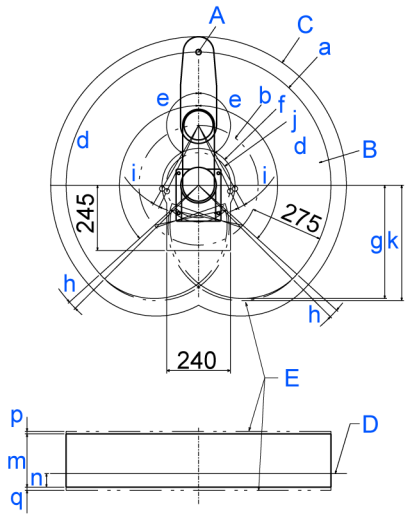
Maximum zone

The area that contains the farthest reach of the arms. If the maximum radius of the end effector is over 60 mm, add the “Area limited by mechanical stop” and “radius of the hand” and specify it as the maximum zone.

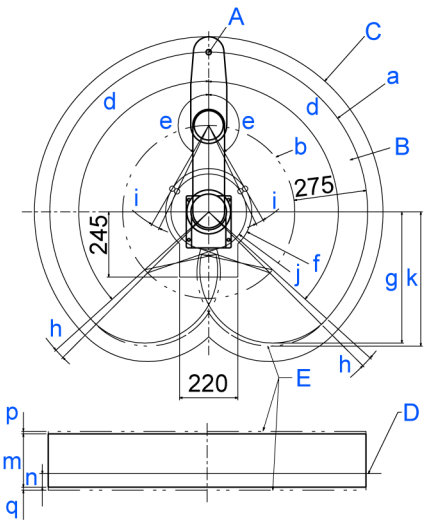
LA3-A402S



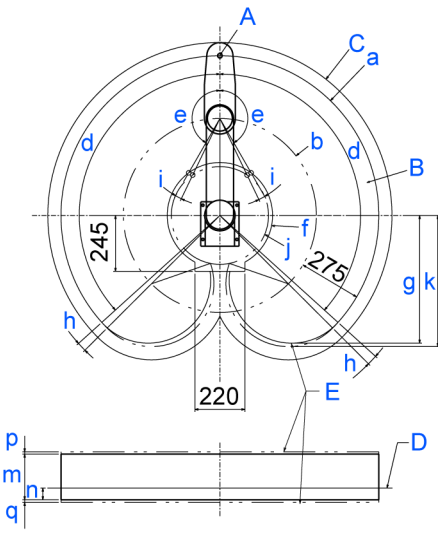
LA6-A502S



LA6-A602S



LA6-A702S



A	Center of Joint #3
B	Motion Range
C	Maximum zone
D	Base mounting surface
E	Range to mechanical stop

		LA3-A401S	LA6-A502S	LA6-A602S	LA6-A702S
a	Arm #1 + Arm #2 length [mm]	400	500	600	700
b	Arm #1 length [mm]	225		325	425
c	Arm #2 length [mm]	175	275		
d	Joint #1 motion angle [°]	132			
e	Joint #2 motion angle [°]	141	150		
f	(Motion range [mm])	141.6	138.1	162.6	232

		LA3-A401S	LA6-A502S	LA6-A602S	LA6-A702S
g	(Motion range at the rear [mm])	325.5	425.6	492.5	559.4
h	Angle of the Joint #1 mechanical stop [°]	2.8			
i	Angle of the Joint #2 mechanical stop [°]	4.2			
j	(Mechanical stop area [mm])	128.8	121.8	142.5	214
k	(Mechanical stop area of the back side [mm])	333.5	433.5	504	574.5
m	(Joint #3 motion range [mm])	150	200		
n	(Distance from base mounting surface [mm])	5.5	51		
p	(Joint #3 mechanical stop area upper end [mm])	6.5	10		
q	(Joint #3 mechanical stop area lower end [mm])	9.3	11.8		

3. Daily Inspection

Accurate inspection work is necessary to prevent breakdowns and ensure safety. This section explains the inspection schedule and what should be inspected.

Perform inspections according to the predetermined schedule.

3.1 Daily Inspection of LA-A Manipulator

Accurate inspection work is necessary to prevent breakdowns and ensure safety. This section explains the inspection schedule and what should be inspected.

Perform inspections according to the predetermined schedule.

3.1.1 Inspection

3.1.1.1 Schedule for Inspection

Inspection items are divided into five stages (daily, 1-month, 3-month, 6-month, and 12-month), with additional items added at each stage. However, if the Manipulator is powered and operated for more than 250 hours in a month, add inspection items every 250, 750, 1500, and 3000 hours.

	Inspection Item					
	Daily Inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection	Overhaul (Parts Replacement)
1 months (250 hours)	Perform daily	✓				
2 months (500 hours)		✓				
3 months (750 hours)		✓	✓			
4 months (1,000 hours)		✓				
5 months (1,250 hours)		✓				
6 months (1,500 hours)		✓	✓	✓		
7 months (1,750 hours)		✓				
8 months (2,000 hours)		✓				
9 months (2,250 hours)		✓	✓			
10 months (2,500 hours)		✓				
11 months (2,750 hours)		✓				
12 months (3,000 hours)		✓	✓	✓	✓	
13 months (3,250 hours)		✓				
⋮	⋮	⋮	⋮	⋮	⋮	⋮

	Inspection Item					
	Daily Inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection	Overhaul (Parts Replacement)
(20,000 hours)						✓

3.1.1.2 Inspection point

Inspection item

Inspection item	Inspection position	Daily inspection	1-month Inspection	3-month Inspection	6-month Inspection	12-month Inspection
Check for loose or rattling bolts.	Hand mounting bolts	✓	✓	✓	✓	✓
	Manipulator mounting bolts	✓	✓	✓	✓	✓
Check looseness of connectors.	External connectors on Manipulator (on the connector plates etc.)	✓	✓	✓	✓	✓
Visually check for external defects. Clean up if necessary.	The entire Manipulator	✓	✓	✓	✓	✓
	External cables		✓	✓	✓	✓
Check for bends or improper location. Repair or place it properly if necessary.	Safeguard etc.	✓	✓	✓	✓	✓
Check the brake operation	Joint #3	✓	✓	✓	✓	✓
Check whether unusual sound or vibration occurs.	Whole	✓	✓	✓	✓	✓

Inspection Method

Inspection Point	Inspection Method
Check looseness or backlash of bolts/screws.	Use an Allen wrench to check that the hand mounting bolts and the Manipulator mounting bolts are not loose. When the bolts are loose, refer to the following and tighten them to the proper torque. **Tightening the hexagon socket head cap bolt**
Check for loose connectors	Check that connectors are not loose. When the connectors are loose, reattach it not to come off.
Visually check for external defects. Clean up if necessary.	Check the appearance of the Manipulator and clean up if necessary. Check the appearance of the cable, and if it is scratched, check that there is no cable disconnection.
Check for bends or improper location. Repair or place it properly if necessary.	Check that the safeguard, etc. are located properly. If the location is improper, place it properly.

Inspection Point	Inspection Method
Check the brake operation	Check that the shaft does not fall when in MOTOR OFF. If the shaft falls when in MOTOR OFF and the brake is not released, contact the supplier. Also, if the break is not released even operated release the break, contact the supplier.
Check whether unusual sound or vibration occurs.	Check that there is no unusual sound or vibration when operating. If there is something wrong, contact the supplier.

3.1.2 Overhaul (Parts Replacement)

Overhaul (replacement) shall be performed by properly trained service engineers.

For details, refer to the following manual.
"Safety Manual - Role and Training for Safety Managers"

For details on overhaul, refer to the following manual.

"Service Manual"

3.1.3 Greasing

The ball screw spline and reduction gear units need greasing regularly. Only use the grease specified.

⚠ CAUTION

- Pay attention to the amount of greasing When grease runs out, scratches and other defects can occur on the slide, not only hindering maximum performance, but also requiring significant time and money to repair.
- If grease gets into your eyes, mouth, or on your skin, follow the instructions below.
  - If grease gets into your eyes

    Flush them thoroughly with clean water, and then see a doctor immediately.
  - If grease gets into your mouth

    If swallowed, do not induce vomiting. See a doctor immediately. If grease just gets into your mouth, wash out your mouth with water thoroughly.
  - If grease gets on your skin

    Rinse with water and soap.

	Part	Interval	Grease	How to grease
Joint #1, Joint #2	Reduction gear units	Overhaul timing	-	Greasing shall be performed by personnel who has taken a proper training. For details, refer to the Maintenance Manual of the Manipulator.
Joint #3	Ball screw spline unit, support shaft	At 100 km of operation (50 km for first greasing)	AFB	Greasing the Ball Screw Spline Unit (mentioned below)

Joint #3 ball screw spline unit and support shaft

The recommended greasing interval is at 100 Km of operation. However, greasing interval also can be checked from the grease condition. As shown in the figure, apply grease when the grease turns black or has dried up.

Normal grease	Blackened grease
	

When greasing for the first time, perform greasing at 50 km of operation.

