

Mitsubishi Electric AC Servo System

MITSUBISHI ELECTRIC SERVO SYSTEM
MELSERVO

Linear Servo Motor
User's Manual
(LM-AJ series)

-LM-AJ

SAFETY INSTRUCTIONS

Please read the instructions carefully before using the equipment.

To use the equipment correctly, do not attempt to install, operate, maintain, or inspect the equipment until you have read through this manual, installation guide, and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information and instructions.

In this manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



WARNING

Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



CAUTION


Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury.

Note that the CAUTION level may lead to a serious consequence depending on conditions.


Please follow the instructions of both levels because they are important to personnel safety.

Forbidden actions and required actions are indicated by the following diagrammatic symbols.



Indicates a forbidden action. For example, "No Fire" is indicated by .



Indicates a required action. For example, grounding is indicated by .

In this manual, precautions for hazards that can lead to property damage, instructions for other functions, and other information are shown separately in the "POINT" area.

After reading this manual, keep it accessible to the operator.

[Transportation]



CAUTION

- To prevent injury, transport the products correctly according to their mass.
-

[Installation/wiring]



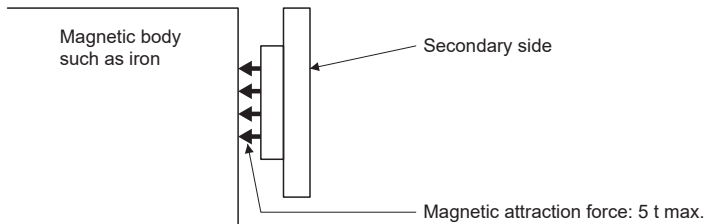
WARNING

- To prevent an electric shock, turn off the power and wait for 15 minutes or more before starting wiring and/or inspection.
 - To prevent an electric shock, ground the linear servo motor securely.
 - To prevent an electric shock, any person who is involved in wiring should be fully competent to do the work.
 - To prevent an electric shock, do not attempt to wire the linear servo motor until it has been mounted.
 - To prevent an electric shock, do not touch the conductive parts.
-

[Installation/wiring]

CAUTION

- To prevent injury, only professional engineers with knowledge of the product should install the product.
- To prevent injury when handling the linear servo motor, do not touch sharp edges such as the sharp edges of the linear servo motor with bare hands.
- On linear servo motors, the permanent magnet on the secondary side generates attraction force in the area between the magnetic material. This attraction force may cause injuries to hands and other body parts that enter the area between the secondary side and the magnetic material, so take special care when handling the motor.



[Maintenance]

WARNING

- To prevent an electric shock, any person who is involved in inspection should be fully competent to do the work.

CAUTION

- To prevent injury, only professional engineers with knowledge of the product should replace the product.

[Disposal]

CAUTION

- To prevent injury, only professional engineers with knowledge of the product should dispose of the product.
- To avoid a burn when heating the secondary side to 300 °C or more in order to demagnetize it, allow the secondary side to adequately cool before touching it.

DISPOSAL OF WASTE

Please dispose of this product and other options according to your local laws and regulations.

ABOUT THE MANUAL

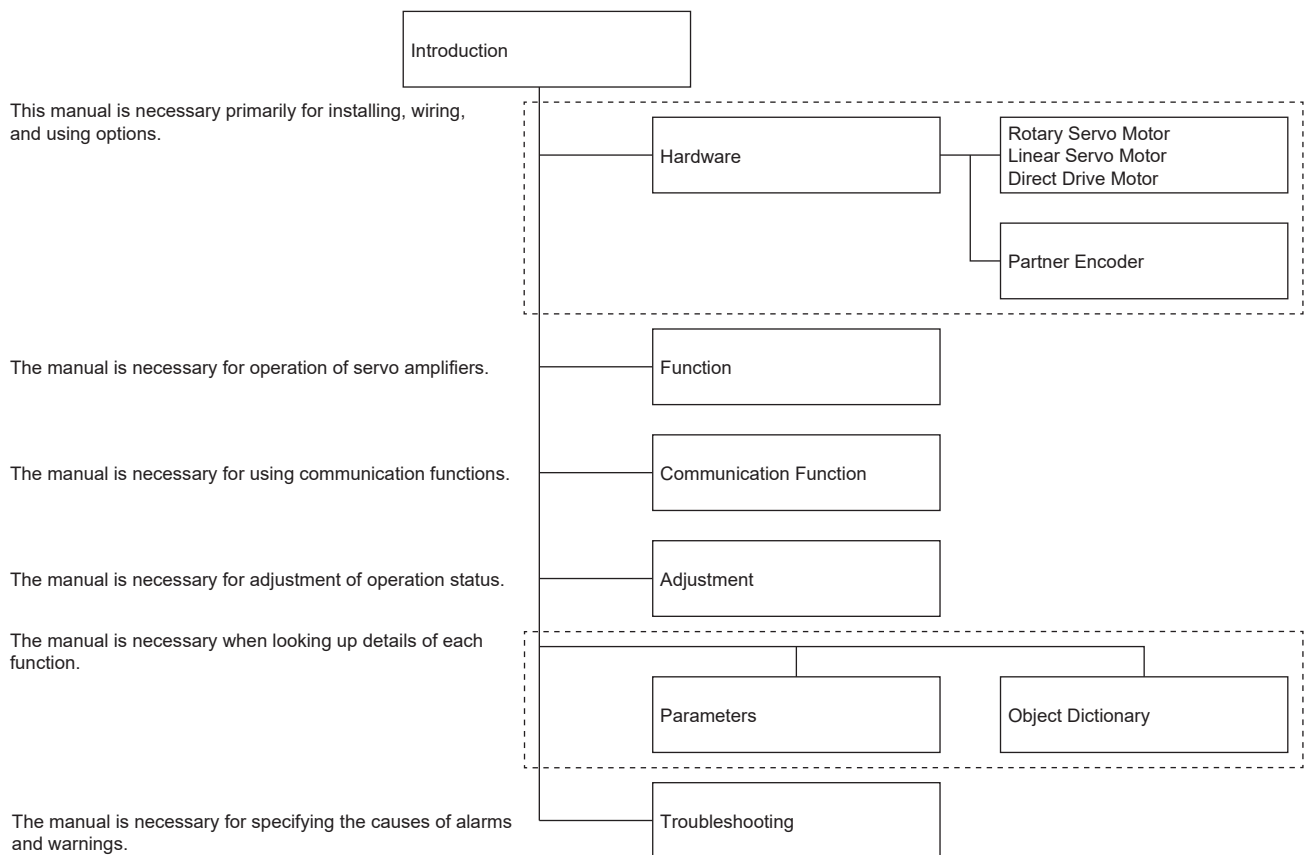
Point

e-Manuals are Mitsubishi Electric FA electronic book manuals that can be browsed with a dedicated tool.

e-Manuals enable the following:

- Searching for desired information in multiple manuals at the same time (manual cross searching)
- Jumping from a link in a manual to another manual for reference
- Browsing for hardware specifications by scrolling over the components shown in product illustrations
- Bookmarking frequently referenced information
- Copying sample programs to engineering tools

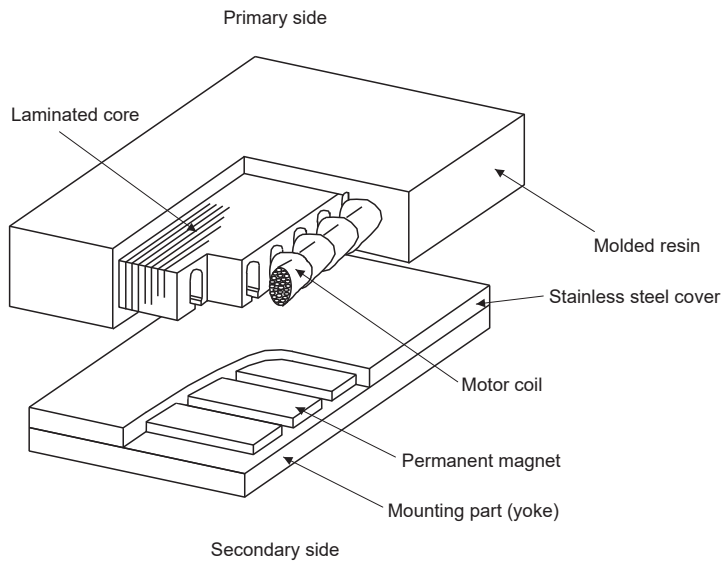
If using the servo for the first time, prepare and use the following related manuals to ensure that the servo is used safely. The manuals used differ depending on the interface of the servo amplifier. For details, refer to the User's Manual (Introduction).



HANDLING THE LINEAR SERVO MOTOR

Structure of the linear servo motor

The linear servo motor consists of a primary side made up of an iron core and coil and a secondary side made up of a mounting part (yoke) and a permanent magnet.



■Primary side

The primary side contains a magnet wire wound around the iron core of the motor and is covered with molded resin.

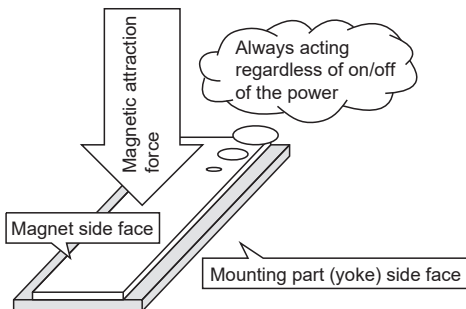
■Secondary side

The secondary side has a permanent magnet on the mounting part (yoke) that is protected with a stainless steel cover.

Magnetic attraction force

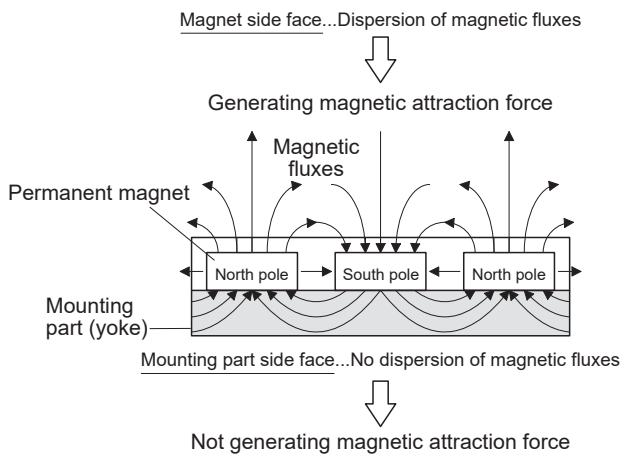
The secondary side of the linear servo motor contains a strong permanent magnet, so a magnetic attraction force (the force by which a magnet attracts magnetic materials) is generated toward magnetic materials such as iron.

This magnetic attraction force is always generated regardless of whether the linear servo motor power is on/off.



The magnetic fluxes generated by the permanent magnet are dispersed into the air from the magnet face side (the side facing the primary side), and most of said fluxes do not leak to the mounting part (yoke) surface side due to its structure.

Because of this, the magnetic attraction force occurs on the magnet face side of the secondary side, not on the mounting part (yoke) surface side.

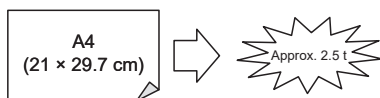


The permanent magnet used for the linear servo motor is very strong.

When an A4-sized iron sheet is fully attracted, the magnetic attraction force becomes as high as 2.5 t. Exercise sufficient caution when handling the product.

Magnetic attraction force ≈ 400 [kPa]

If an A4-size iron sheet is fully attracted...



For safety

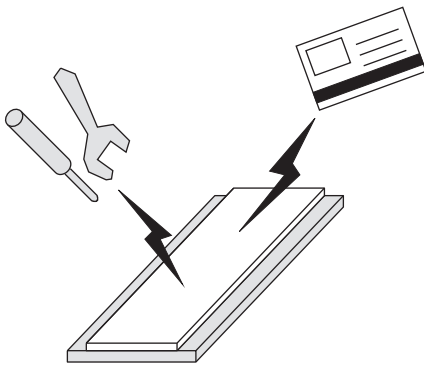
The magnetic attraction force is in inverse proportion to the square of the distance between magnetic materials, and said force drastically increases when the distance becomes small.

When mounting the secondary side of the linear side motor, ensure that the distance from nearby magnetic materials is sufficient and securely fix said magnetic materials into place.

If a problem is suspected with the product, stop using it immediately.

