

Linear Servo Actuator LSA Series

Operating Manual

Third Edition

Small Type: H8SS, H8SM, H8HS, H8HM
Flat Type: L15SS, S15SM

IAI Corporation



Please Read Before Use

Thank you for purchasing our product.

This Operating Manual explains the handling methods, structure and maintenance of this product, among others, providing the information you need to know to use the product safely.

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.

Please download the user's manual from our website.

You can download it free of charge. User registration is required for the first time downloading.

URL : www.iai-robot.co.jp/data_dl/CAD_MANUAL/

When using the product, refer to the necessary portions of the applicable instruction manual by printing them out or displaying them on a PC.

After reading the Operating Manual, keep it in a convenient place so that whoever is handling this product can reference it quickly when necessary.

[Important]

- This Operating Manual is original.
- This product is not to be used for any other purpose from what is noted in this Operating Manual. IAI shall not be liable whatsoever for any loss or damage arising from the result of using the product for any other purpose from what is noted in the manual.
- The information contained in this Operating Manual is subject to change without notice for the purpose of production improvement.
- If you have any question or finding regarding the information contained in this Operating Manual, contact our customer center or our sales office near you.
- Using or copying all or a part of this Operating Manual without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

Table of Contents

Safety Guide.....	1
Caution in Handling	8
International Standards Compliances.....	9
Names of the Parts.....	10
1. Small Type H8SS, H8SM, H8HS, H8HM	10
2. Flat Type L15SS, L15SM.....	10
 1. Specifications Check	11
1.1 Checking the Product.....	11
1.1.1 Parts.....	11
1.1.2 Operating Manuals for the Controllers Related to this Product	11
1.1.3 How to Read the Model Nameplate.....	12
1.1.4 How to Read the Model Number.....	13
1.2 Specification	14
1.2.1 Speed.....	14
1.2.2 Maximum acceleration/deceleration, Maximum load capacity and Rated thrust.....	15
1.2.3 No. of Encoder Pulses	16
1.2.4 Positioning Precision.....	16
1.2.5 Allowable Load Moments of the Actuator	17
1.2.6 Duty Ratio in Continuous Operation	17
1.3 Operating conditions	18
1.3.1 Available Conditions for Operation	18
1.3.2 Availability Judgment for each Operational Condition	19
1.3.3 Example for Judging Operation Availability by Operational Conditions.....	21
1.4 Option.....	23
1.4.1 Cable Carrier Attachment Orientations 2 to 6 (Model: CT2 to CT6).....	23
1.4.2 Cable Carrier for User S Type Attachment Orientations 1 to 6 (Model: US1 to US6).....	24
1.4.3 Cable Carrier for User M Type Attachment Orientations 1 to 6 (Model: UM1 to UM6).....	25
1.5 Motor • Encoder Cables	26
1.5.1 Motor • Encoder Cables for Linear Servo Actuator	26
1.5.2 Cable in the bearer	28
 2. Installation	29
2.1 Transportation	29
2.2 Installation and Storage • Preservation Environment	31
2.3 How to Install.....	32
2.3.1 Installation	32
2.3.2 Installation of Main Unit.....	33
2.3.3 Attachment of Transported Object	37
2.3.4 Installation Surface	39
2.3.5 Mount of Connector Box and Others	40
 3. Connecting with the Controller	41
 4. Operation.....	45
4.1 Home Return.....	45
4.1.1 Principle of Home-Return Operation.....	45
4.1.2 Fine-tuning the Home Position.....	45
4.1.3 Changing the Home Direction.....	45
 5. Troubleshooting	47
5.1 Encoder Open Error (Error Code: D12)	47
5.2 Driver Overload Error (Error Code: D0A).....	48
5.3 Deviation Overflow Error (Error Code: C6B).....	49



6. Maintenance and Inspection.....	51
6.1 Inspection Items and Schedule.....	51
6.2 External Visual Inspection.....	51
6.3 Cleaning	51
6.4 Interior Inspection.....	52
6.4.1 Small Type H8SS, H8SM, H8HS, H8HM	52
6.4.2 Flat Type L15SS, L15SM	52
6.5 Procedures for Replacement and Adjustment of Stainless Steel Sheet.....	53
6.5.1 Replacement Procedure for Stainless Steel Sheet.....	54
6.5.2 Adjusting the Stainless Steel Sheet Tension	55
6.5.3 Operation Check	57
7. Life.....	59
8. External Dimensions.....	61
8.1 Small Type H8SS	61
8.2 Small Type H8SM.....	62
8.3 Small Type H8HS	63
8.4 Small Type H8HM	64
8.5 Flat Type L15SS.....	65
8.6 Flat Type L15SM	66
9. Warranty	67
9.1 Warranty Period	67
9.2 Scope of the Warranty.....	67
9.3 Honoring the Warranty	67
9.4 Limited Liability	67
9.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications	68
9.6 Other Items Excluded from Warranty.....	68
Change History.....	69