KEY POINTS

In Epson RC+, the recommended greasing interval for the ball screw spline unit is referred in Epson RC+ [Maintenance].

Applying grease to the ball screw spline unit

	Name	Quantity	Note
Grease used	For Ball Screw Spline Unit (AFB grease)	Appropriate amount	
Tools used	Wiping cloth	1	For wiping grease (Spline shaft)

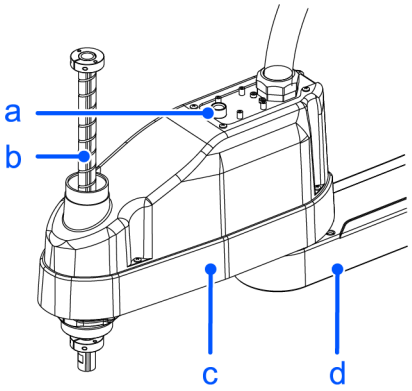
KEY POINTS

Cover the surrounding area such as the hand and peripheral equipment in case the grease drips.

1. Turn ON the Controller.
2. Move the shaft to its lower limit in one of the following methods.
   - Move the shaft to its lower limit manually while pressing the brake release switch.
   - Move the shaft to its lower limit from Epson RC+ [Tools]-[Robot Manager]-[Jog & Teach].

KEY POINTS

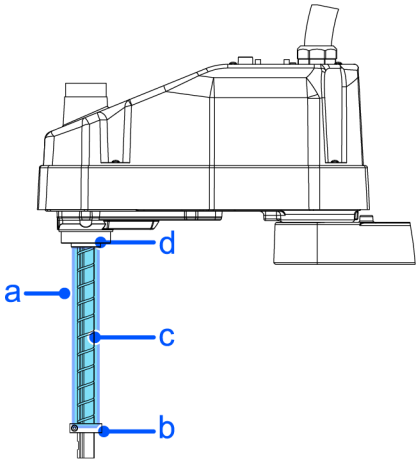
- Be sure to keep enough space and prevent the hand from hitting any peripheral equipment.
- The brake release switch is used with Joint #3. When the brake release switch is pressed, the brake for Joint #3 is released. Be careful of the shaft falling and rotating while the brake release switch is pressed because the shaft may be lowered by the weight of the hand.



Symbol	Description
a	Joint #3 brake release switch
b	Shaft
c	Arm #2
d	Arm #1

3. Turn off the Controller.
4. Wipe off the old grease from the shaft, and then apply new grease to it.

   The grease application area is from the end of the spline nut to the mechanical stop.



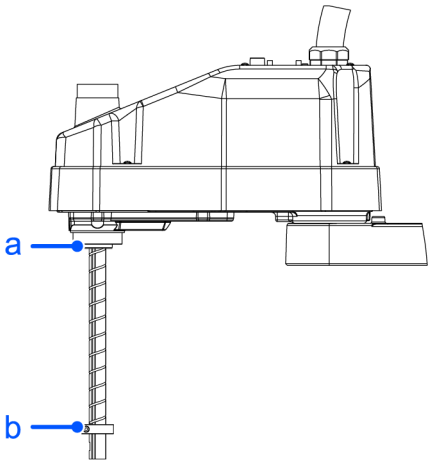
Symbol	Description
a	Application area
b	Mechanical stop
c	Shaft
d	End of the spline nut

5. Grease should be applied to the helical and vertical grooves of the ball screw spline so that the grooves are filled evenly.

   Grease application example:

6. Turn on the Controller.
7. Start the Robot Manager, and move the shaft to the origin position.

   Be careful not to hit peripheral equipment.
8. After moving to the origin position, reciprocate the shaft. The reciprocating operation is a low power mode operation program that performs from the upper limit to the lower limit. Run for about 5 minutes to spread the grease over the shaft.
9. Turn off the Controller.
10. Wipe off any excess grease at the spline nut end, mechanical stop, and the lower side of the shaft.



Symbol	Description
a	End of the spline nut
b	Mechanical stop

3.1.4 Tightening the hexagon socket head cap bolt

Hexagon socket head cap bolts (referred to as "bolts" below) are used in locations where mechanical strength is required. During assembly, these bolts are tightened at the tightening torques shown in the following table.

Unless otherwise specified, when retightening these bolts in the work procedures described in this manual, use a torque wrench or similar tool to obtain the tightening torques in the following table.

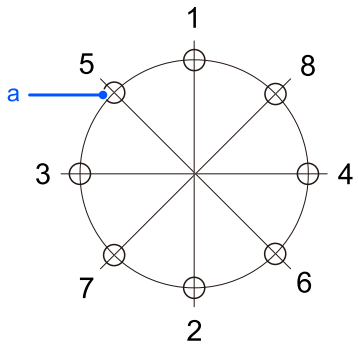
Bolt	Tightening Torque
M3	2.0 ± 0.1 N·m (21 ± 1 kgf·cm)
M4	4.0 ± 0.2 N·m (41 ± 2 kgf·cm)

Bolt	Tightening Torque
M5	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)
M6	13.0 ± 0.6 N·m (133 ± 6 kgf·cm)
M8	32.0 ± 1.6 N·m (326 ± 16 kgf·cm)
M10	58.0 ± 2.9 N·m (590 ± 30 kgf·cm)
M12	100.0 ± 5.0 N·m (1,020 ± 51 kgf·cm)

For set screw, refer to the following table.

Set Screw	Tightening Torque
M4	2.4 ± 0.1 N·m (26 ± 1 kgf·cm)
M5	3.9 ± 0.2 N·m (40 ± 2 kgf·cm)
M6	8.0 ± 0.4 N·m (82 ± 4 kgf·cm)

It is recommended that bolts arranged in a circular pattern be secured in place by tightening in criss-cross order as shown in the figure.



Symbol	Description
a	Threaded holes

When securing the bolts, do not tighten the bolts all at once, but tighten them in two or three separate rounds with an Allen wrench, and then use a torque wrench or similar tool to secure them at the tightening torques shown in the table above.

4. Appendix

Stopping time and Stopping distance in Emergency based on each model.

4.1 Appendix A: Specifications Table

4.1.1 Specification table

Item		LA3-A401S	LA6-A502S	LA6-A602S	LA6-A702S
Machinery name		Industrial robot			
Product series		LA			
Model		LA*-A*0*S **Model number**			
Installation method		Table top mounting type			
Arm length	Arm #1 + Arm #2	400 mm	500 mm	600 mm	700 mm
	Arm #1	225 mm		325 mm	425 mm
	Arm #2	175 mm	275 mm		
Weight (not including weight of cables)		12 kg: 26.5 lbs. (pound)	16 kg: 35.3 lbs. (pound)		17 kg: 37.5 lbs. (pound)
Driving method	All joints	AC servo motor			
Max. operating speed *1	Joint #1+ #2	6000 mm/s	6150 mm/s	6800 mm/s	7450 mm/s
	Joint #3	1100 mm/s			
	Joint #4	2600°/s	2000°/s		
Repeatability	Joint #1+ #2	± 0.01 mm	± 0.02 mm		
	Joint #3	± 0.01 mm			
	Joint #4	± 0.01°			
Max. motion range	Joint #1	± 132°			
	Joint #2	± 141°	± 150°		
	Joint #3	150 mm	200 mm		
	Joint #4	± 360°			
Max. pulse range (pulse)	Joint #1	-95574 to 505174 pulse	-152918 to 808278 pulse		
	Joint #2	320854 pulse	341334 pulse		
	Joint #3	-187734 to 0 pulse	-245769 to 0 pulse		
	Joint #4	186778 pulse	245760 pulse		
Resolution	Joint #1	0.000439°/pulse	0.000275°/pulse		
	Joint #2	0.000439°/pulse			

Item			LA3-A401S	LA6-A502S	LA6-A602S	LA6-A702S
	Joint #3		0.000799 mm/pulse	0.000814 mm/pulse		
	Joint #4		0.001927°/pulse	0.001465°/pulse		
Motor rated capacity	Joint #1		200 W			
	Joint #2		100 W	200 W		
	Joint #3		100 W			
	Joint #4		100 W			
Payload (load)	Rating		1 kg	2 kg		
	Max.		3 kg	6 kg		
Joint #4 allowable moment of inertia *2	Rating		0.005 kg·m^2	0.01 kg·m^2		
	Max.		0.05 kg·m^2	0.12 kg·m^2		
Hand diameter	Mounting		ø 16 mm	ø 20 mm		
	Through hole		ø 11 mm	ø 14 mm		
Mounting hole			120× 120 mm 135× 120 mm (Either is acceptable)	150× 150 mm		
			4-M8			
Joint #3 press force			100 N			
Environmental Requirements	Ambient Temp *3		5 to 40 °C			
	Ambient relative humidity		10 to 80 % (no condensation)			
Noise level *4			LAeq = 70 dB (A) or under			
Applicable Controller			RC800L			
Assignable Value ( ) Default values		Speed	1 to (5) to 100			
		Accel *5	1 to (10) to 120			
		SpeedS	1 to (50) to 2000			
		AccelS	1 to (200) to 25000			
		Fine	0 to (1250) to 65535			
		Weight	0 to (1) to 3	0 to (2) to 6		

Item			LA3-A401S	LA6-A502S	LA6-A602S	LA6-A702S
M/C Cable Specifications	Cable weight (cable only)	For fixing and signal	0.06 kg/m			
		For fixing and power	0.30 kg/m			
	Cable outer diameter	For fixing and signal	ø6.2 mm(typ)			
		For fixing and power	ø13.7 mm(typ)			
	Minimum bending radius	For fixing and signal	39 mm			
		For fixing and power	83 mm			

*1: When PTP command is used. Maximum operating speed for CP command is 2000 mm/s on horizontal plane.