Notes on handling

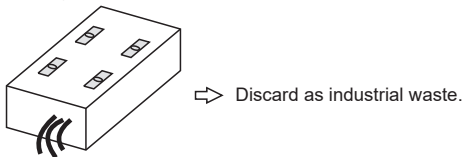
- Only professional engineers with knowledge of the product should handle it.
- Individuals using a medical device such as a pacemaker must keep a distance from the product and equipment.
- Do not wear metal items such as watches, earrings, necklaces, etc.
- Use non-magnetic tools. (Example) BEALON explosion-proof beryllium copper alloy safety tools (NGK)
- Do not place magnetic cards, watches, portable phones, etc. close to the motor.
- Do not process or strike the product.
- Place signage stating "Caution - Strong magnetic field", etc. In addition, take measures that make the location of the product known in the surrounding area.



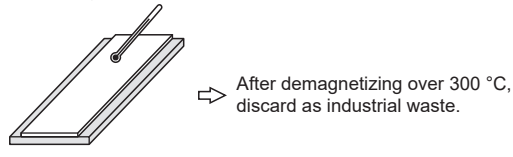
Disposal of the linear servo motor

- The primary side must be discarded as industrial waste.
- The secondary side must be discarded as industrial waste after it is demagnetized by being heating to 300 °C or more.
- Do not leave the product unpacked when it is not in use.

Primary side



Secondary side



CABLES USED FOR WIRING

Cables mentioned in this manual are selected based on an ambient temperature of 40 °C.

U.S. CUSTOMARY UNITS

U.S. customary units are not shown in this manual. Convert the values if necessary according to the following table.

Quantity	SI (metric) unit	U.S. customary unit
Mass	1 [kg]	2.2046 [lb]
Length	1 [mm]	0.03937 [inch]
Torque	1 [N•m]	141.6 [oz•inch]
Moment of inertia	1 [$\times 10^{-4}$ kg•m ²]	5.4675 [oz•inch ²]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [$^{\circ}$ C] \times 9/5 + 32	N [$^{\circ}$ F]

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1 INTRODUCTION

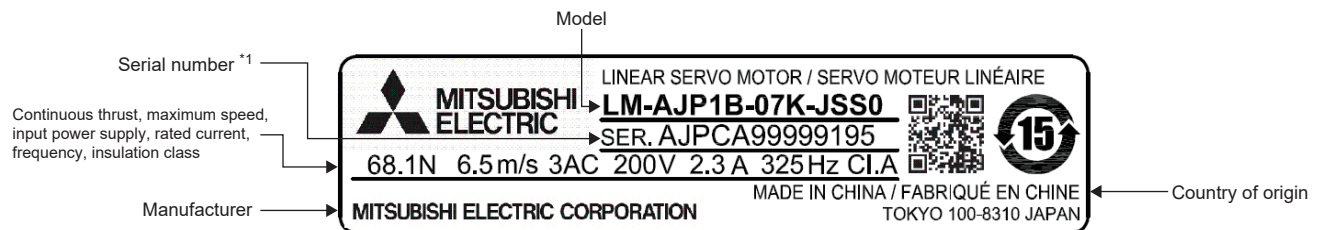
The linear servo motor uses a strong magnet on the secondary side. Incorrect handling is extremely dangerous and may cause serious accidents. Please read this chapter and thoroughly understand the contents before using the motor and be sure to handle the motor carefully.

1.1 Rating plate

The following shows an example of the rating plate for explanation of each item.

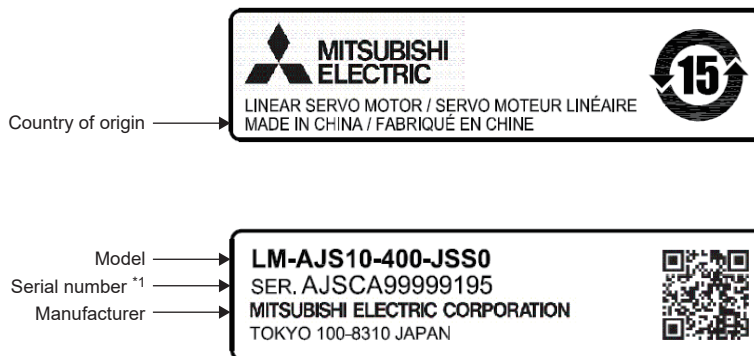
Primary side (coil)

■LM-AJ series



*1 The production year and month of the primary side of the linear servo motor are indicated in the serial number on the rating plate. For the production year and month, the last two digits of the year and the month in numerical format [1 to 9, X (10), Y (11), and Z (12)] are displayed. For January 2012, the serial number would be "SER. _____ 121".

Secondary side (magnet)



*1 The production year and month of the secondary side of the linear servo motor are indicated in the serial number on the rating plate. For the production year and month, the last two digits of the year and the month in numerical format [1 to 9, X (10), Y (11), and Z (12)] are displayed. For January 2012, the serial number would be "SER. _____ 121".

1.2 Environment

Item	Operation	Storage/transportation
Ambient temperature	0 °C to 40 °C (non-freezing)	-15 °C to 70 °C (non-freezing)
Ambient humidity	10 %RH to 80 %RH (non-condensing)	10 %RH to 90 %RH (non-condensing)
Ambience	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust	
Altitude	1000 m or less	
Vibration resistance	☞ Page 29 Standard specifications list	

1.3 Design instructions

Precautions

- Although a dynamic brake can be applied by the servo amplifier, the coasting distance becomes longer when the mass of the moving part is heavy or when the speed is high. This is highly dangerous and may result in a collision into the stroke end. Install an anti-collision mechanism such as an air brake or an electric/mechanical stopper such as a shock absorber to reduce the shock of moving parts. (No linear servo motor with an electromagnetic brake is available.)
- The magnetic attraction force operating between the primary and secondary sides is always in operation even when the linear servo motor power is not turned on. As such, the machine must be designed with sufficient rigidity to support the magnetic attraction force and maintain the accuracy.
- Since the running load increases in proportion to the magnetic attraction force due to friction, arrange to reduce friction as much as possible by precisely installing the linear guide, etc.
- When the linear servo motor is used on a vertical axis, provide a drop prevention system to prevent free fall at servo-off by using a spring or a counter balance.
- Install the linear servo motor so that the thrust operates on the center of gravity of the moving part. When the thrust does not operate on the center of gravity of the moving part, a moment occurs.
- If magnetic powders such as iron shavings are present, they may stick to the permanent magnet on the secondary side and cause a malfunction. In such an environment, take measures to prevent the adhesion and entry of magnetic powders.
- While both the linear encoder and the linear servo motor should be oil and dust proofed, oil and dust proofing are especially important for the linear encoder. For details, contact the manufacturer of the linear encoder being used.
- Do not allow the primary side to come into contact with the stopper. Doing so may damage the primary side. Arrange the system so that only the table attached to the primary side comes into contact with the stopper.
- Do not use the screw holes of the linear servo motor for any purpose other than for machine installation.
- For installation, use all of the screw holes provided on the linear servo motor.
- If it is assumed that a power failure or product malfunction may result in a hazardous situation, provide an external brake system for holding purposes to prevent such hazards.
- Provide adequate protection to prevent an unexpected restart after an instantaneous power failure.
- Arrange for the primary and secondary side to satisfy the mounting dimensions.
- When using a linear guide as the base, check the specifications and determine the processing accuracy. For details, contact the manufacturer of the linear guide being used.
- The movable range of the linear servo motor should be equal to or less than the effective measurement length of the linear encoder.
- For the stopper, use shock-absorbing material such as polyurethane rubber.
- Conditions where cutting fluid or lubricating oil are constantly applied or where condensation occurs for an extended period of time due to the effects of oil-mist lubrication, over-cooling, or excessive humidity may result in the deterioration of the insulation on the linear servo motor. Provide measures such as oil proofing, a dust proof cover, or condensation prevention to protect the linear servo motor.
- Consider the installation work when designing the system. For details of installation, refer to the following and the "Installation" section in the chapter for the linear servo motor series being used.

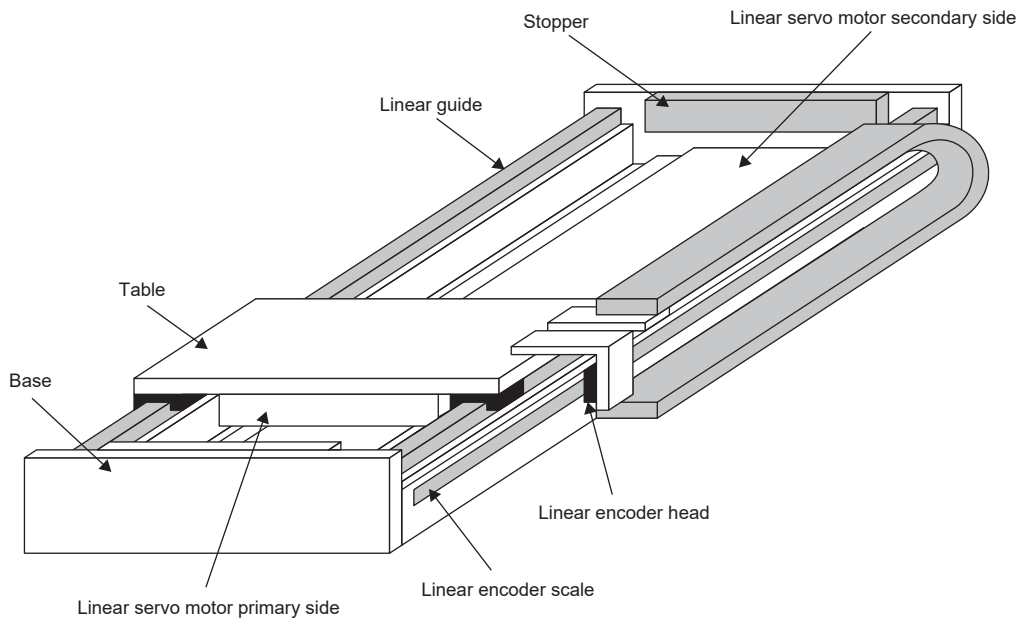
Page 14 Instructions on installation

- For high-accuracy positioning, ensure that the rigidity of the machines has been maximized and increase the mechanical resonance points.
- To ensure that the rigidity of the machines is maximized, adopt an integrated structure for the base. When it is necessary to use bolts, etc. as a fastener, use thick bolts with short neck dimensions. Make the pitch dimension of bolt holes as small as possible.
- Make the moving parts as light as possible, and make the base parts heavy and sturdy.
- When loading works, etc. on the table, make the center of gravity as low as possible. Additionally, the position of the center of gravity should be between the two linear guides.
- Since the movement or accuracy of the machine may be adversely affected, arrange for the center of thrust of the linear servo motor and the center of gravity of the moving object to be closer with one another.

- When the mounting rigidity of the linear encoder is insufficient, the feedback signal may be disturbed by the machine vibration, and the desired performance may not be achieved. Furthermore, as the same condition also applies in cases where the linear encoder is susceptible to electric noise, arrange or install the linear encoder in a way that minimizes exposure to vibration and electric noise.
- Establish a structure that can withstand high speeds and high acceleration/deceleration.

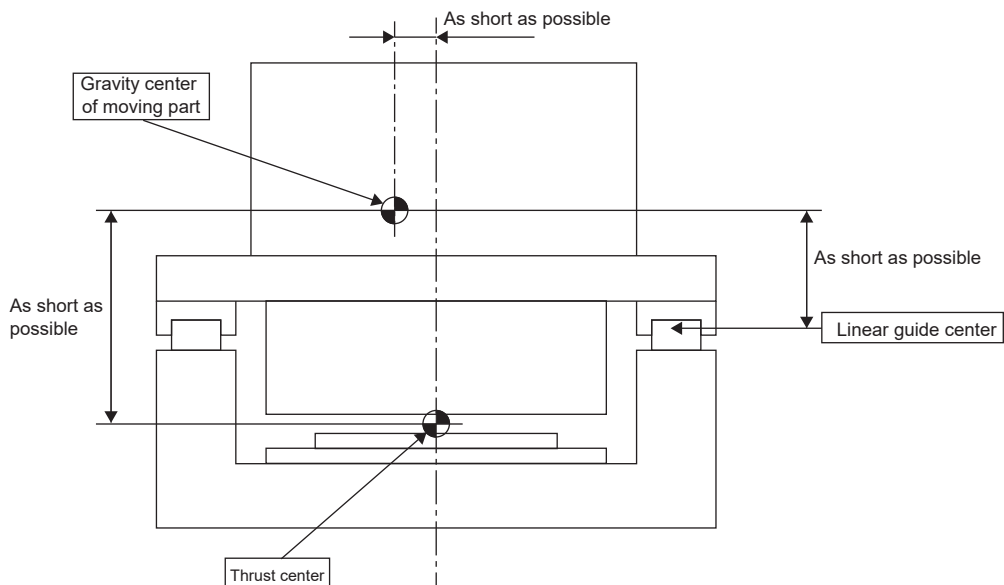
Basic structure for sliders incorporating the linear servo motor

The following figure shows an example of the basic structure for a linear slider.