Safety Guide

“Safety Guide” has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Description
1	Model Selection	- This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications. 1) Medical equipment used to maintain, control or otherwise affect human life or physical health. 2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) - Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product. - Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact - For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	• When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. • When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. • Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the Operating manual for each model. • Do not step or sit on the package. • Do not put any heavy thing that can deform the package, on it. • When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. • When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. • Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. • Do not get on the load that is hung on a crane. • Do not leave a load hung up with a crane. • Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	• The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. • Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. • Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. • Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. • When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets

No.	Operation Description	Description
4	Installation and Start	(2) Cable Wiring • Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. • Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. • Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. • When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. • Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. • Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire. (3) Grounding • The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation. • For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm² (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). • Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
4	Installation and Start	(4) Safety Measures • When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. • Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. • Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. • Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. • When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. • Take the measure so that the work part is not dropped in power failure or emergency stop. • Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. • Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. • When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. • When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. • Place a sign "Under Operation" at the position easy to see. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Description
6	Trial Operation	• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. • When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. • Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. • Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	• Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. • Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. • Make sure to operate automatic operation start from outside of the safety protection fence. • In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. • When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. • Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. • When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. • When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. • When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. • Place a sign “Under Operation” at the position easy to see. • For the grease for the guide or ball screw, use appropriate grease according to the Operating Manual for each model. • Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. • When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. • The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. • Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
9	Modification and Dismantle	• Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	• When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. • When removing the actuator for disposal, pay attention to drop of components when detaching screws. • Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	• Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. • See Overseas Specifications Compliance Manual to check whether complies if necessary. • For the handling of actuators and controllers, follow the dedicated Operating manual of each unit to ensure the safety.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Operating Manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	 Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	 Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	 Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly.	 Notice

Caution in Handling

1. **Make sure to follow the usage condition, environment and specification range of the product.**
In case it is not secured, it may cause a drop in performance or malfunction of the product.
2. **Back and forth operation in a short distance may cause wear of grease.**
If the actuators are moved back and forth continuously over a short distance of 30 mm or less, grease film may run out. As a guide, move the actuators back and forth repeatedly for around 5 cycles over a distance of 50 mm or more after every 5,000 to 10,000 cycles. Keep using the actuators with the grease worn out may cause malfunction.
3. **Make sure to attach the actuator properly by following this operating manual.**
Using the product with the actuator not being certainly retained or affixed may cause abnormal noise, vibration, malfunction or shorten the product life.



Warning: Do not get closer than 30cm if you are a person who needs a support of a medical device such as a pacemaker. This actuator uses high-performance rare-earth permanent magnets. Therefore an unexpected operation may be caused to a medical device especially when using such a device such as a pacemaker.



Caution:

- Do not attempt to get a magnetic card close to the product. Having a magnetic storage medium close to the product may disable the medium by destroying data.
- Do not attempt to get a precision instrument such as an electric watch close to the product. Doing so may cause a trouble to the instrument

International Standards Compliances

This actuator complies with the following overseas standard.
Refer to Overseas Standard Compliance Manual (ME0287) for more detailed information.

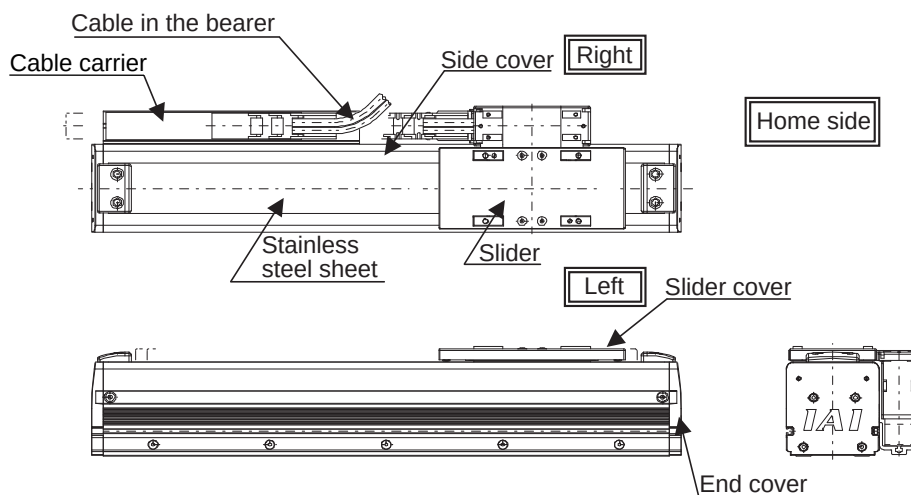
RoHS Directive	CE Marking
○	×

Names of the Parts

In this manual, the right-left directions of the actuator are indicated by viewing the actuator from its top and also from its home side, with the actuator placed horizontally. “Front” refers to the side opposite to one on which the actuator home is located.