*2: In the case where the center of gravity is at the center of Joint #4. If the center of gravity is not at the center of Joint #4, set the parameter using Inertia setting.

*3: When the product is used in a low temperature environment around the minimum temperature of the product specification, or when the product is suspended for a long time on holidays or at night, a collision detection error may occur due to the large resistance of the drive unit immediately after the start of operation. In such cases, warm-up operation for about 10 minutes is recommended.

*4: Conditions of Manipulator during measurement as follows:

- Operating conditions : Under rated load, 4-joints simultaneous motion, maximum speed
- Measurement point: Rear of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.

*5: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning. Although values larger than 100 can be set to Accel, it is recommended to minimize the use of large values to necessary motions since operating the manipulator continuously with the large Accel setting may shorten the product life remarkably.

KEY POINTS

You cannot use the SFree command to J3 and J4.

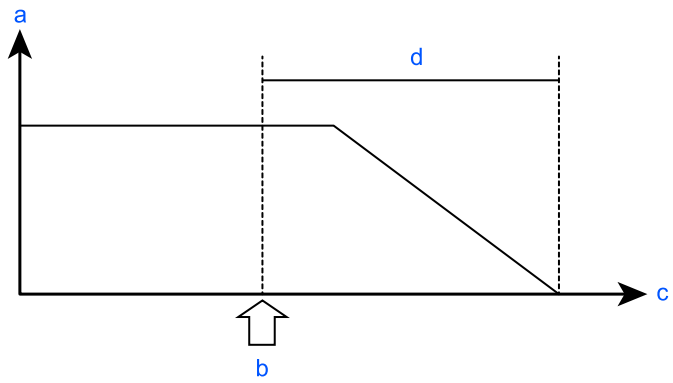
You cannot use the function to predict the robot life.

4.2 Appendix B: Stopping Time and Stopping Distance at Emergency Stop

The stopping time and stopping distance at an emergency stop are shown in the graphs for each model.

The stopping time is “Stopping time” in the figure below. Be sure to confirm that safety is ensured according to the installation environment and operation of the robot.

For models equipped with a safety board such as RC700-E, RC800-A, the stopping time and stopping distance when using the Safety Limited Speed (SLS), Safety Limited Position (SLP), and Soft Axis Limiting are equivalent to those of the emergency stop.



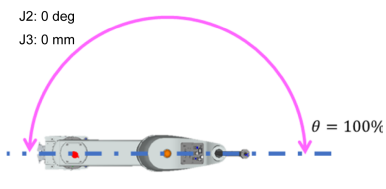
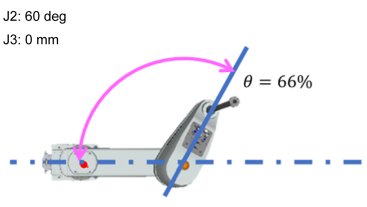
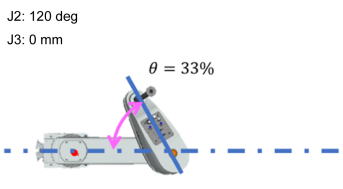
Symbol	Description
a	Motor speed
b	Emergency stop, Maximum Speed of SLS exceeded, monitoring areas and Joint Angle Limit of SLP exceeded, restricted range of Soft Axis Limiting exceeded
c	Time
d	Stopping Time

Condition:

The stopping time and stopping distance depend on the parameters (setting values) that were set for the robot. These graphs show the time and distance for the following parameters.
These conditions are based on the ISO 10218-1:2011 Annex B.

- Accel: 100, 100
- Speed： 100 %, 66 %, 33 % Settings
- Weight: 100 %, 66 %, 33 % of the maximum payload, rated payload
- Arm elongation rate: 100% 66%, 33% *1
- Other: Default
- Motion: Singular axis of a Go command
- Input timing of the Stop signal: Input with maximum speed. In this motion, it is the center of the motion range.

*1 The arm elongation rate when J1 is operating: Arm elongation rate 0 is as shown in the figure below.
The graphs indicate the results where the stopping time and the stopping distance in the longest among the following arm elongation rate.
When J2 is operating, J3 is 0 mm.

Axis	θ = 100%	θ = 66%	θ = 33%
J1			

Explanation of legend

The graphs are displayed for each Weight setting value (at 100%, approx. 66%, and approx. 33% of the maximum payload, and at the rated payload).

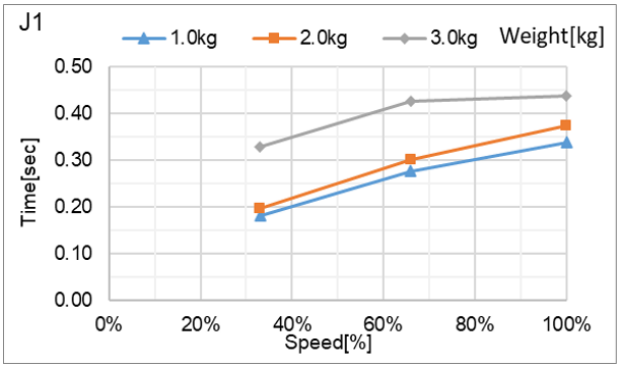
- Horizontal axis: Arm speed (Speed value)
- Vertical axis: Stopping time and stopping distance in each arm speed
- Time (sec): Stopping time (sec)
- Distance (deg): J1 and J2 stopping distance (degree)
- Distance [mm]: Stopping distance of J3

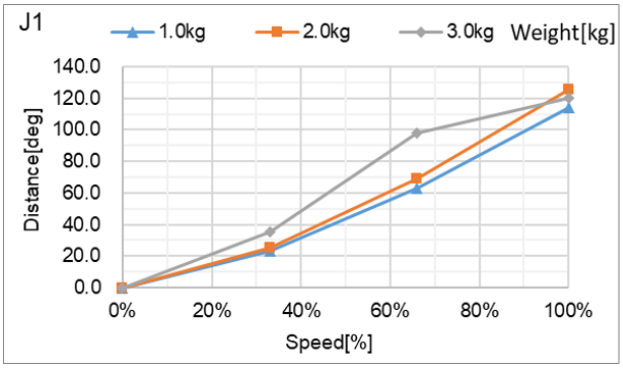
When single failures are taken into account, the following adjustments are used.

- Stopping distance and angle: Each axis reaches the mechanical stop
- Stopping time: Add 500 ms

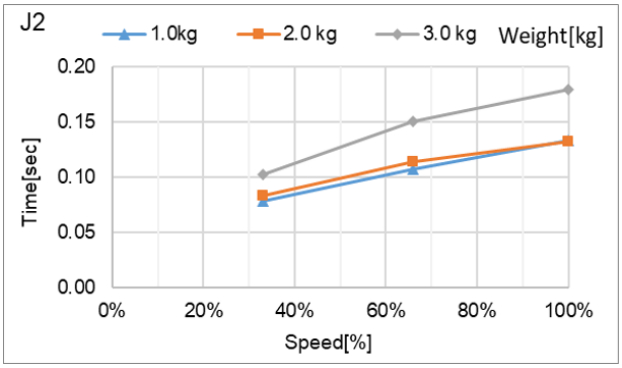
4.2.1 Stopping time and Stopping distance in Emergency