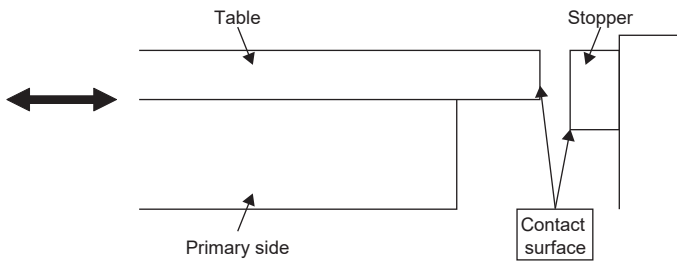
Instructions on the structure of the linear slider

Instructions on the structure of the linear slider are shown in the following figure.



Stopper

As shown in the following figure, arrange the system so that only the table attached to the primary side comes into contact with the stopper.



Linear encoder

While both the linear encoder and the linear servo motor should be oil and dust proofed, oil and dust proofing are especially important for the linear encoder.

For details, contact the manufacturer of the linear encoder being used.

Linear guide

Precisely install the linear guide.

For details, contact the manufacturer of the linear guide being used.

1.4 Instructions on installation

Instructions on the use of lifting machines such as cranes when installing the linear servo motor are shown below.

Precautions

- The cables should not be damaged, stressed, loaded, or pinched.
- Install the linear servo motor on incombustible material. Installing the linear servo motor either directly on or near combustibles may lead to smoke or a fire.
- Provide adequate protection so as to prevent conductive matter (such as screws and metal fragments) and combustible matter (such as oil) from entering the linear servo motor.
- The linear servo motor may become hot depending on the operating method. Take safety measures such as providing covers.
- Machine operators and workers installing linear servo motors are not allowed to wear or carry electronic devices (such as watches, calculators, and personal computers) and carry magnetic recording media (IC cards, magnetic cards, floppy disks, etc.) when working close to the secondary side. The magnetic effect of such items may cause operation failure or malfunction.
- Securely fix the linear servo motor to the machine. If attached insecurely, the motor may come off during operation.
- Do not overtighten the eyebolts of the linear servo motor. Tightening too hard may damage the tap.
- Do not stack in excess of the specified number of product packages.
- Do not carry the linear servo motor by the cables or connectors. Doing so may damage the linear servo motor.
- When installing the linear servo motor, follow the user's manual and install the motor in a place that can support its weight.
- When installing the secondary side, use non-magnetic tools.
- Securely fix the linear servo motor to the machine. If attached insecurely, the motor may come off during operation.
- The travel direction of the linear servo motor and the linear encoder must match. Failing to do so may cause the linear servo motor to operate unexpectedly.
- To prevent a connection failure, malfunction, or similar problem, do not strike the connector.
- Use the product within the specified environment. For details of the environment, refer to the specifications for the linear servo motor series being used.
- To prevent rust, do not touch the linear servo motor with bare hands.
- The primary side and secondary side of the linear servo motor may be damaged if they are dropped or struck.
- Do not install or operate a servo amplifier or linear servo motor that is missing parts or is damaged.
- The permanent magnet on the secondary side of the linear servo motor generates a magnetic attraction force against magnetic materials. Therefore, individuals using a medical device such as a pacemaker must check with the medical device manufacturer regarding whether they can work in such an environment.
- When in the original packing state (inside the cardboard box) that it was in when shipped from Mitsubishi Electric, the magnet on the secondary side does not have any serious impact on the outside environment. However, do not place magnetic materials (including the primary side, other secondary sides, and tools) close to the secondary side until the linear servo motor is assembled to the machine. Be cautious in the workplace and its surroundings.
- When installing the linear servo motor and working near the linear servo motor, use non-magnetic tools. Such tools are necessary to ensure safety and improve workability. In particular, exercise care when installing the primary side after installation of the secondary side is complete. For which screws to use, refer to the "Dimensions" section in the chapter for the linear servo motor series being used.
- Do not get on the equipment or put a heavy load on it.
- Do not drop or strike the linear servo motor.
- To prevent a fire or injury from occurring in case of an earthquake or other natural disasters, securely install, mount, and wire the linear servo motor in accordance with the user's manual.
- To prevent an electric shock or a fire, do not disassemble, repair, or modify the product. Disassembled, repaired, and/or modified products are not covered under warranty.
- Keep the cumulative pitch error of the mounting screw holes to within ± 0.2 mm. When two or more secondary sides are installed, clearance may be left between the secondary sides depending on the installing method and the number of secondary sides.

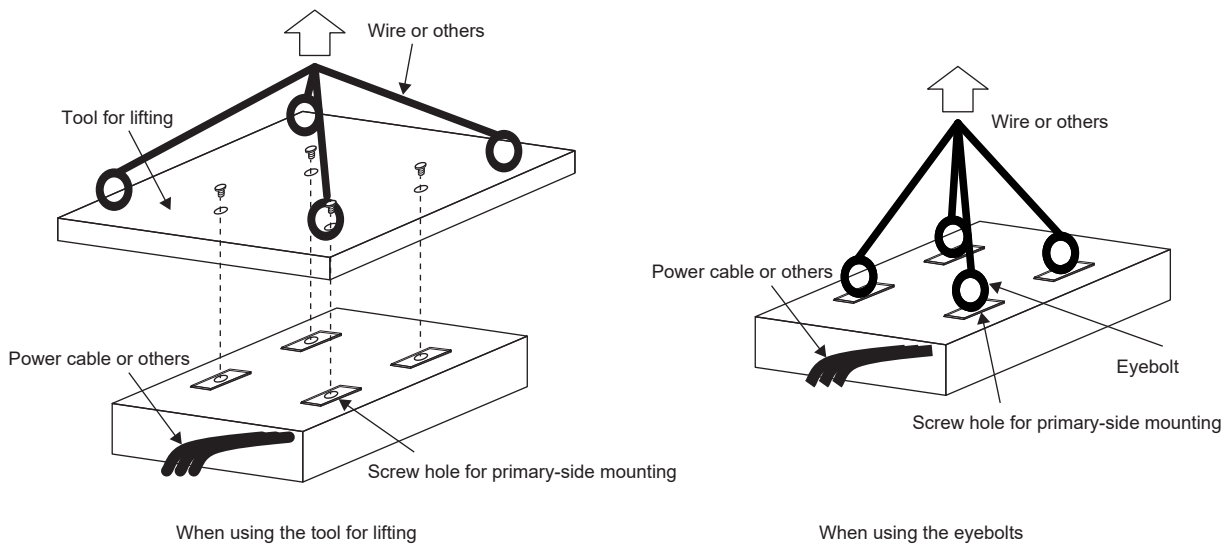
- When multiple personnel are working simultaneously, confirm that the area of the product containing moving parts is free of personnel before turning on the power. When personnel are present in the area containing moving parts, take measures such as providing an interlock to ensure that the equipment does not move.
- During installation, be sure to remove any iron powder or similar debris attached to the product.

Primary side (coil)

To lift the primary side, either attach a lifting tool to the primary side or attach eyebolts to the screw holes used for primary-side mounting as shown in the following figure.

When lifting, ensure that the wire does not apply stress to the mold part or the power supply cable, etc.

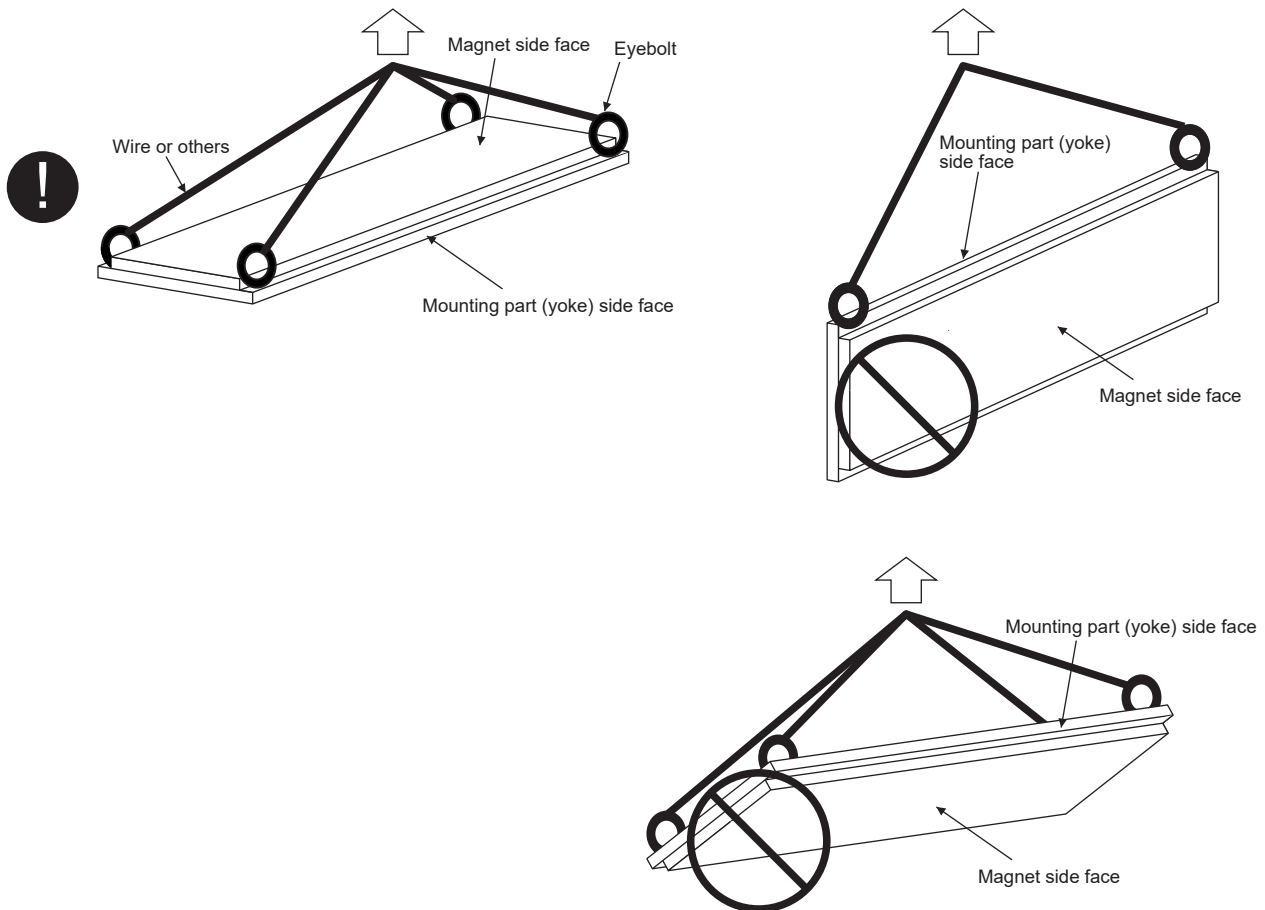
Set the lifting points (two or more) on both longitudinal ends.



Secondary side (magnet)

To lift the secondary side, attach eyebolts to the screw holes used for secondary-side mounting as shown in the following figure.

To avoid danger due to the magnetic attraction force when lifting the secondary side, ensure that the magnet face side is directed upward and set four or more lifting points.



1.5 Instructions on storage

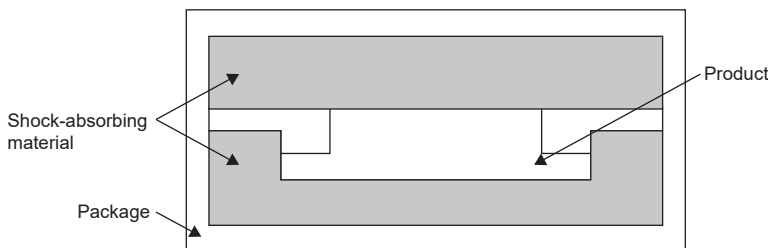
Precautions

Note the following when storing the linear servo motor for an extended period of time (guideline: three or more months).