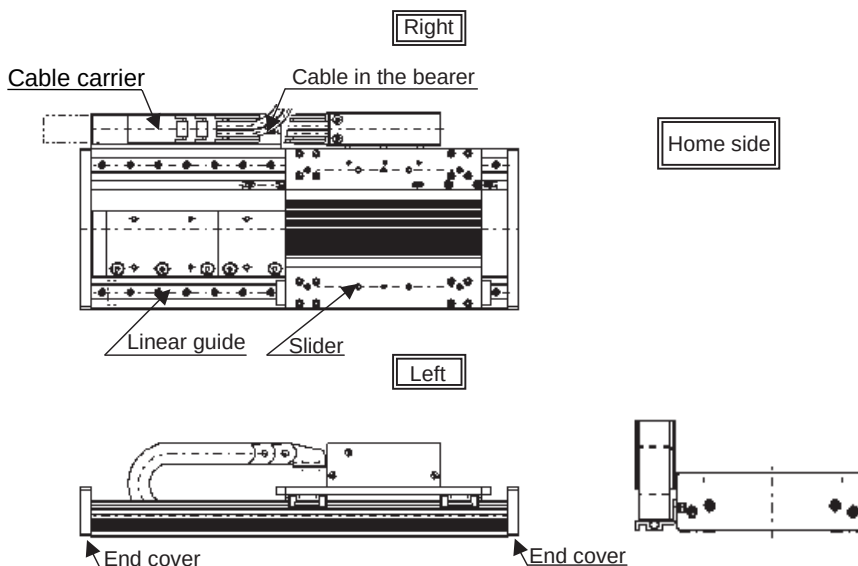
1. Small Type H8SS, H8SM (Note 1), H8HS, H8HM (Note 1)

Note 1 Multi-slider type: There are two sliders mounted.



2. Flat Type L15SS, L15SM (Note 1)

Note 1 Multi-slider type: There are two sliders mounted.



(Reference)

In the above figure, the cables are facing up or the top side, while the home is located on the right side. The actuator is shipped with its home adjusted to the side specified by the customer. Accordingly, the home position on your actuator may be different from the direction shown in the figure.

1. Specifications Check

1.1 Checking the Product

The standard configuration of this product is comprised of the following parts.
See the component list for the details of the enclosed components. If you find any fault or missing parts, contact your local IAI distributor.

1.1.1 Parts

No.	Name	Model number	Quantity	Remarks
1	Actuator	Refer to "How to Read the Model Nameplate" and "How to Read the Model Number."	1	
Accessories				
2	Motor • encoder cables (Note1)		1set	
3	Safety Guide		1	

Note1 [Refer to 1.5, "Motor • Encoder Cables."]

1.1.2 Operating Manuals for the Controllers Related to this Product

(1) Manuals Related to XSEL-P/Q controllers

No.	Name	Control No.
1	Operating Manual for XSEL-P/Q/PCT/QCT Controller	ME0148
2	Operating Manual for XSEL-P/Q/PX/QX RC Gateway Function	ME0188
3	Operating Manual for PC Software IA-101-X-MW/IA-101-X-USBMW	ME0154
4	Operating Manual for Teaching Pendant SEL-T/TD/TG	ME0183
5	Operating Manual for Teaching Pendant IA-T-X/XD	ME0160
6	Operating Manual for DeviceNet	ME0124
7	Operating Manual for CC-Link	ME0123
8	Operating Manual for PROFIBUS-DP	ME0153

(2) Manuals Related to SSEL controllers

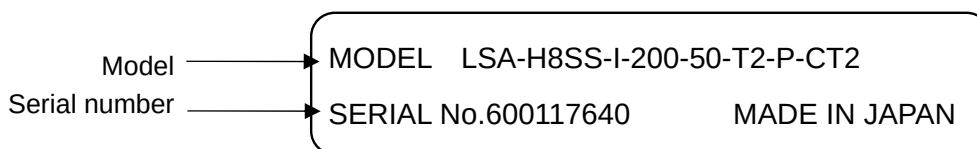
No.	Name	Control No.
1	Operating Manual for SSEL Controller	ME0157
2	Operating Manual for PC Software IA-101-X-MW/IA-101-X-USBMW	ME0154
3	Operating Manual for Teaching Pendant SEL-T/TD/TG	ME0183
4	Operating Manual for Teaching Pendant IA-T-X/XD	ME0160
5	Operating Manual for DeviceNet	ME0124
6	Operating Manual for CC-Link	ME0123
7	Operating Manual for PROFIBUS-DP	ME0153