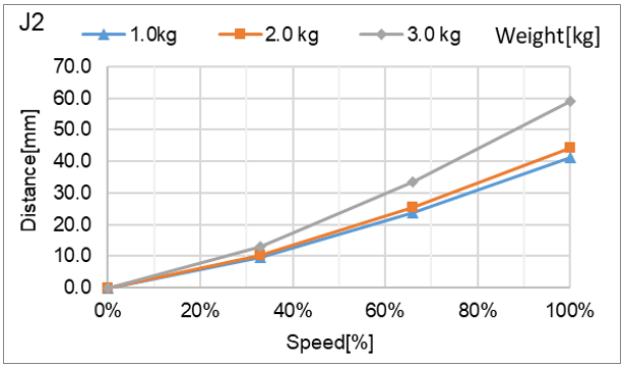
LA3-A401S: J1



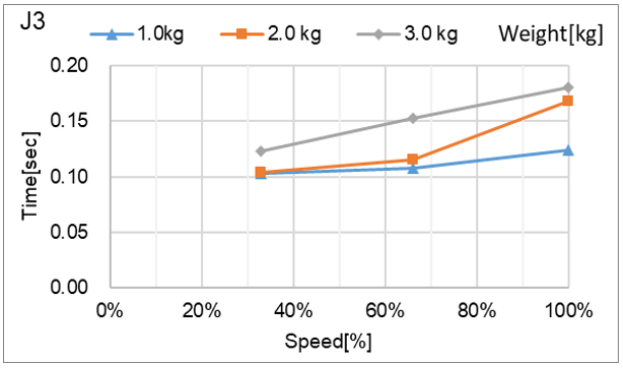


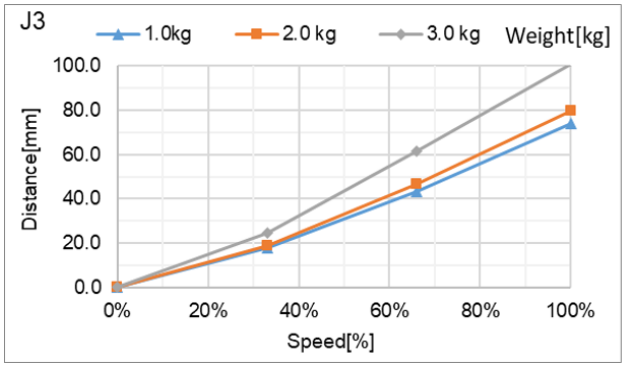
LA3-A401S: J2



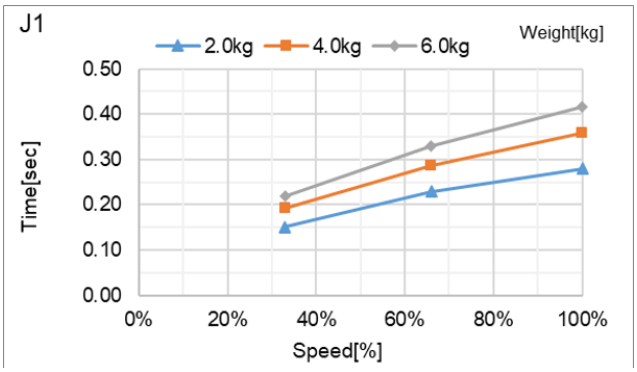


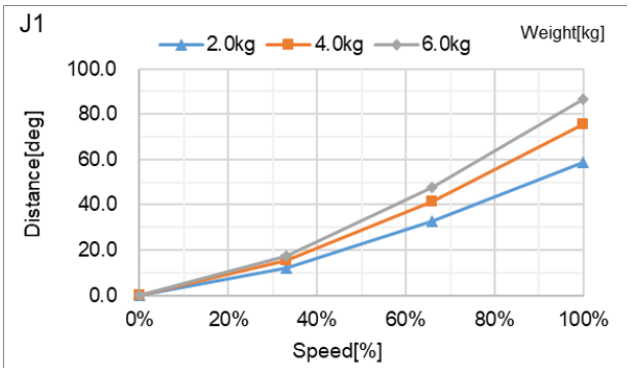
LA3-A401S: J3



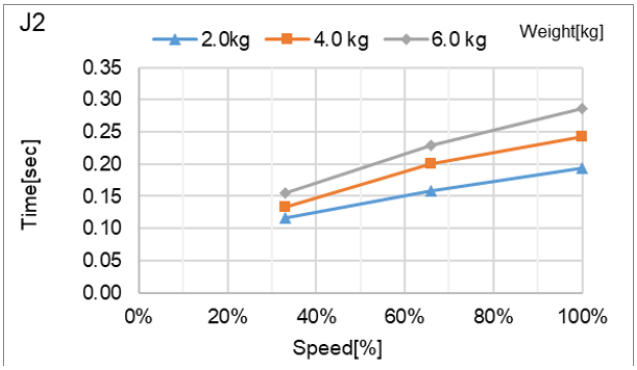


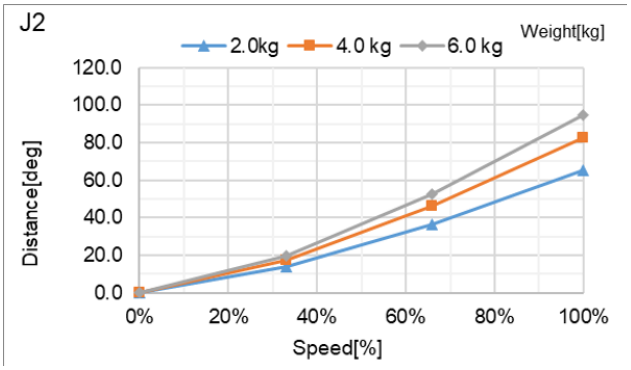
LA6-A502S: J1



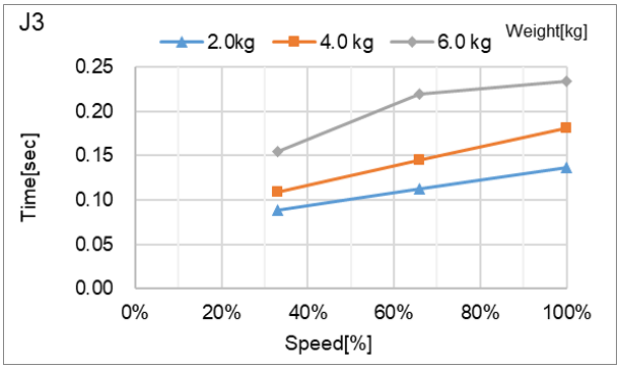


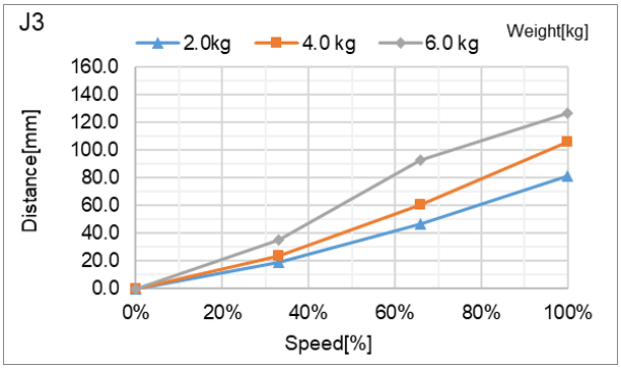
LA6-A502S: J2



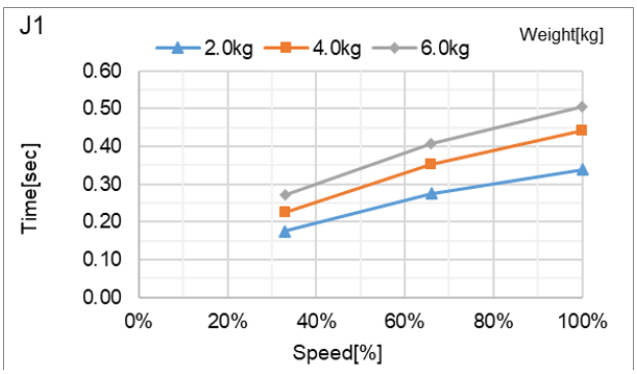


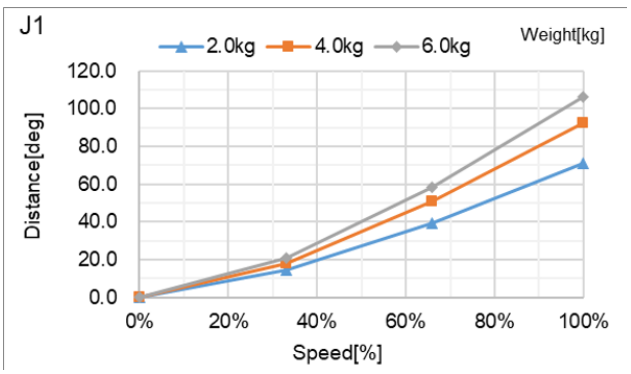
LA6-A502S: J3





LA6-A602S: J1





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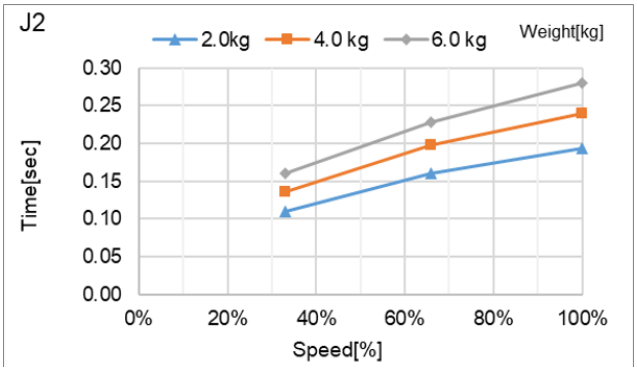
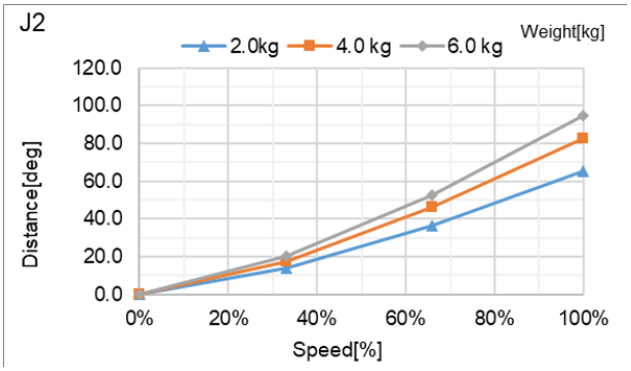
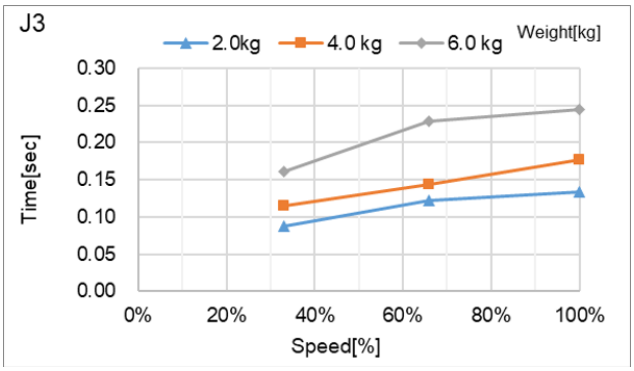
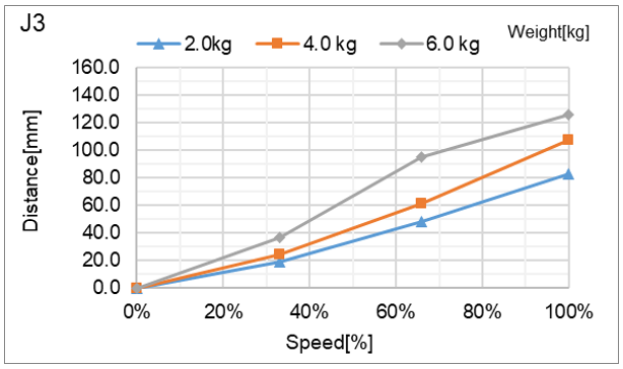


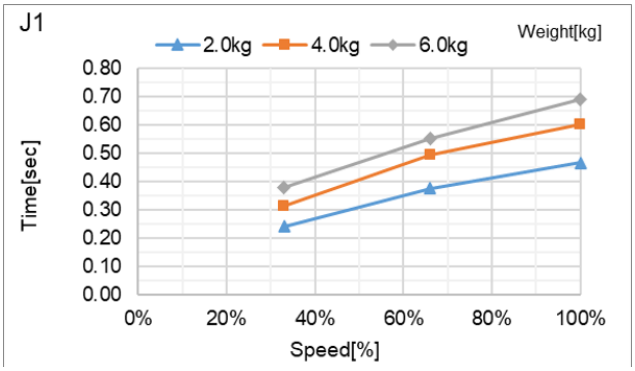


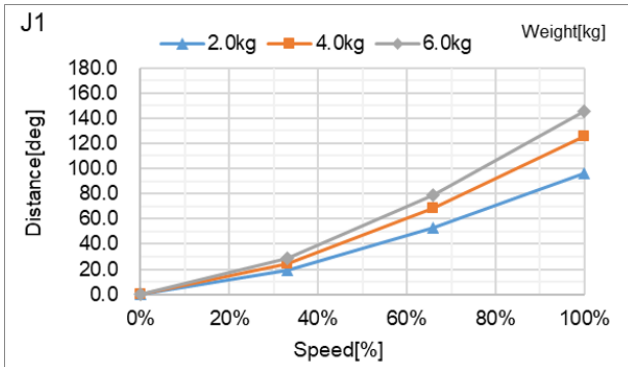
LA6-A602S: J3





LA6-A702S: J1





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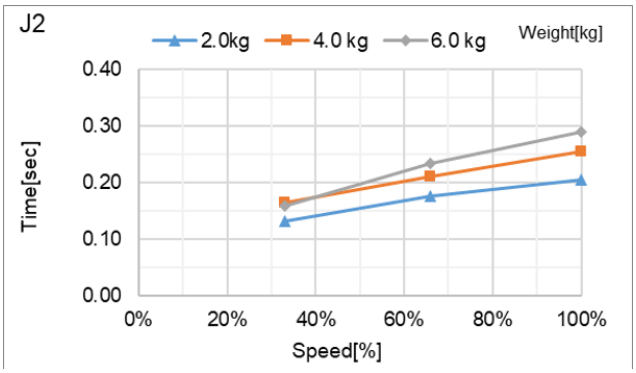
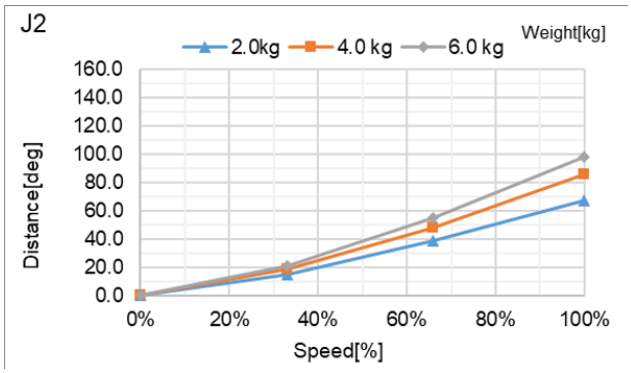
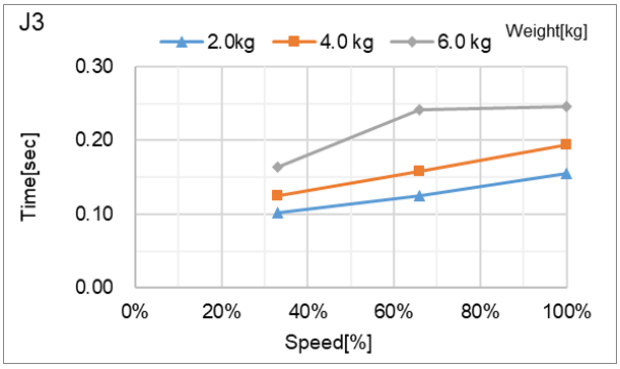
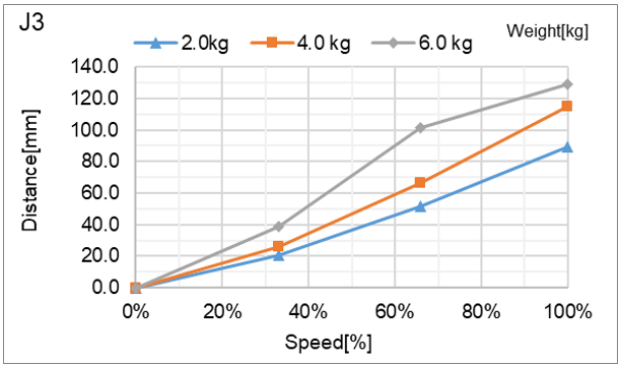




LA6-A702S: J3


J3
2.0kg
4.0 kg
6.0 kg
Weight[kg]
0.30
0.20
0.10
0.00
Time[sec]
0%
20%
40%
60%
80%
100%
Speed[%]


J3
2.0kg
4.0 kg
6.0 kg
Weight[kg]
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Distance[mm]
0%
20%
40%
60%
80%
100%
Speed[%]

4.2.2 Supplementary Information regarding the Stopping Time and Stopping Distance at Emergency Stop

The stopping time and stopping distance described in Appendix B was measured by the motion determined by us based on the ISO 10218-1.

Therefore, it does not guarantee the maximum value of the stopping time and stopping distance in the customer's environment.