- Always store the linear servo motor indoors in a clean and dry place.
- When storing in a dusty and humid area, take measures such as covering the whole product.
- Although the linear servo motor has been rust-proofed with paint and rust prevention oil before shipment, rust may appear if the linear servo motor is stored in poor conditions for an extended period of time. If the servo motor is to be stored for longer than six months, re-apply rust prevention oil again to machined surfaces such as the rotating parts.
- When the product has been stored for an extended period of time, contact your local sales office.
- Be sure to strictly maintain the storage requirements (ambient temperature and humidity, etc.).
- Store the product in an environment that is protected from rain water, low in dust, and free of oil and chemical adhesion.
- Do not apply a shock to the servo amplifier or linear servo motor.
- If the insulation resistance of the magnet wire decreases, reconsider how the equipment is being stored.
- Ensure that the product is stored with each side facing the proper direction.
- Do not leave the product (primary or secondary-side) unpacked when it is not in use. If the product is not fixed into place on the machine or equipment, store it correctly in the packing box that it came in.

Storage method

- Correctly store the linear servo motor inside the packing box it came in.



- When storing the secondary side, place signage stating "Handle with care - Strong magnetic field" or similar on the packing box or storage shelf, and also take measures that make the storage location known in the surrounding area.
- Do not use a deformed packing box.
- For details of the storage environment requirements, refer to the following.

☞ Page 10 Environment

- When lifting the product using a hoisting attachment, do not apply shock and stress to the mold part.

1.6 Instructions on disposal

Precautions

- The servo amplifier and the primary side of the linear servo motor must be disposed in accordance with "DISPOSAL OF WASTE".
- Since the secondary side of the linear servo motor uses a permanent magnet, demagnetize the entire secondary side by heating it to 300 °C or more, then dispose of it in accordance with "DISPOSAL OF WASTE".
- The permanent magnet on the secondary side of the linear servo motor generates a magnetic attraction force against magnetic materials. Therefore, individuals using a medical device such as a pacemaker must check with the medical device manufacturer regarding whether they can work in such an environment.
- Exercise caution against the magnetic force from the secondary side during and after disassembly, and until the secondary side has been demagnetized.
- When disassembling and disposing of the linear servo motor, do not place magnetic materials (including the primary side, other secondary sides, and tools) close to the secondary side.
- Use non-magnetic tools when disassembling and disposing of the linear servo motor, and when working near the motor. Such tools are necessary to ensure safety and improve workability.

2 INSPECTION

The linear servo motor is able to function as a motor after it is mounted in (built-in) the equipment. The IP rating is IP00. Perform the following inspections and cleaning.

Precautions

- The linear servo motor is structurally unrepairable. If the linear servo motor is damaged, it must be replaced.
- Customers must not disassemble and/or repair the equipment.
- Discoloration of the molded resin of the linear servo motor may occur. Although the chance of malfunction due to discoloration is slim, still inspect the molded resin portion.
- If a stainless steel magnet protective cover is used for the secondary side, damage or deformation may occur if the cover is strongly pressed or if magnetic material is attached to it. Exercise special care with the end part of the product as it is easily deformed.

2.1 Inspections of the primary side (coil)

Attachment of water and oil

Check that the primary and secondary side of the linear servo motor are not wet with water or oil. If the linear servo motor is wet, a malfunction may occur due to deterioration of the insulation on the primary side. Establish a mechanical structure in which water and oil do not become attached to the linear servo motor.

Molded resin

Check the molded resin on the primary side for fragmentations, breakages, and cracks. If fragmentations, breakages, and cracks are found, replace the primary side as a malfunction may occur due to deterioration of the insulation.

Scratches on the surface that faces the secondary side (magnet)

Check for scratches on the primary side surface facing the secondary side. If there are scratches on the primary side surface facing the secondary side, replace the primary side. If scratches appear on the primary side due to foreign matter caught in the empty clearance between the primary and secondary side, remove the foreign matter, then establish a mechanical structure that prevents such matter from entering the clearance.

Looseness of mounting screws

Check the mounting screws on the primary side for looseness. If the mounting screws on the primary side are loose, tighten the applicable screws.

Scratches and cracks on the linear servo motor cables

Check for scratches and cracks on the linear servo motor cables. If the linear servo motor cables have any scratches and cracks, replace the applicable cables. It is important to perform periodic inspections, especially when the cables are moved during operation.

2.2 Inspections of the secondary side (magnet)

Attachment of water and oil

Check that the primary and secondary side of the linear servo motor are not wet with water or oil. If the linear servo motor is wet, a malfunction may occur due to deterioration of the insulation on the primary side. Establish a mechanical structure in which water and oil do not become attached to the linear servo motor.

Exposure and levitation of the magnet

Check if the magnet on the secondary side is exposed or levitated. If the magnet on the secondary side is exposed or levitated, replace the secondary side immediately.

Magnet protective cover

The secondary side surface has a stainless steel cover to protect the magnet.

- If foreign matter such as dust is attached to the surface, gently clean the cover with an acetone soaked cloth.
- If scratches appear on the secondary side due to foreign matter caught in the empty clearance between the primary and secondary side, remove the foreign matter, then establish a mechanical structure that prevents such matter from entering the clearance.

Looseness of mounting screws

Check the mounting screws on the secondary side for looseness. If the mounting screws on the secondary side are loose, tighten the applicable screws.

2.3 Inspections of the linear encoder

It may become necessary to inspect the linear encoder. For information regarding inspections of the linear encoder, contact the manufacturer of the linear encoder being used.

3 REPLACEMENT OF THE LINEAR SERVO MOTOR IN THE ABSOLUTE POSITION DETECTION SYSTEM

3.1 Replacement of the primary side (coil) or secondary side (magnet)

After replacing the primary side or the secondary side, perform magnetic pole detection again.

3.2 Replacement of the linear encoder

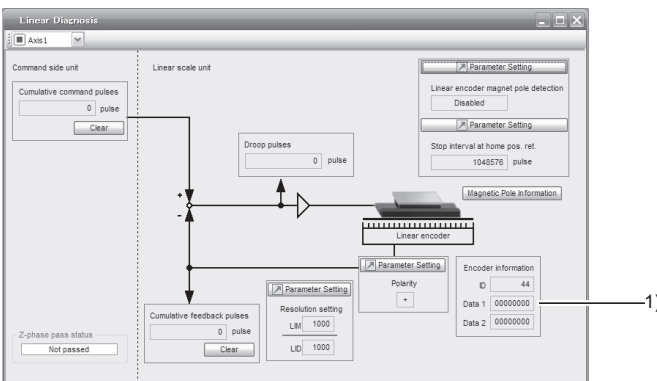
After replacing the linear encoder, perform magnetic pole detection and homing.

Method for checking the mounting position of the linear encoder

1. Before replacing the linear encoder, check the encoder information using MR Configurator2 with the linear servo motor fixed at the specified position.
2. When replacing the linear encoder, ensure that the position mismatch before and after replacement is ± 0.1 mm.
3. After replacing the linear encoder, check the encoder information again using MR Configurator2 with the linear servo motor fixed at the specified position.
4. Confirm that the value converted from the difference of the encoder information (resolution unit) is ± 0.1 mm or less both before and after replacement of the linear encoder.

Method for viewing encoder information using MR Configurator2

1. After confirming that the personal computer is connected with the servo amplifier, first select "Diagnosis", then select "Linear diagnosis". The following window will appear.

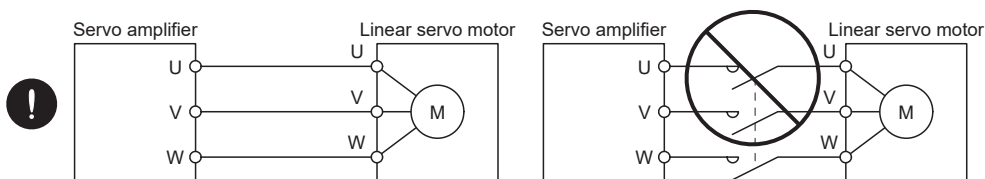


2. The encoder information data ("1") can be viewed here.

4 CONNECTING THE SERVO AMPLIFIER AND LINEAR SERVO MOTOR

Precautions

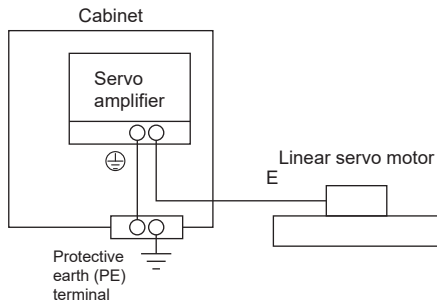
- Insulate the conductive parts of the terminals.
- Performance is not guaranteed if the specified servo amplifier and linear servo motor are not used together in combination. If the combination used is not the specified combination, the servo amplifier or linear servo motor may be damaged or may operate unexpectedly.
- The equipment must be installed in the specified direction.
- Do not install or operate any linear servo motor that is missing parts or is damaged.
- Do not modify the linear servo motor.
- To prevent the linear servo motor from operating unexpectedly, wire the equipment correctly and securely.
- Make sure to connect the cables and connectors by using the fixing screws and the locking mechanism. Failing to do so may cause the cables and connectors to disconnect during operation.
- Do not install a power capacitor, surge killer, or radio noise filter (optional FR-BIF(-H)) on the servo amplifier output side.
- To avoid a linear servo motor malfunction, connect the wires to the correct phase terminals (U/V/W) of the servo amplifier and the linear servo motor.
- To prevent abnormal operation and malfunction, connect the servo amplifier power outputs (U/V/W) to the linear servo motor power inputs (U/V/W) directly. Do not connect a magnetic contactor or the like between the servo amplifier power output and the linear servo motor power input.



- To prevent a malfunction, do not connect the AC power supply directly to the linear servo motor.
- When the wires are not properly secured to the terminal block, the wires and terminal block may generate heat because of the poor contact. Be sure to secure the wires with the specified torque.
- Cables such as the power cable that extends from the primary side cannot withstand being bent for an extended period of time. Avoid bending the cables by fixing them to the moving part, etc. In addition, wire the servo amplifier using cables that can withstand being bent for an extended period of time.
- Use the linear servo motor and the servo amplifier in the specified combination.
- To prevent malfunction, eliminate static electricity before wiring, switch operation, or similar operations.
- To prevent failure and malfunction, only the power/signal specified in the user's manual should be connected to each terminal.
- We recommend using HIV wires to connect the servo amplifier to the linear servo motor. Therefore, the recommended wire sizes may differ from those of wires used for previous generation linear servo motors.

4.1 Precautions for wiring

To ground the linear servo motor, connect the grounding lead wire to the servo amplifier, then connect the wire from the servo amplifier to the ground via the protective earth (PE) terminal of the cabinet. Do not connect the wire directly to the protective earth (PE) terminal of the cabinet.



Precautions

- To avoid a linear servo motor malfunction, connect the wires to the correct phase terminals (U/V/W) of the servo amplifier and the linear servo motor.
- To prevent a malfunction, do not connect the AC power supply directly to the linear servo motor.

4.2 Servo motor power supply cable wiring diagrams

To wire to the servo amplifier, use connectors packed with the servo amplifier or optional connectors.

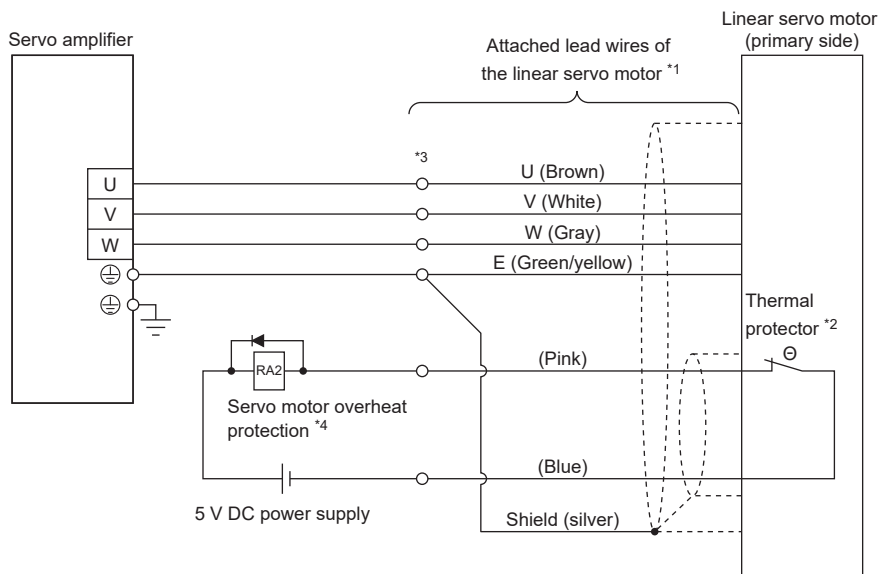
For details on wiring the connectors, refer to the User's Manual (Hardware).