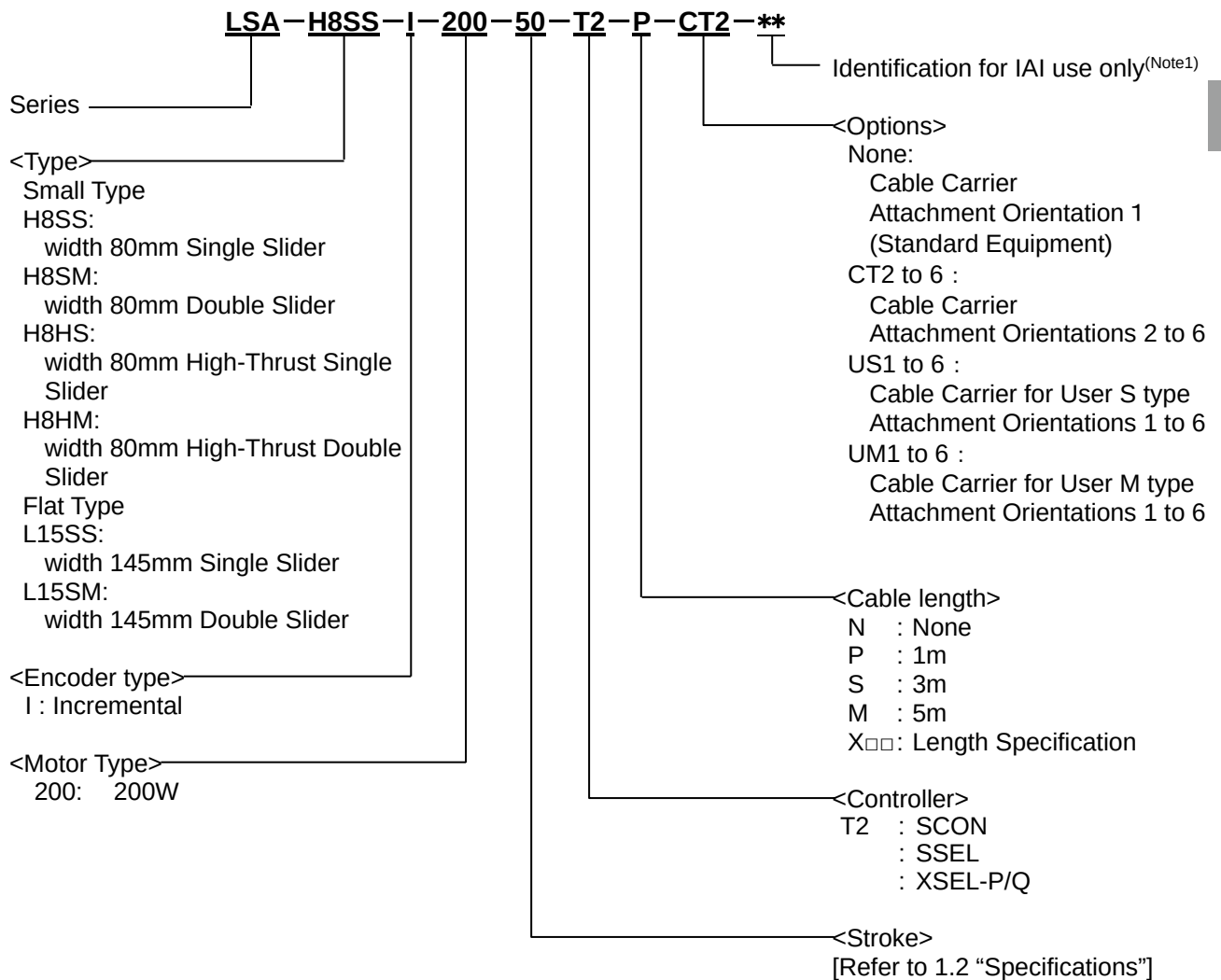
(3) Manuals Related to SCON controllers

No.	Name	Control No.
1	Operating Manual for SCON Controller	ME0161
2	Operating Manual for SCON-CA Controller	ME0243
3	Operating Manual for PC Software RCM-101-MW/RCM-101-USB	ME0155
4	Operating Manual for Teaching Pendant CON-T/TG	ME0178
5	Operating Manual for Touch Panel Teaching Pendant CON-PT/PD/PG	ME0227
6	Operating Manual for Touch Panel Teaching Pendant CON-PTA/PDA/PGA	ME0295
7	Operating Manual for Simple Teaching Pendant RCM-E	ME0174
8	Operating Manual for Data Setter RCM-P	ME0175
9	Operating Manual for Touch Panel Display RCM-PM-01	ME0182
10	Operating Manual for DeviceNet	ME0124
11	Operating Manual for CC-Link	ME0123
12	Operating Manual for PROFIBUS-DP	ME0153

1.1.3 How to Read the Model Nameplate



1.1.4 How to Read the Model Number



Note 1 Identification for IAI use only : It may be displayed for IAI use. It is not a code to show the model type.

1.2 Specification

1.2.1 Speed

[1] H8SS

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]									
		50	150	250	350	450	550	650	750	850	
200	1	2500									
		950	1050	1150	1250	1350	1450	1550	1650	-	
		2500									

[2] H8SM

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]							
		130	230	330	430	530	630	730	
200	1	2500							
		830	930	1030	1130	1230	1330	1430	
		2500							

[3] H8HS

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]								
		50	150	250	350	450	550	650	750	
200	1	2500								
		850	950	1050	1150	1250	1350	1450	1550	
		2500								

[4] H8HM

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]						
		130	230	330	430	530	630	
200	1	2500						
		730	830	930	1030	1130	1230	
		2500						

[5] L15SS

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]								
		150	250	350	450	550	650	750	850	
200	1	2500								
		950	1050	1150	1250	1350	1450	1550	1650	
		2500								

[6] L15SM

Speed limits (Unit: mm/s)