The stopping time and stopping distance differs depending on the robot's model, motion, and input timing of the stop signal. Make sure to always calculate the stopping time and stopping distance that matches the customer's environment.

KEY POINTS

The following are included in the robot's motion and parameter.

- • the motion's starting point, target point, and relay point
- • motion commands (Go, Move, Jump etc.)
- • Weight and Inertia Settings
- Motion speed, acceleration, deceleration, and one where the motion timing changes.

For details, refer to the following.

Weight and Inertia Settings

4.2.2.1 How to check the stopping time and stopping distance in the customer's environment

Measure the stopping time and stopping distance of the actual operation with the following method:

1. Create a motion program in the customer's environment.
2. When the motion to check the stopping time and stopping distance starts, input the stop signal on your own timing.
3. Write down the time and distance of when the manipulator stops from the minute the stop signal is input.
4. Repeat 1 through 3 mentioned above and check the maximum stopping time and stopping distance.

- How to input the stop signal: Manually operate the stop switch or input the stop signal with the Safety PLC.
- How to measure the stopping position: Use a measure. You can also measure the angle with the Where or RealPos command.
- How to measure the stopping time: Use a stop watch. You can also measure with the Tmr function.

⚠ CAUTION

The stopping time and stopping distance varies depending on the timing that the stop signal was input.

Perform a risk assessment based on the maximum stopping time and stopping distance and design the device to prevent interfering with people and objects.

Therefore, make sure to always change the timing you input the stop signal and continue measuring to get the maximum value.