Refer to the following for information about which wires to use for wiring.

☞ Page 27 Wire selection example

LM-AJ series

Connecting with the MR-J5-_/MR-J5-_-RJ/MR-JET-_- servo amplifier



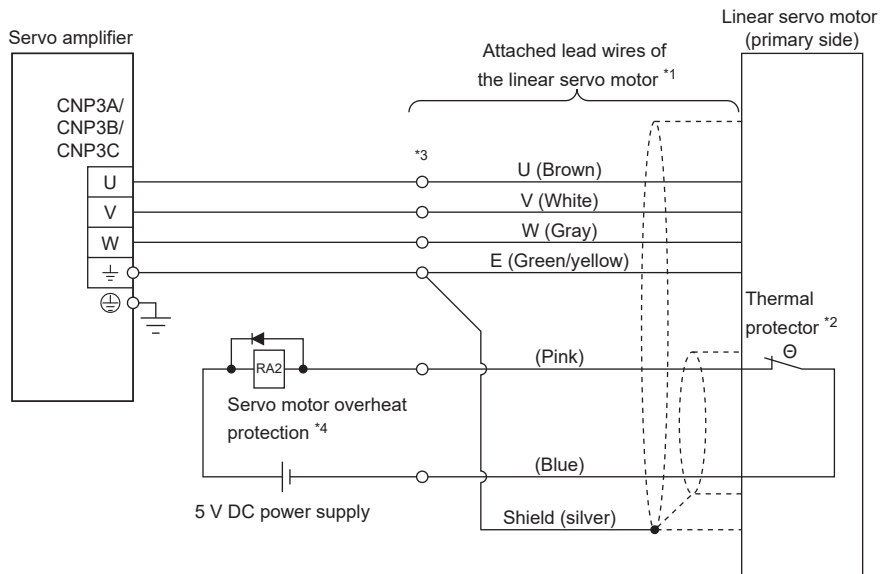
*1 The signal names are not attached on the lead wires. Use the color of the wire to determine which signal it is for.

*2 There is no polarity for the thermal protector.

*3 Discrete wires are used for the lead wires. Mount a round crimp terminal, etc. to connect the wires.

*4 Configure a relay circuit to shut off the main circuit power supply in the event that the thermal protector opens due to overheating. In addition, use an energizing current of 1000 mA or less for the relay. If a mechanical relay is used, use a relay designed for a flowing current of 50 mA to 1000 mA.

Connecting with the MR-J5W_ servo amplifier



*1 The signal names are not attached on the lead wires. Use the color of the wire to determine which signal it is for.

*2 There is no polarity for the thermal protector.

*3 Discrete wires are used for the lead wires. Mount a round crimp terminal, etc. to connect the wires.

*4 Configure a relay circuit to shut off the main circuit power supply in the event that the thermal protector opens due to overheating. In addition, use an energizing current of 1000 mA or less for the relay. If a mechanical relay is used, use a relay designed for a flowing current of 50 mA to 1000 mA.

4.3 Wire selection example

Selection requirements for the wire size are as follows.

- Construction requirements: Single suspended wire
- Wiring length: 30 m or less

The following shows examples of the wire sizes to select when using HIV wires.

Wire size selection examples

■Wire size selection example 1 (HIV wire)

Linear servo motor (primary side)	Wire [mm ²]	
	For power/grounding (U/V/W/E)	For thermal protector
LM-AJP1B-07K-JSS0	1.25 (AWG 16)	0.2 (AWG 24)
LM-AJP1D-14K-JSS0		
LM-AJP2B-12S-JSS0		
LM-AJP2D-23T-JSS0		
LM-AJP3B-17N-JSS0		
LM-AJP3D-35R-JSS0		
LM-AJP4B-22M-JSS0		
LM-AJP4D-45N-JSS0		

5 LM-AJ SERIES

5.1 Model designation

Primary side (coil)

The following describes what each block of a model name indicates. Not all combinations of the symbols are available.

LM - A J P 1 B - 0 7 K - J S S 0

Series

Primary side
(coil)

Maximum speed

Symbol	Maximum speed [m/s]
M	2.0
N	2.5
R	3.5
S	4.0
T	5.0
K	6.5

Continuous thrust

Symbol	Continuous thrust [N]
07	68.1
12	117.0
14	136.2
17	174.5
22	223.4
23	234.0
35	348.9
45	446.8

Length (nominal dimension)

Symbol	Dimension [mm]
B	96
D	176

Width (nominal dimension)

Symbol	Dimension [mm]
1	50
2	75
3	100
4	125

Secondary side (magnet)

LM - A J S 1 0 - 0 8 0 - J S S 0

Series

Secondary side
(magnet)

Length (nominal dimension)

Symbol	Dimension [mm]
080	80
200	200
400	400

Width (nominal dimension)

Symbol	Dimension [mm]
1	50
2	75
3	100
4	125

5.2 Standard specifications

Standard specifications list

Linear servo motor (primary side) LM-AJ_		P1B-07K-JSS0	P1D-14K-JSS0	P2B-12S-JSS0	P2D-23T-JSS0	P3B-17N-JSS0	P3D-35R-JSS0	P4B-22M-JSS0	P4D-45N-JSS0
Linear servo motor (secondary side) LM-AJ_		S10-080-JSS0 S10-200-JSS0 S10-400-JSS0		S20-080-JSS0 S20-200-JSS0 S20-400-JSS0		S30-080-JSS0 S30-200-JSS0 S30-400-JSS0		S40-080-JSS0 S40-200-JSS0 S40-400-JSS0	
Power supply capacity [kVA]		Refer to "Power supply capacity and generated loss" in the User's Manual (Hardware).							
Cooling method		Natural cooling							
Thrust	Continuous ^{*2 *4} [N]	68.1	136.2	117.0	234.0	174.5	348.9	223.4	446.8
	Maximum [N]	214.7	429.4	369.0	738.1	550.2	1100.4	704.5	1409.1
Maximum speed ^{*1} [m/s]		6.5		4.0	5.0	2.5	3.5	2.0	2.5
Magnetic attraction force [N]		378.8	757.6	651.1	1302.1	970.7	1941.4	1242.9	2485.9
Rated current [A]		2.3	4.6	2.3	4.6	2.3	4.6	2.3	4.6
Maximum current [A]		9.0	18.0	9.0	18.0	9.0	18.0	9.0	18.0
Recommended load to motor mass ratio ^{*5}		10 times or less	25 times or less	20 times or less	25 times or less	30 times or less			
Thermal protector		Built-in							
Insulation class		105 (A)							
Structure		Open (IP rating: IP00 ^{*3})							
Vibration resistance [m/s ²]		49							
Mass	Primary side [kg]	0.6	1.1	0.9	1.7	1.2	2.3	1.5	2.9
	Secondary side [kg]	0.26 (80 mm/pc) 0.65 (200 mm/pc) 1.30 (400 mm/pc)		0.40 (80 mm/pc) 1.00 (200 mm/pc) 2.00 (400 mm/pc)		0.56 (80 mm/pc) 1.40 (200 mm/pc) 2.80 (400 mm/pc)		0.70 (80 mm/pc) 1.70 (200 mm/pc) 3.50 (400 mm/pc)	

*1 The actual maximum speed of the linear servo motor is the lower value between the maximum speed of the linear servo motor and the rated speed of the linear encoder.

*2 The continuous thrust values in the table apply when an aluminum board with the dimensions (L [mm] × W [mm] × H [mm]) shown below is mounted on the primary side. (The dimensions shown are for reference purposes only)

LM-AJP1B-07K-JSS0: 230 × 365 × 30

LM-AJP1D-14K-JSS0: 525 × 525 × 40

LM-AJP2B-12S-JSS0: 230 × 365 × 30

LM-AJP2D-23T-JSS0: 525 × 525 × 40

LM-AJP3B-17N-JSS0: 230 × 365 × 30

LM-AJP3D-35R-JSS0: 525 × 525 × 40

LM-AJP4B-22M-JSS0: 230 × 365 × 30

LM-AJP4D-45N-JSS0: 525 × 525 × 40

*3 IP classifies the degree of protection provided against the intrusion of solid objects and water in electrical enclosures.

*4 Use the linear servo motor with 70 % or less of the effective load ratio when it is servo-locked or if there is faint reciprocating motion.

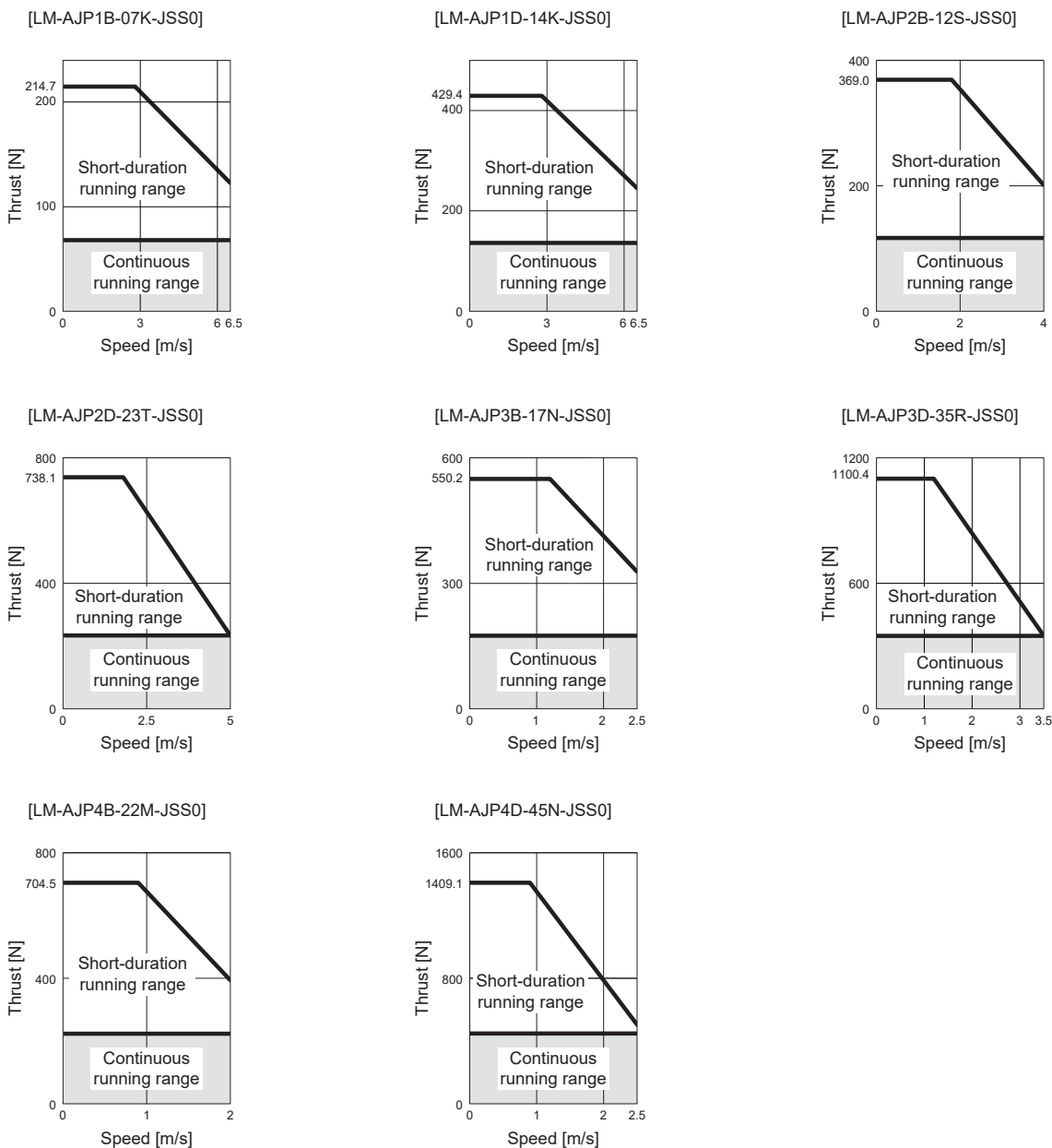
*5 Indicates the load to motor mass ratio in relation to the mass of the primary side of the linear servo motor. If the load to motor mass ratio exceeds the indicated value, contact your local sales office.