Motor Type	Minimum Speed	Stroke [mm]								
		50	150	250	350	450	550	650	750	
200	1	2500								
		850	950	1050	1150	1250	1350	1450	-	
		2500								



1.2.2 Maximum acceleration/deceleration, Maximum load capacity and Rated thrust

Type	Item	Specifications
H8SS, H8SM	Maximum acceleration/deceleration (Note 1)	3G
	Maximum load capacity (Note 1)	5kg
	Rated thrust	30N
H8HS, H8HM	Maximum acceleration/deceleration (Note 1)	3G
	Maximum load capacity (Note 1)	8kg
	Rated thrust	60N
L15SS, L15SM	Maximum acceleration/deceleration (Note 1)	3G
	Maximum load capacity (Note 1)	5kg
	Rated thrust	30N

Note 1 The available acceleration/deceleration and the load capacity may differ depending on the operational conditions.
[Refer to 1.3 “Operating conditions”]



1.2.3 No. of Encoder Pulses

Type	No. of Encoder Pulses	Lead Length [mm]
H8SS, H8SM	50000	50
H8HS, H8HM	50000	50
L15SS, L15SM	50000	50

1.2.4 Positioning Precision

Type	Item	Specifications
H8SS, H8SM	Positioning Repeatability	$\pm 0.005\text{mm}$
	Lost Motion	0.02mm or less
H8HS, H8HM	Positioning Repeatability	$\pm 0.005\text{mm}$
	Lost Motion	0.02mm or less
L15SS, L15SM	Positioning Repeatability	$\pm 0.005\text{mm}$
	Lost Motion	0.02mm or less

The values shown above are the accuracy at the delivery from the factory.
It does not include the consideration of time-dependent change as it is used.

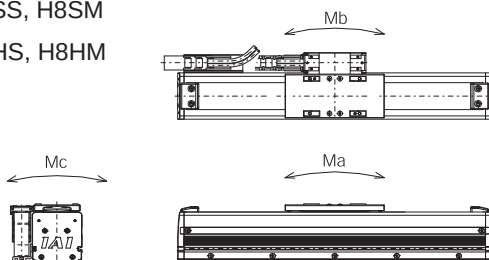
1.2.5 Allowable Load Moments of the Actuator

Type	Allowable Dynamic Load Moment [N·m]			Allowable Overhang Load Length (L) (Note 1)
	Ma	Mb	Mc	
H8SS, H8SM H8HS, H8HM	8.65	8.65	8.65	Ma direction: 300mm or less Mb, Mc direction: 300mm or less
L15SS, L15SM	24.2	24.2	24.2	Ma direction: 525mm or less Mb, Mc direction: 525mm or less

Note 1: The values for allowable overhang load length are those when the center of the gravity of the load is at 1/2 of the overhang length.

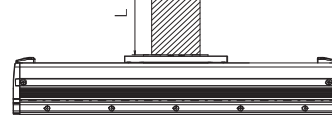
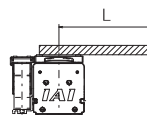
H8SS, H8SM

H8HS, H8HM

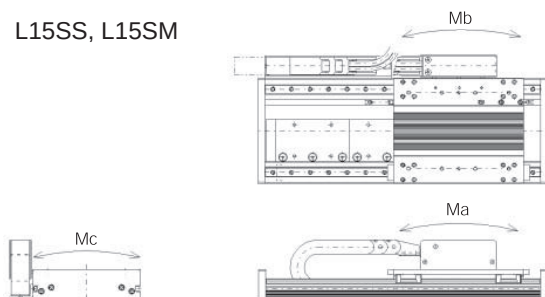


Mb or Mc direction

Ma direction

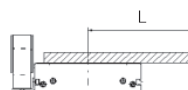


L15SS, L15SM



Mb or Mc direction

Ma direction



Caution: Using the product above the allowable moment or overhang load length may cause not only to generate abnormal noise or vibration, but also to shorten the product life remarkably.

1.2.6 Duty Ratio in Continuous Operation

The duty ratio may differ depending on the acceleration/deceleration and transported weight.
[Refer to 1.3 "Operating conditions"]

1.3 Operating conditions

1.3.1 Available Conditions for Operation

When selecting a desired model of linear servo actuator (small type / flat type), you must ensure that the selected actuator satisfies the following two conditions.

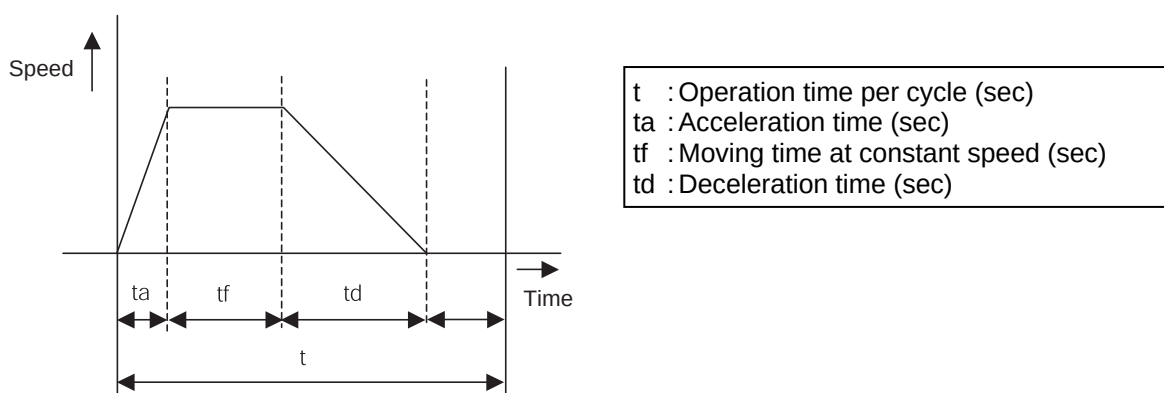
[Condition 1]