To shorten the stopping time and stopping distance, use the safety limited speed and limit the maximum speed.

For details on the safety limited speed (SLS), refer to the following manual:

“Safety Function Manual”

4.2.2.2 Introduction of commands that are useful in measuring the stopping time and stopping distance

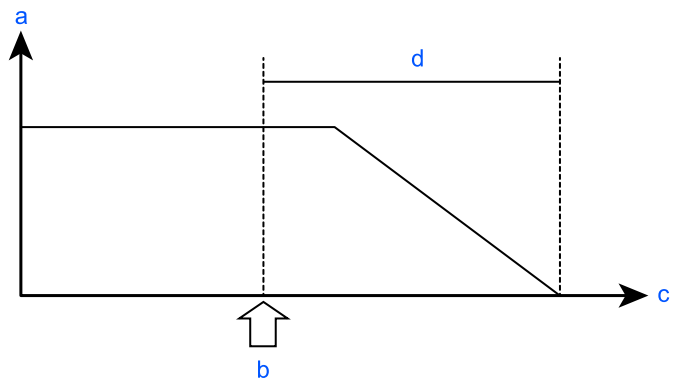
Commands	Functions
Where	Displays the data of the robot’s current position.
RealPos	Returns the specified robot’s current position. Unlike the CurPos’s motion target position, it receives the robot's position from the encoder.
PAgl	Returns by calculating the Joint’s position from the specified coordinate value. P1 = RealPos ‘Gets the current position. Joint1 = PAgl (P1, 1) ‘ Call for J1’s angle from the current position
SF_RealSpeedS	Displays the current speed from the Safety Limited Speed in mm/s.
Tmr	The Tmr function returns the time, in seconds, since the timer starts.
Xqt	Runs the program specified by the function name and creates a task. Run the functions used to measure the stopping time and stopping distance with the task that was setup by installing the NoEmgAbort option. Run tasks that does not stop even with the emergency stop or when the safeguard is open.

For details, refer to the following manual.
“Epson RC+ SPEL+ Language Reference”

4.3 Appendix C: Stopping Time and Stopping Distance When Safeguard is Open

The stopping time and stopping distance when the safeguard is opened are shown in the graphs for each model.

The stopping time is “Stopping time” in the figure below. Be sure to confirm that safety is ensured according to the installation environment and operation of the robot.



Symbol	Description
a	Motor speed
b	Safeguard open
c	Time

Symbol	Description
d	Stopping Time

Conditions

The stopping time and stopping distance depend on the parameters (setting values) that were set for the robot. These graphs show the times and distances for the following parameters.

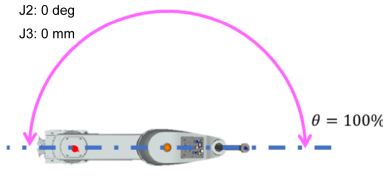
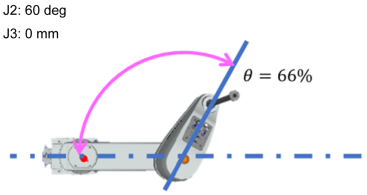
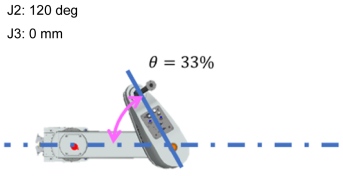
These conditions are based on the ISO 10218-1:2011 Annex B.

- Accel: 100, 100
- Speed： 100 %, 66 %, 33 % Settings
- Weight: 100 %, 66 %, 33 % of the maximum payload, rated payload
- Arm elongation rate: 100% 66%, 33% *1
- Other: Default
- Motion: Singular axis of a Go command
- Input timing of the Stop signal: Input with maximum speed. In this motion, it is the center of the motion range.

*1 The arm elongation rate when J1 is operating: Arm elongation rate 0 is as shown in the figure below.

The graphs indicate the results where the stopping time and the stopping distance in the longest among the following arm elongation rate.

When J2 is operating, J3 is 0 mm.

Axis	θ = 100%	θ = 66%	θ = 33%
J1			

Explanation of legend The graphs are displayed for each Weight setting value (at 100%, approx. 66%, and approx. 33% of the maximum payload, and at the rated payload).

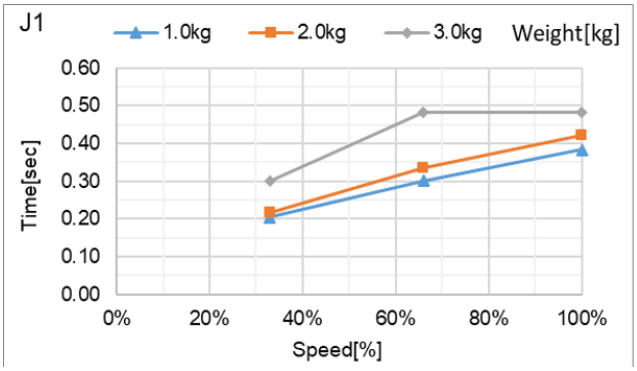
- Horizontal axis: Arm speed (Speed value)
- Vertical axis: Stopping time and stopping distance in each arm speed
- Time [sec]: Stopping time
- Distance [deg]: Stopping distance of J1 and J2
- Distance [mm]: Stopping distance of J3

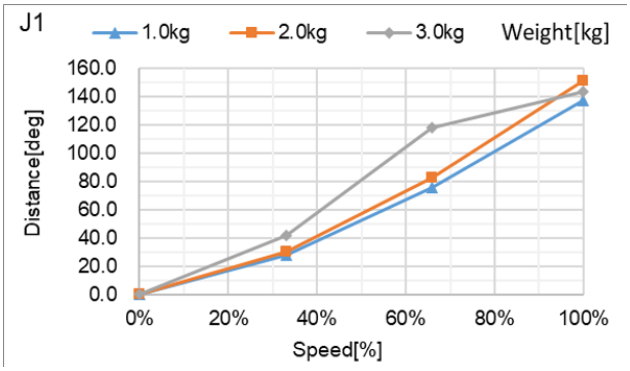
When single failures are taken into account, the following adjustments are used.

- Stopping distance and angle: Each axis reaches the mechanical stop
- Stopping time: Add 500 ms

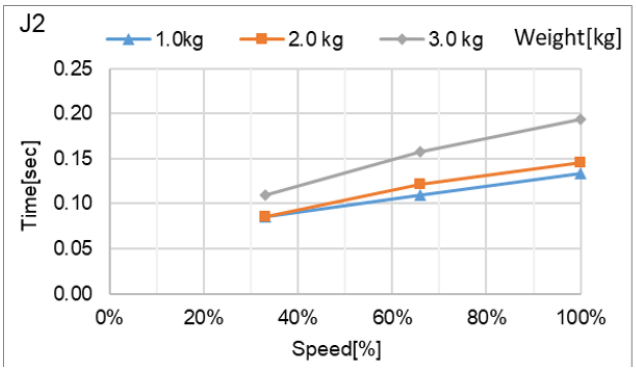
4.3.1 Stopping Time and Stopping Distance When Safeguard is Open