Thrust characteristics

The following shows the thrust characteristic when the power supply input of the servo amplifier is 3-phase 200 V AC. The continuous/maximum thrust and maximum speed of the linear servo motor have the values for rated voltage and frequency from the combined servo amplifier applied.

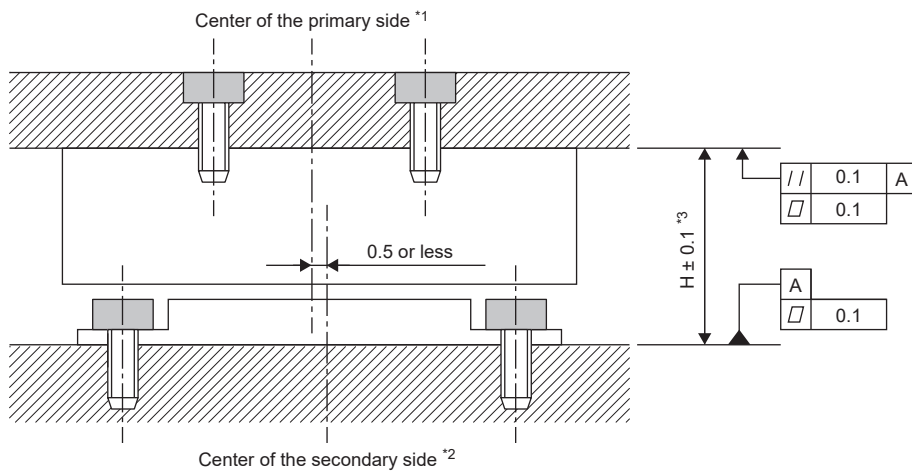
For the thrust characteristic when the power supply input of the servo amplifier is 1-phase 200 V AC, contact your local sales office.

3-phase 200 V AC



5.3 Installation

Fitting method



[Unit: mm]

*1 The locations of the center of the primary side are shown below.

LM-AJP1_ _ : the center of the mounting screw pitch

LM-AJP2_ _ : the position of the center mounting screw

LM-AJP3_ _ : the center of the mounting screw pitch

*2 The center of the secondary side is located at the center of the mounting screw pitch.

*3 H length indicates (height of primary side) + (height of secondary side) + (length of empty clearance: 0.8 mm).

H = 34.3 mm

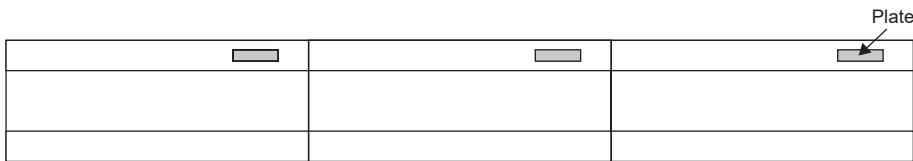
Installation of the secondary side (magnet)

Precautions

- If mounting an additional secondary side with a secondary side already set, first set the additional side so that it is distanced from the already mounted one, then slide the additional side to mount it in its specified position as shown in this section.
- Keep the cumulative pitch error of the mounting screw holes to within ± 0.2 mm. When two or more secondary sides are installed, clearance may be left between the secondary sides depending on the installing method and the number of secondary sides.

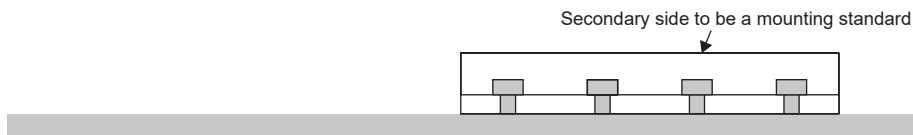
Procedure

When using multiple secondary sides, arrange them so that the name plate attached to each side all share the same orientation to keep the layout of magnetic poles.

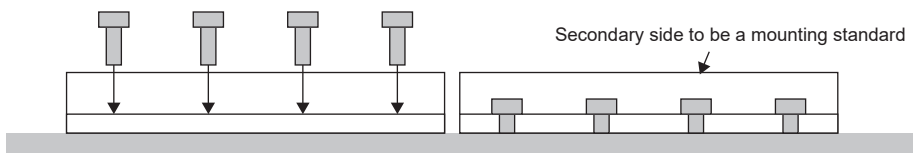


In addition, use the following procedure when mounting the secondary sides to decrease the clearance between them.

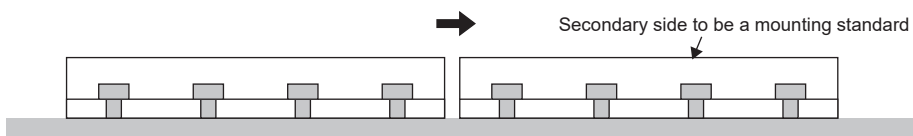
1. Use bolts to securely fix the secondary side that will be used as the mounting standard into place.



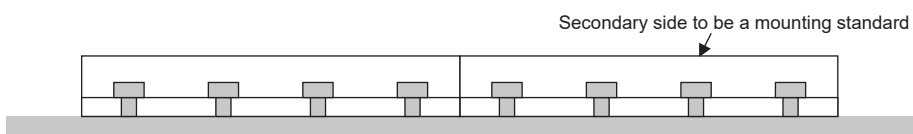
2. Set the next secondary side on the mounting face and use bolts to temporarily fix it into place.



3. Press the added secondary side toward the secondary side that is being used as the mounting standard.



4. Use bolts to securely fix the added secondary side into place.



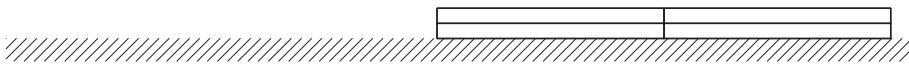
Installation of the primary side (coil)

Precautions

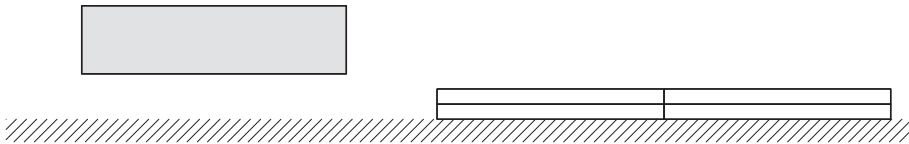
- We recommend mounting the primary side in a position where no secondary side is present. If the primary side must be mounted over the secondary side, use material handling equipment such as cranes that can fully withstand the load of the attraction force, etc.
- When sliding the the primary side over the secondary side after installing, take precautions against the attraction force that is generated.

Procedure

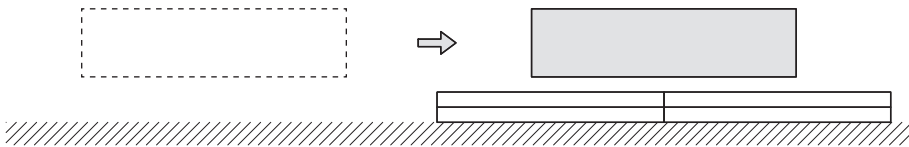
1. Mount a portion of the secondary sides.



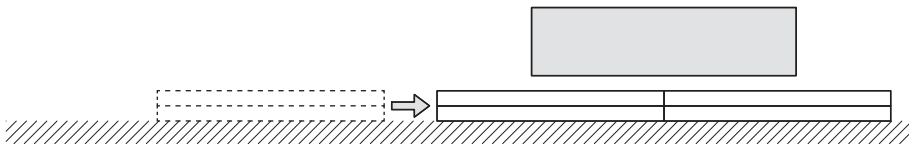
2. Mount the primary side in a position where no secondary side is present.



3. Move the primary side over the mounted secondary side. Confirm that the primary and secondary sides are not touching each other.



4. Mount the rest of the secondary sides. Confirm that the primary and secondary sides are not touching each other.

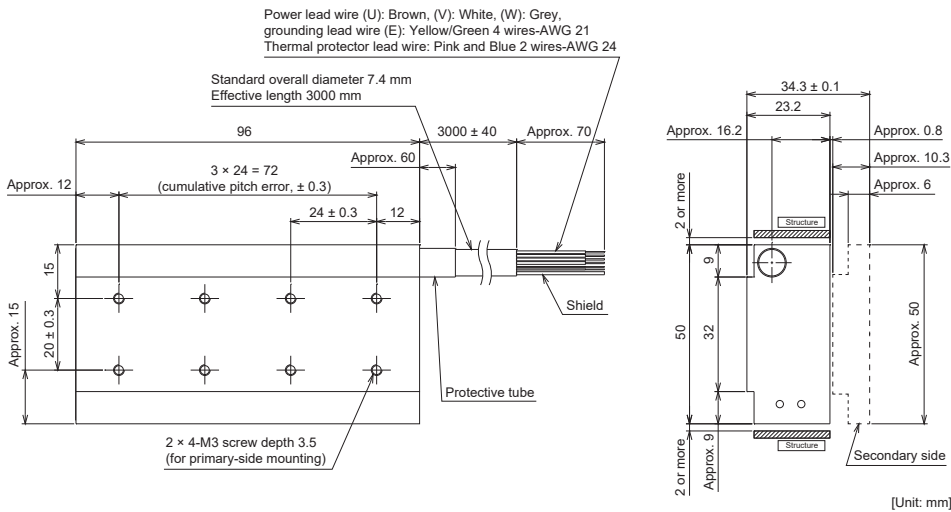


5.4 Dimensions

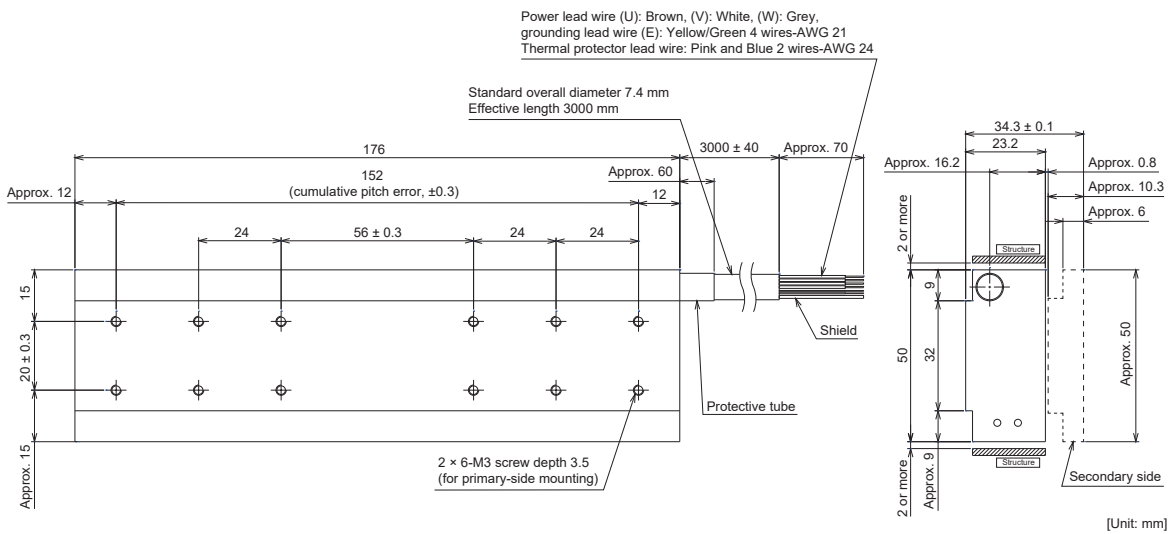
Primary side (coil) dimensions

- When mounting the primary side, use hexagon socket head cap screws (material should be SCM435 with a lower yield point of 900 N/mm² or equivalent).
- The recommended tightening torque for mounting screws on the primary side is 7.0 N•m (permissible range: 6.0 N•m to 7.8 N•m).
- The power lead wires, grounding lead wires, and thermal protectors are for fixed wiring. Securely fix them to the structure. The recommended minimum bending radius for the lead wire is ten times or more (reference value) the standard overall diameter of the lead wire. Consider the speed of the linear servo motor and the flexing radius when selecting the cable to use for the moving part.
- Leave 2 mm or more on each side of the clearance between the side face of the primary side and the structure.