The thrust required for acceleration must not exceed the maximum thrust of the linear servo actuator.

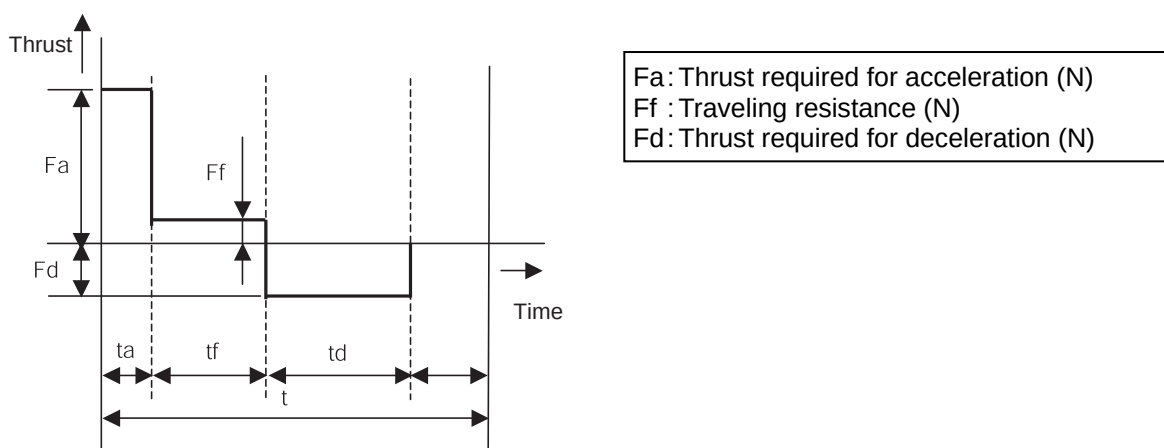
[Condition 2]

The thrust during continuous operation must not exceed the rated thrust of the linear servo actuator.

The above conditions are explained by using a trapezoid operation as an example.



The above operation pattern can be expressed differently in a graph where the vertical axis represents thrust.



1.3.2 Availability Judgment for each Operational Condition

[1] Condition 1 Judgment of Thrust Necessary for Acceleration

For the slider to accelerate according to a command, the thrust required for acceleration, or F_a , must be smaller than the maximum thrust.

$$F_a = (M + m) \cdot a + F_t$$

Here,

M : Slider weight (kg)

m : Slider payload (kg)

a : Commanded acceleration (m/s^2)* *1G = 9.8 m/s^2

F_t : Traveling resistance (N)

[Slider weight]

Small type H8SS, H8SM : 1.5kg

Small type H8HS, H8HM : 2.0kg

Flat type L15SS, L15SM : 1.5kg

In the case of a linear servo actuator (small type / flat type), the traveling resistance is determined by the speed and empirically calculated as specified below.

[Traveling resistance]

The table below lists the traveling resistance of each model.

$$F_f = 2V + 10 \quad V: \text{Slider speed (m/s)}$$

(Achieved speed is used in a triangle wave operation.)

If the obtained F_a is smaller than the maximum thrust of the linear servo actuator (small type / flat type), condition 1 is satisfied.

	Maximum thrust (N)
H8SS, H8SM	90
H8HS, H8HM	180
L15SS, L15SM	90

[2] Condition 2 Judgment of Thrust for Continuous Operation

It is necessary that the continuous operational thrust F_t considering the load and duty is smaller than the rated thrust.

$$F_t = \sqrt{\frac{F_a^2 \cdot t_a + F_f^2 \cdot t_f + F_d^2 \cdot t_d}{t}}$$

F_a : Thrust required for acceleration (N)

t_a : Acceleration time (sec)

t_d : Deceleration time (sec)

F_f : Traveling resistance (N)

t_f : Moving time at constant speed (sec)

t : Operation time per cycle (sec) ($t = t_a + t_f + t_d + 0.15$)

Here, F_d indicates the thrust required for deceleration and can be calculated as follows:

$$F_d = (M + m) \cdot d - F_f$$

M : Slider weight (kg)

m : Slider payload (kg)

d : Commanded deceleration (m/s^2)

F_f : Traveling resistance (N)

[Slider weight]

Small type H8SS, H8SM : 1.5kg

Small type H8HS, H8HM : 2.0kg

Flat type L15SS, L15SM : 1.5kg

Condition 2 is satisfied if the continuous operational thrust F_t figured out as described above is smaller than the rated thrust.