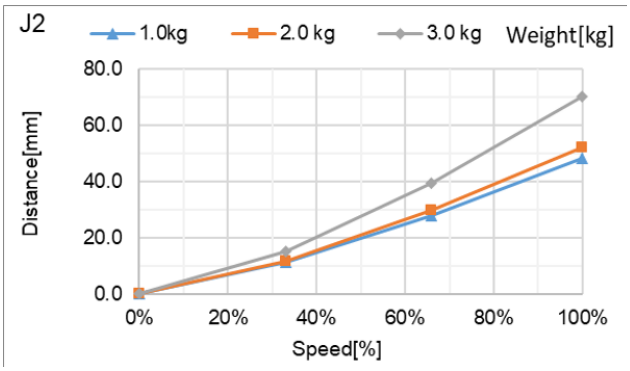
LA3-A401S: J1



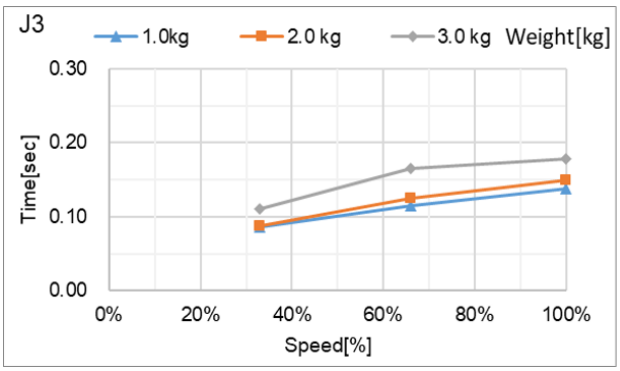


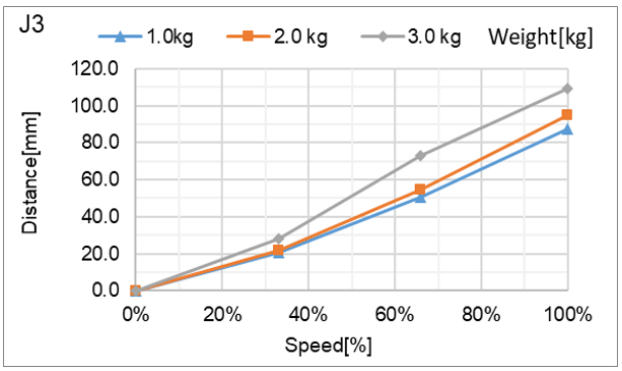
LA3-A401S: J2



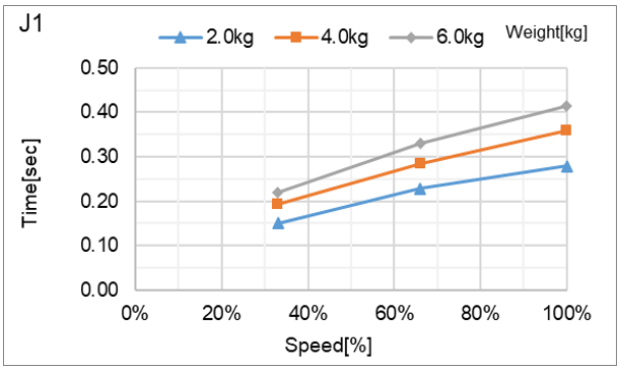


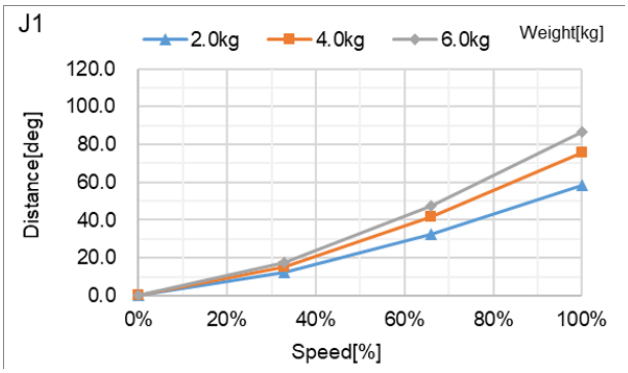
LA3-A401S: J3



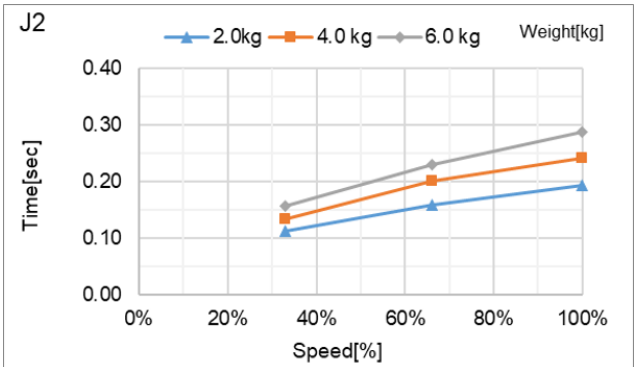


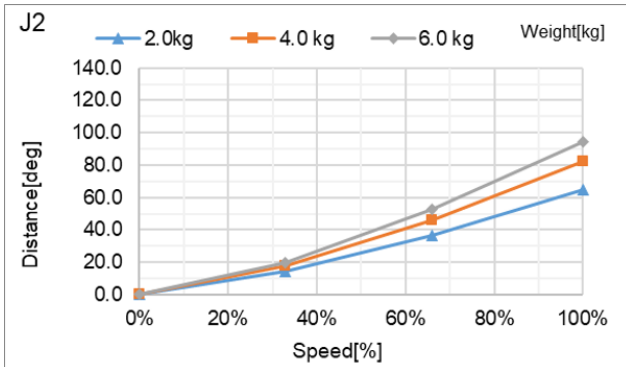
LA6-A502S: J1



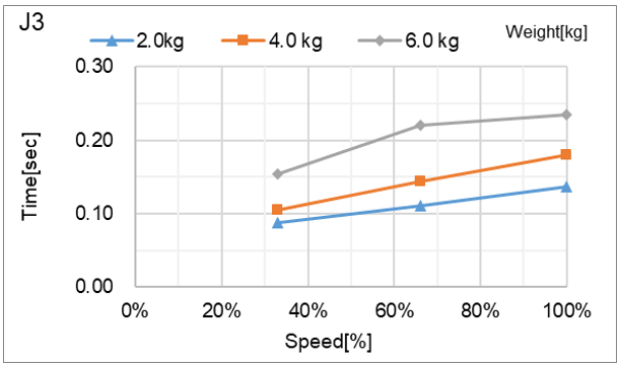


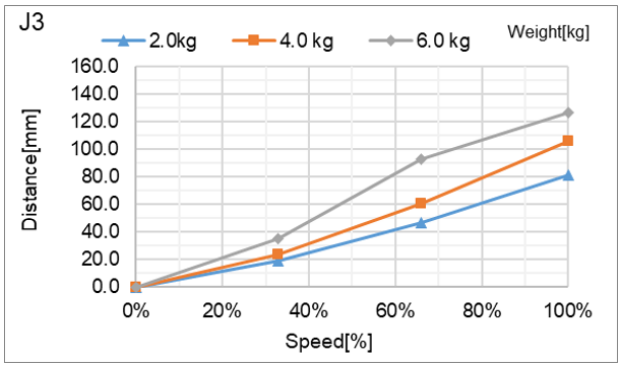
LA6-A502S: J2



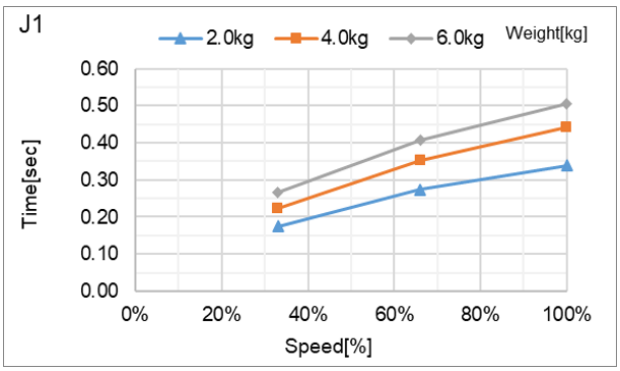


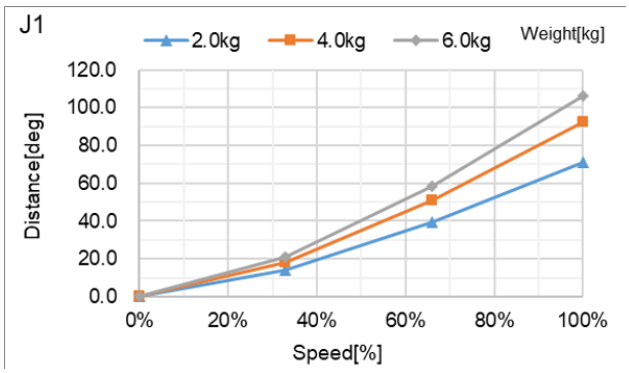
LA6-A502S: J3





LA6-A602S: J1





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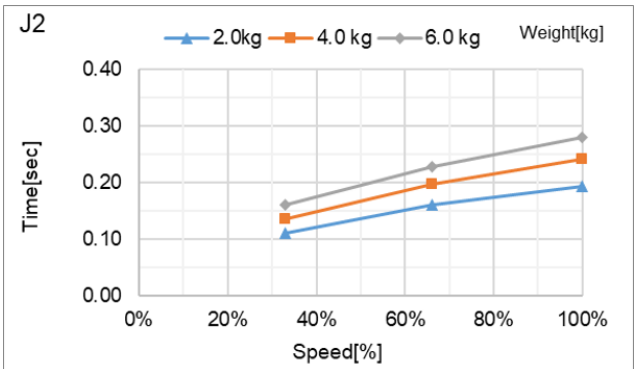
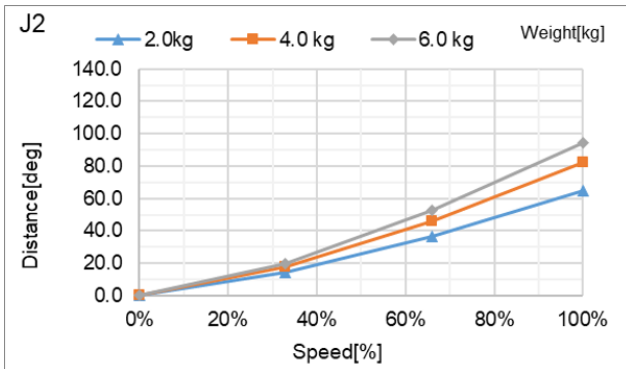
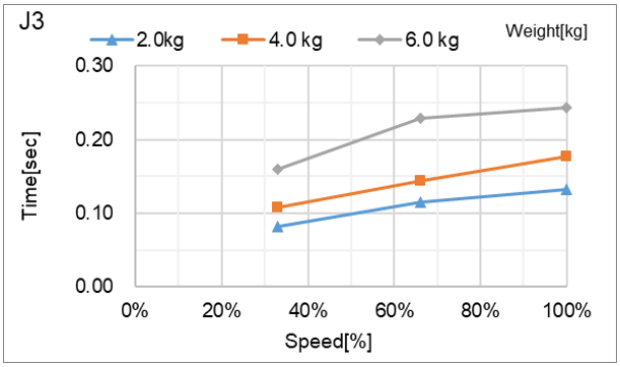
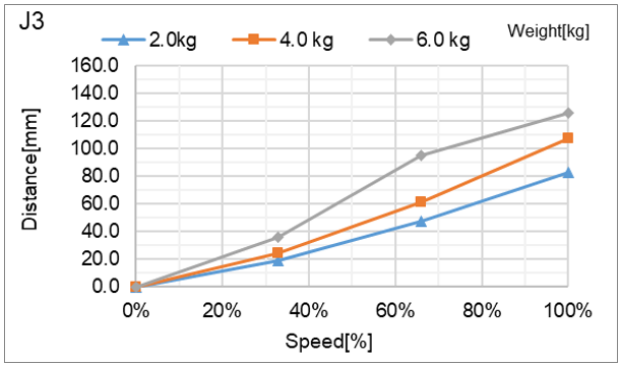