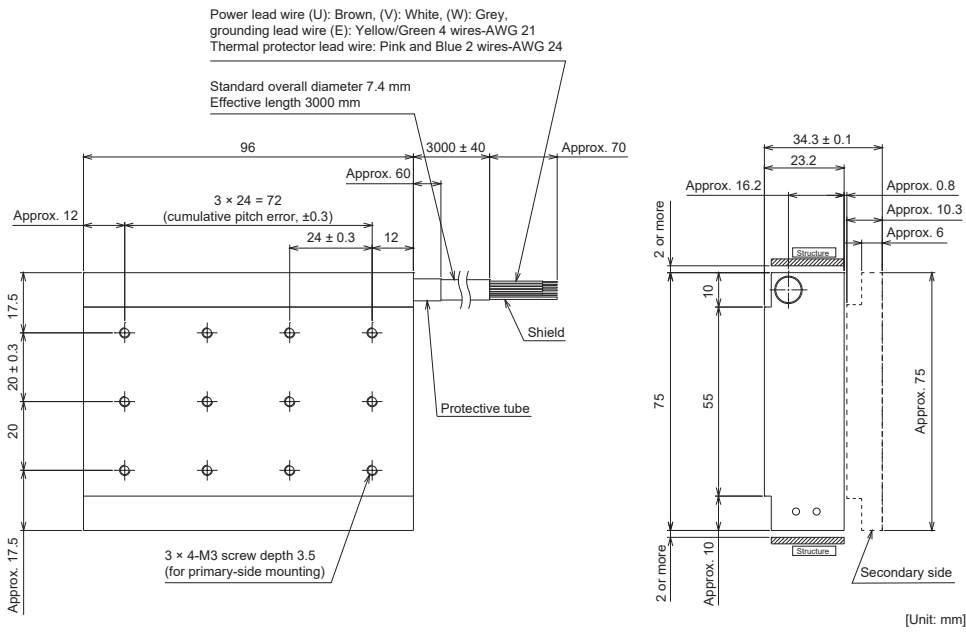
LM-AJP1B-07K-JSS0



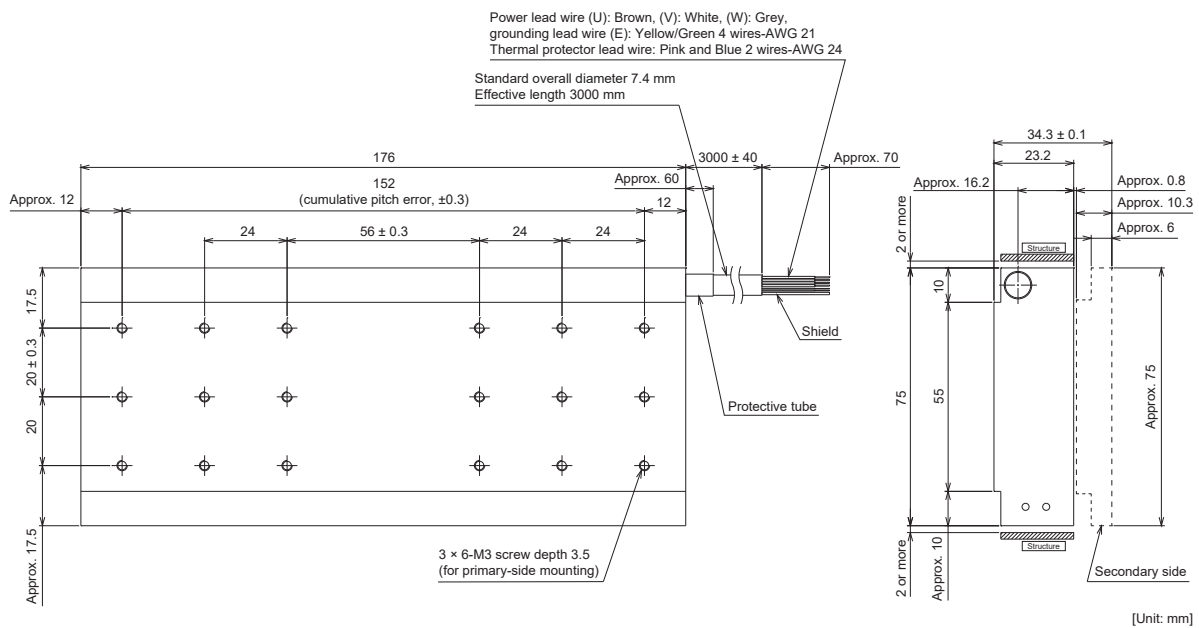
LM-AJP1D-14K-JSS0



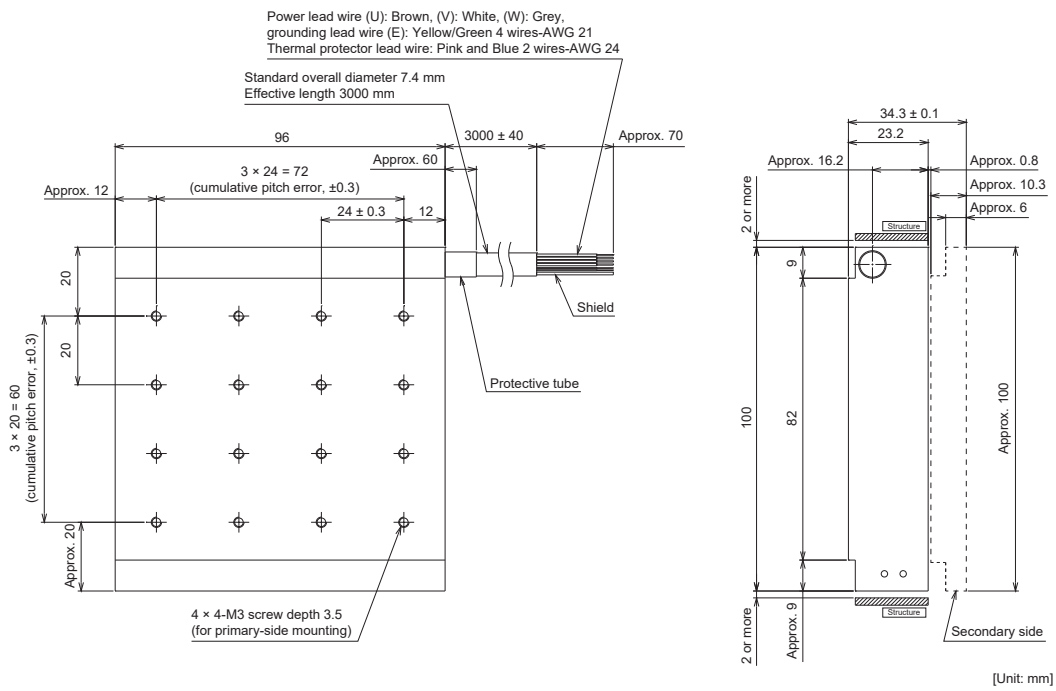
LM-AJP2B-12S-JSS0



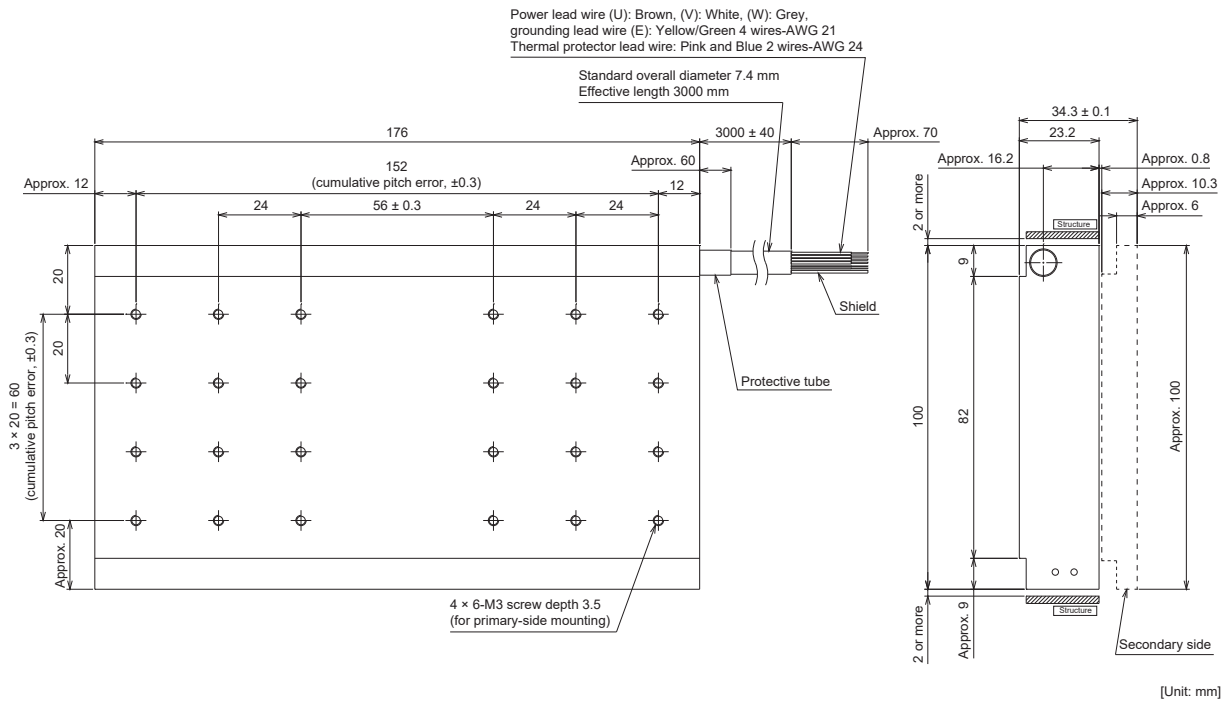
LM-AJP2D-23T-JSS0



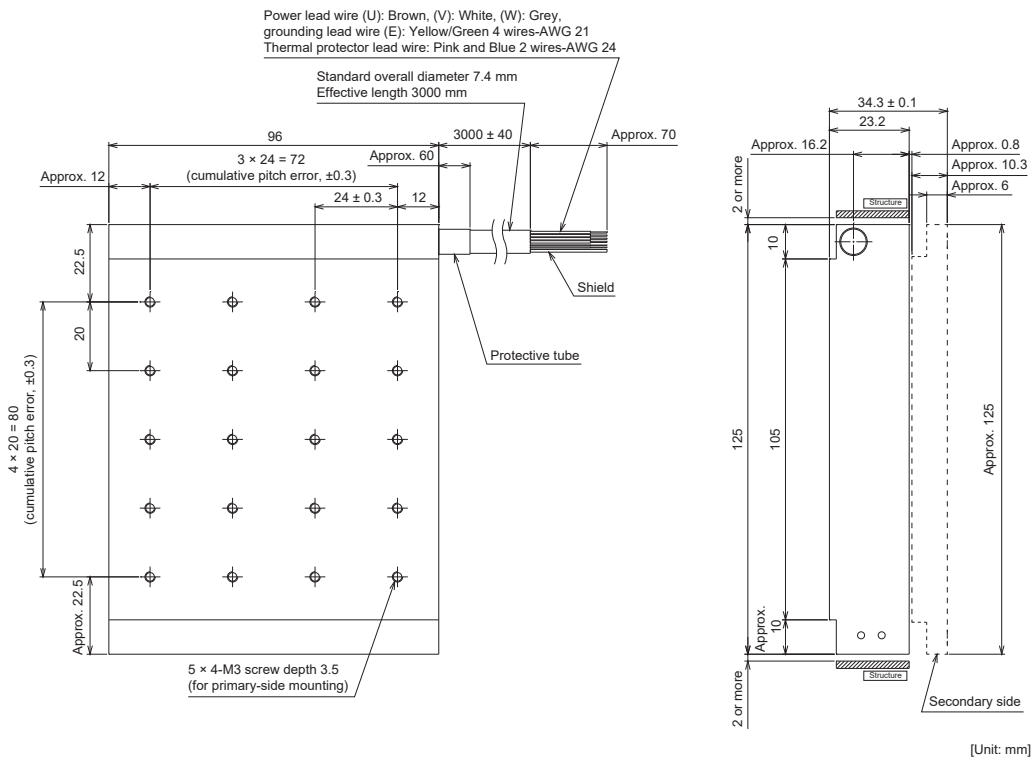
LM-AJP3B-17N-JSS0



LM-AJP3D-35R-JSS0

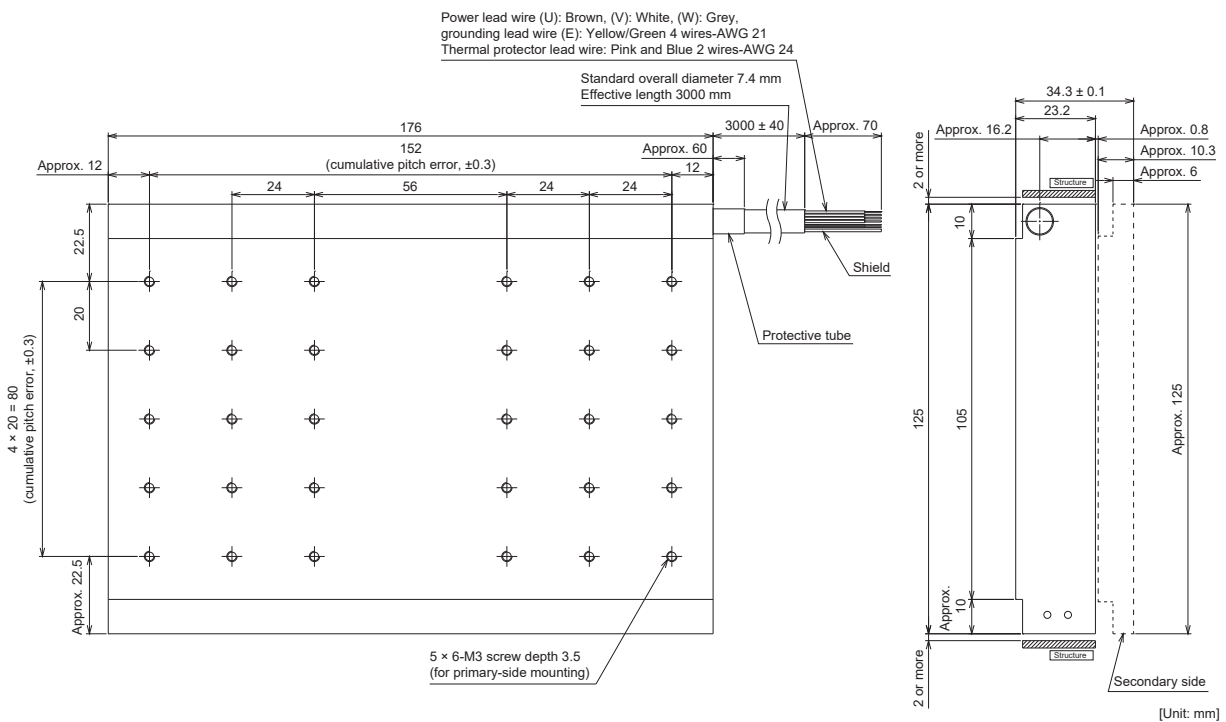


LM-AJP4B-22M-JSS0



5

LM-AJP4D-45N-JSS0

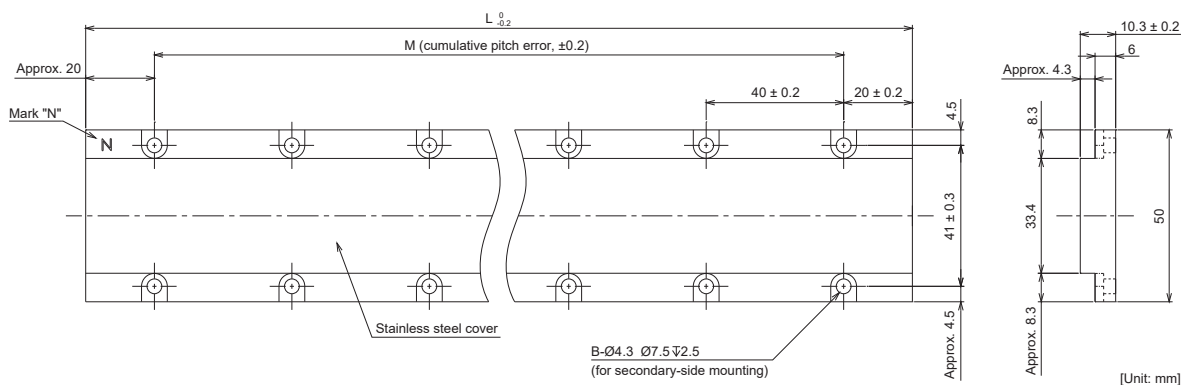


Secondary side (magnet) dimensions

When mounting the secondary side, use hexagon socket head cap screws with a screw head height of 4.3 mm or less.

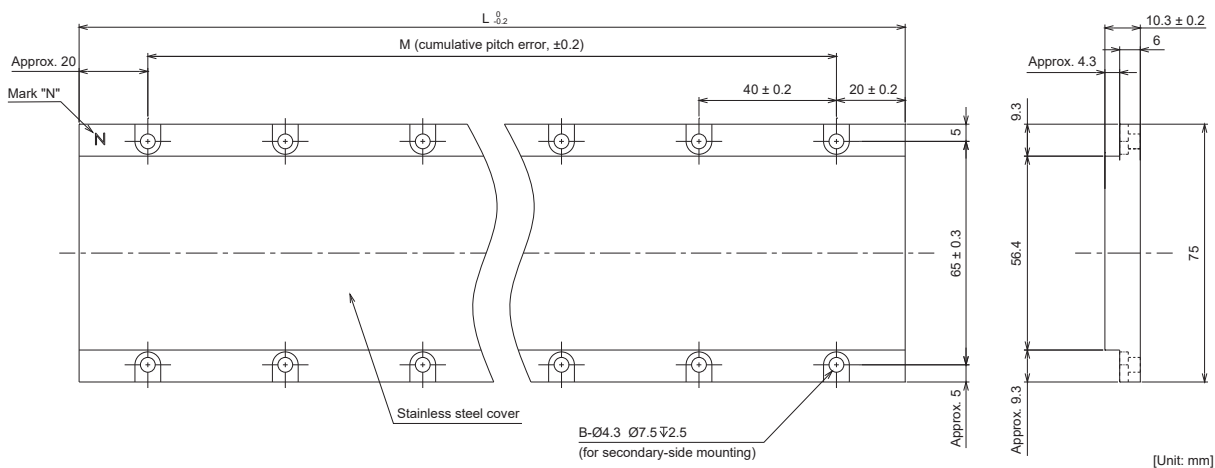
LM-AJS10-_-JSS0

Model	Variable dimensions		
	L	M	B
LM-AJS10-080-JSS0	80	40	2 × 2
LM-AJS10-200-JSS0	200	160	2 × 5
LM-AJS10-400-JSS0	400	360	2 × 10



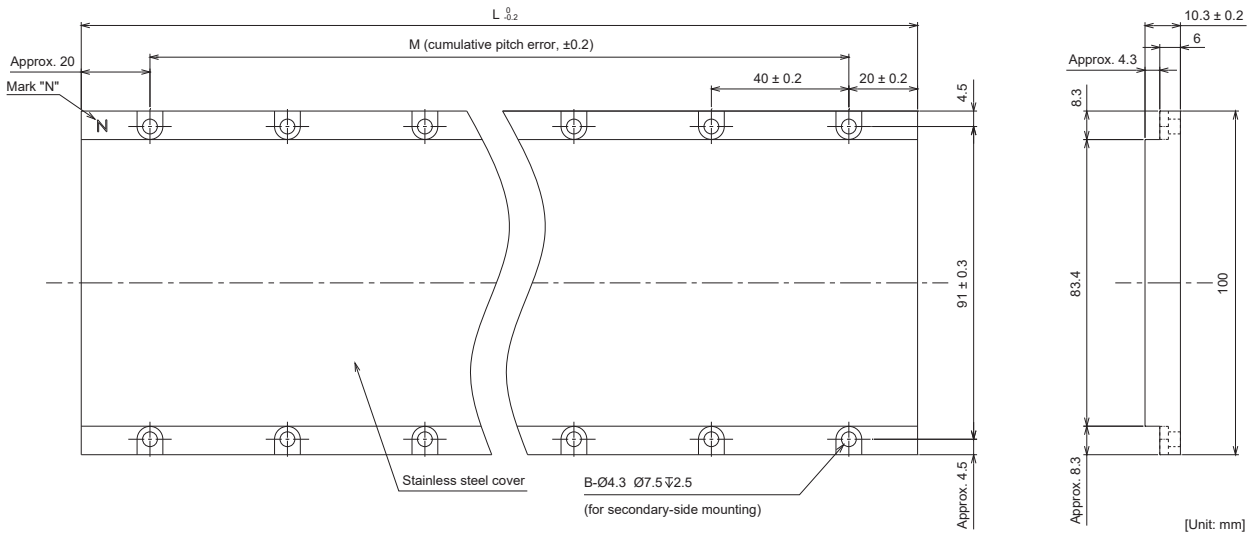
LM-AJS20-_-JSS0

Model	Variable dimensions		
	L	M	B
LM-AJS20-080-JSS0	80	40	2 × 2
LM-AJS20-200-JSS0	200	160	2 × 5
LM-AJS20-400-JSS0	400	360	2 × 10



LM-AJS30-_-JSS0

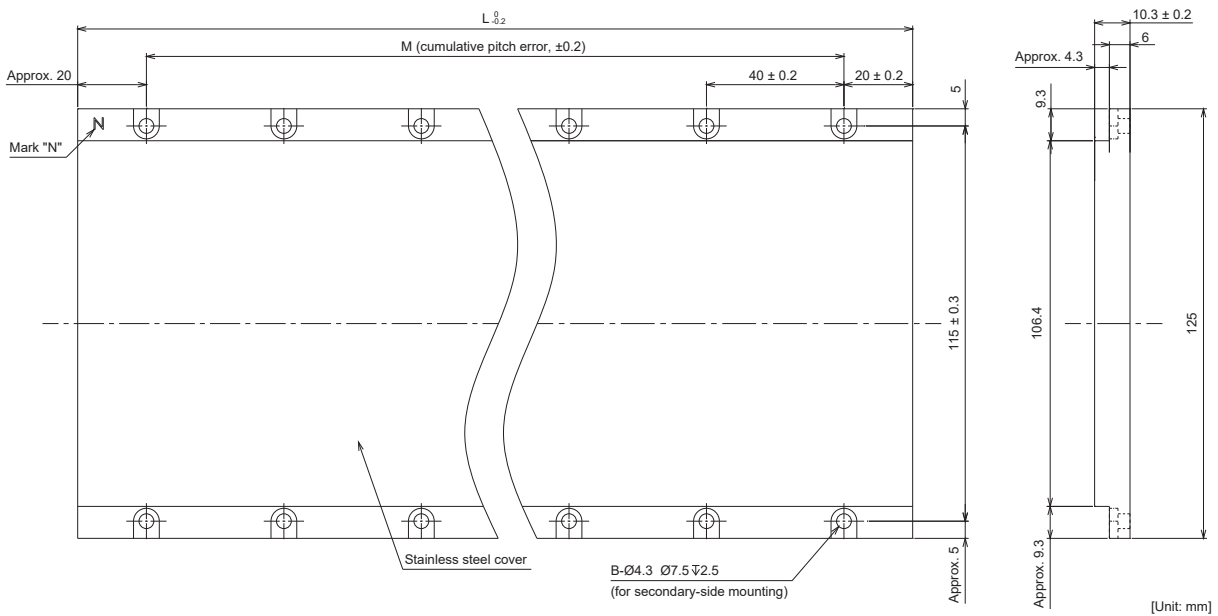
Model	Variable dimensions		
	L	M	B
LM-AJS30-080-JSS0	80	40	2 × 2
LM-AJS30-200-JSS0	200	160	2 × 5
LM-AJS30-400-JSS0	400	360	2 × 10



5

LM-AJS40-_-JSS0

Model	Variable dimensions		
	L	M	B
LM-AJS40-080-JSS0	80	40	2 × 2
LM-AJS40-200-JSS0	200	160	2 × 5
LM-AJS40-400-JSS0	400	360	2 × 10



REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
July 2020	IB(NA)-0300518ENG-A	First edition

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WARRANTY

Warranty

1. Warranty period and coverage

We will repair any failure or defect hereinafter referred to as "failure" in our FA equipment hereinafter referred to as the "Product" arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

For terms of warranty, please contact your original place of purchase.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule.

It can also be carried out by us or our service company upon your request and the actual cost will be charged. However, it will not be charged if we are responsible for the cause of the failure.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;

1. a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
2. a failure caused by any alteration, etc. to the Product made on your side without our approval
3. a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
4. a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
5. any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
6. a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
7. a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
8. any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas countries

Our regional FA Center in overseas countries will accept the repair work of the Product. However, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

- (1) For the use of our AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in AC Servo, and a backup or fail-safe function should operate on an external system to AC Servo when any failure or malfunction occurs.
- (2) Our AC Servo is designed and manufactured as a general purpose product for use at general industries. Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used. In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used. We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

TRADEMARKS

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