	Rated thrust (N)
H8SS, H8SM	30
H8HS, H8HM	60
L15SS, L15SM	30

The actuator can be used in any operating conditions that satisfy both conditions 1 and 2 specified above.

If either condition cannot be satisfied, take appropriate measures such as reducing the slider load, acceleration or duty.

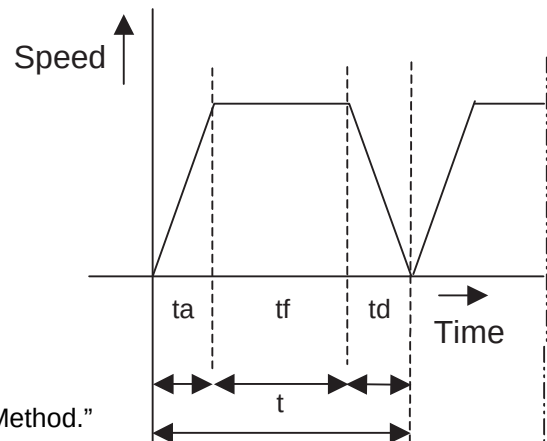
1.3.3 Example for Judging Operation Availability by Operational Conditions

[Operating conditions]

- Applicable model : H8SS/H8SM type
- Speed : 2.5m/s
- Acceleration : 19.6m/s² (The deceleration is assumed to be the same.)
- Travel : 1.5m
- Slider payload : 3kg
- The actuator moves back and forth over a stroke of 1.5m.

$$1G = 9.8m/s^2$$

The above operation pattern can be illustrated by the graph shown to the right.



Now, let's start calculation according to "Selection Method."

- 1) Figure out the maximum thrust of Condition 1.
Apply the above operation pattern to the aforementioned equation of maximum thrust.

$$F_a = (M + m) \cdot a + F_f$$

Here,

- M : Slider weight (1.5kg for the H8SS/H8SM)
- m : Slider load (kg) : 3kg in this example
- a : Commanded acceleration (m/s²) : 19.6m/s² in this example
- F_f : Traveling resistance (N) : 15N in this example

From above, F_a is calculated as follows:

$$F_a = (4.5 \times 19.6 + 15) \rightarrow 103.2N$$

The calculated value exceeds the maximum thrust 90N of the H8SS/H8SM.

Let's lower the specified acceleration to 14.7m/s². F_a changes as follows:

$$F_a = (4.5 \times 14.7 + 15) \rightarrow 81.15N.$$

The calculated value is smaller than the maximum thrust 90N of the H8SS/H8SM.



- 2) Figure out the continuous operational thrust of Condition 2.
Substitute the operation pattern above to the continuous operational thrust formula.
Based on the examination result of maximum thrust, the specified acceleration is assumed as 14.7m/s^2 .

$$F_t = \sqrt{\frac{F_a^2 \cdot t_a + F_f^2 \cdot t_f + F_d^2 \cdot t_d}{t}}$$

Here,

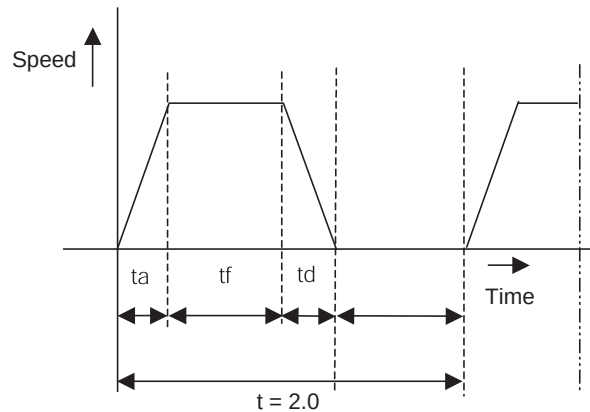
$F_a = 81.15\text{N}$, $F_f = 15\text{N}$, $F_d = 51.15\text{N}$, $t_a = t_d = 0.17\text{s}$, $t_f = 0.43\text{s}$, $t = 0.92\text{s}$

From the above, F_t is calculated as 42.49N .

Since this value exceeds the rated thrust 30N of the H8SS/H8SM, this actuator cannot be used in the aforementioned operation pattern.

Let's lower the duty and see what happens.

Repeat the above calculation based on $t = 2.0\text{s}$.



This time, F_t is calculated as 28.82N .

Accordingly, the actuator can be used in this operation pattern.

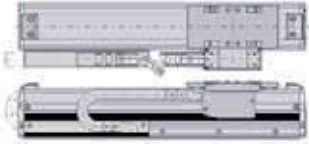
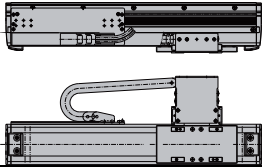
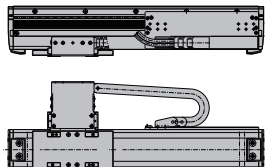
1.4 Option

1.4.1 Cable Carrier Attachment Orientations 2 to 6 (Model: CT2 to CT6)

These are the attachment orientation indications with no cable carrier for user (option).
The attachment orientation of cable carrier is either the four orientations in Standard Horizontal Orientation Mount or two orientations in Horizontally Oriented Wall Mount.
Refer to the table below for the availability of Single Slider and Double Slider.