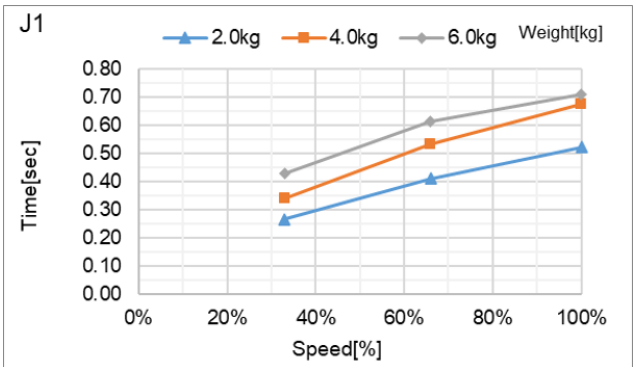


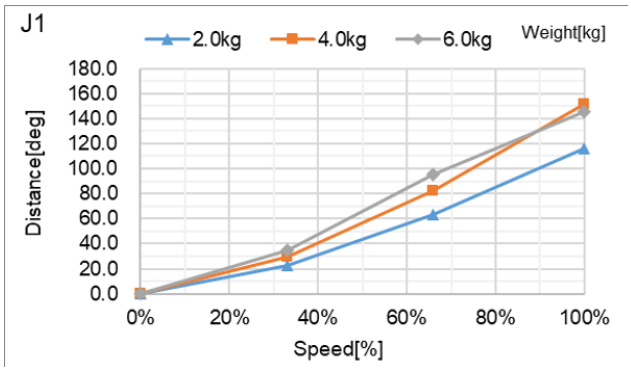
LA6-A602S: J3



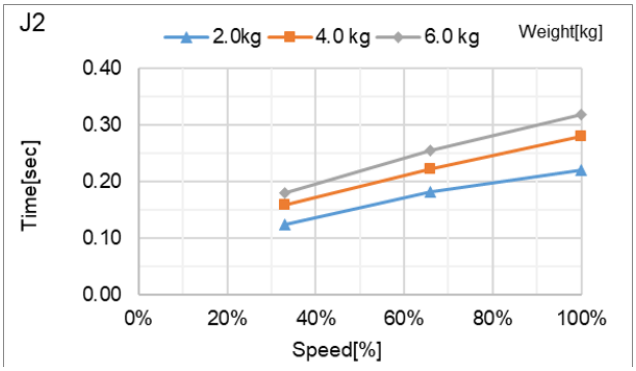


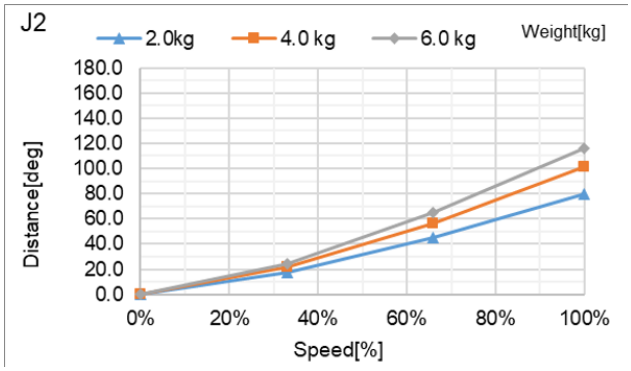
LA6-A702S: J1



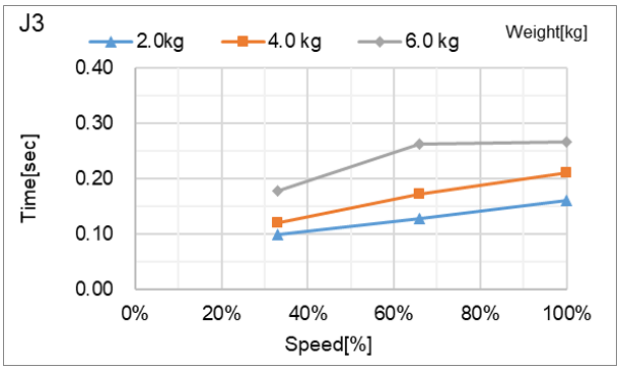


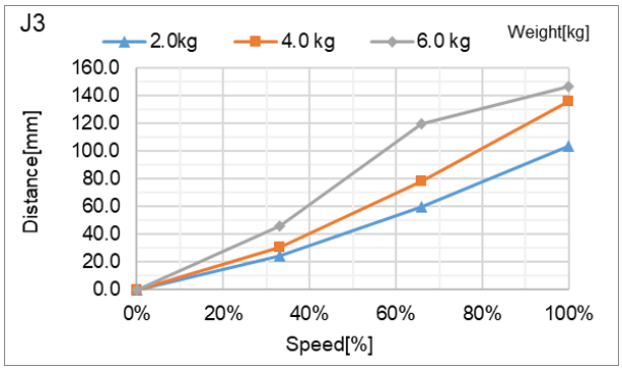
LA6-A702S: J2





LA6-A702S: J3





4.3.2 Supplementary Information regarding the Stopping Time and Stopping Distance when the Safeguard is Open

The stopping time and stopping distance described in Appendix C was measured by the motion determined by us based on the ISO 10218-1.

Therefore, it does not guarantee the maximum value of the stopping time and stopping distance in the customer's environment.

The stopping time and stopping distance differs depending on the robot's model, motion, and input timing of the stop signal.

Make sure to always calculate the stopping time and stopping distance that matches the customer's environment.

KEY POINTS

The following are included in the robot's motion and parameter.

- the motion's starting point, target point, and relay point
- motion commands (Go, Move, Jump etc.)
- Weight and Inertia Settings
- Motion speed, acceleration, deceleration, and one where the motion timing changes.

Refer to the following.

Weight and Inertia Settings

4.3.2.1 How to check the stopping time and stopping distance in the customer's environment

Measure the stopping time and stopping distance of the actual operation with the following method:

1. Create a motion program in the customer's environment.
2. When the motion to check the stopping time and stopping distance starts, input the stop signal on your own timing.
3. Write down the time and distance of when the manipulator stops from the minute the stop signal is input.
4. Repeat 1 through 3 mentioned above and check the maximum stopping time and stopping distance.

- How to input the stop signal: Manually operate the stop switch/safeguard or input by using the safety PLC.
- How to measure the stopping position: Use a measure. You can also measure the angle with the Where or RealPos command.
- How to measure the stopping time: Use a stop watch. You can also measure with the Tmr function.

⚠ CAUTION

The stopping time and stopping distance varies depending on the timing that the stop signal was input.

Perform a risk assessment based on the maximum stopping time and stopping distance and design the device to prevent the Manipulator from interfering with people and objects.

Therefore, make sure to always change the timing you input stop signal during the actual operation and continue to measure to get the maximum value.

To shorten the stopping time and stopping distance, use the safety limited speed (SLS) and limit the maximum speed.

For details on the safety limited speed (SLS), refer to the following manual:

“Safety Function Manual”

4.3.2.2 Introduction of commands that are useful in measuring the stopping time and stopping distance

Commands	Functions
Where	Displays the data of the robot’s current position.
RealPos	Returns the specified robot’s current position. ※ Unlike the CurPos’s motion target position, it receives the robot's position from the encoder.
PAgl	Returns by calculating the Joint’s position from the specified coordinate value. P1 = RealPos ‘Gets the current position. Joint1 = PAgl (P1, 1) ‘ Call for J1’s angle from the current position
SF_RealSpeedS	Displays the current speed from the Safety Limited Speed in mm/s.
Tmr	The Tmr function returns the time, in seconds, since the timer starts.
Xqt	Runs the program specified by the function name and creates a task. Run the functions used to measure the stopping time and stopping distance with the task that was setup by installing the NoEmgAbort option. Run tasks that does not stop even with the emergency stop or when the safeguard is open.

For details, refer to the following manual.

“Epson RC+ SPEL+ Language Reference”