Option Model	Attachment Orientation	Single Slider	Double Slider
None	Attachment Orientation 1	○	○
CT2	Attachment Orientation 2	○	×
CT3	Attachment Orientation 3	○	×
CT4	Attachment Orientation 4	○	×
CT5	Attachment Orientation 5	○	○
CT6	Attachment Orientation 6	○	×

[Attachment Orientation]

Attachment Orientation 1 (Standard)	Attachment Orientation 2 (Opposite Type) CT2	Attachment Orientation 3 CT3
Single Slider is to be attached in the orientation shown in the figure below. Multi Slider is to be attached in the orientation shown in the figure below on both right and left sides. 	It is the opposite type in the attachment to Attachment Orientation 1 (Standard). 	It is the type with the home position on the opposite side from Attachment Orientation 1 (Standard). 
Attachment Orientation 4 CT4	Attachment Orientation 5 (Standard Horizontally Oriented Wall Mount) CT5	Attachment Orientation 6 (Opposite Type Horizontally Oriented Wall Mount) CT6
It is the opposite type in the attachment to and also the home position on the opposite side from Attachment Orientation 1 (Standard). 	Single Slider is to be attached in the orientation shown in the figure below. Multi Slider is to be attached in the orientation shown in the figure below on both right and left sides. 	It is the opposite type in the attachment to Attachment Orientation 6 (Standard Horizontally Oriented Wall Mount). 

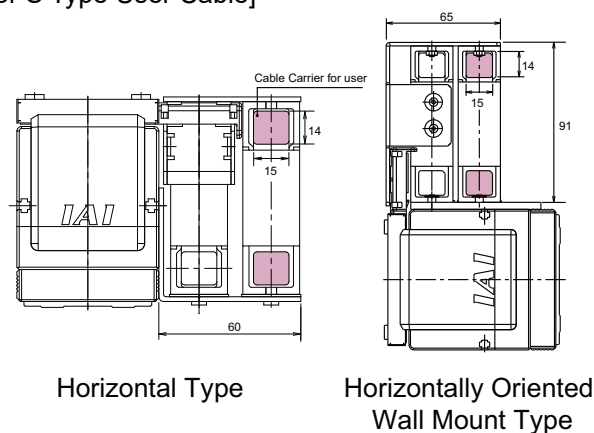
1.4.2 Cable Carrier for User S Type Attachment Orientations 1 to 6 (Model: US1 to US6)

These are the indications when attaching S Type User Cable Carrier to the standard cable carrier. Attachment orientation is also to be indicated. The attachment orientation of cable carrier is either the four orientations in Standard Horizontal Orientation Mount or two orientations in Horizontally Oriented Wall Mount. [Refer to “Attachment Orientation” in the “1.4.1 Cable Carrier Attachment Orientations 2 to 6 (Model: CT2 to CT6)”]

Refer to the table below for the availability of Single Slider and Double Slider.

Option Model	Attachment Orientation	Single Slider	Double Slider
US1	Attachment Orientation 1	○	○
US2	Attachment Orientation 2	○	×
US3	Attachment Orientation 3	○	×
US4	Attachment Orientation 4	○	×
US5	Attachment Orientation 5	○	○
US6	Attachment Orientation 6	○	×

[Dimensional Drawing for S Type User Cable]



1.4.3 Cable Carrier for User M Type

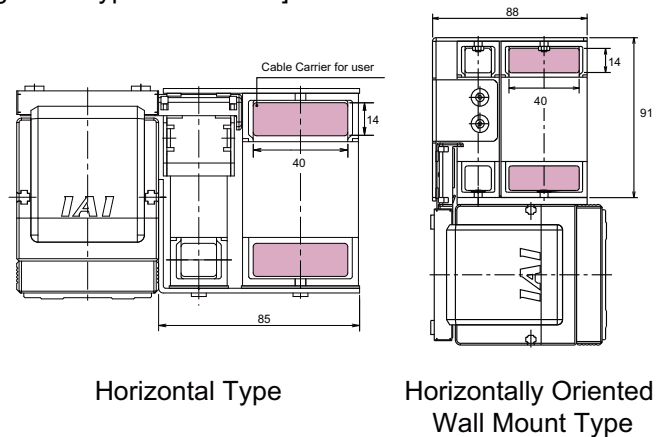
Attachment Orientations 1 to 6 (Model: UM1 to UM6)

These are the indications when attaching M Type User Cable Carrier to the standard cable carrier. Attachment orientation is also to be indicated. The attachment orientation of cable carrier is either the four orientations in Standard Horizontal Orientation Mount or two orientations in Horizontally Oriented Wall Mount. [Refer to “Attachment Orientation” in the “1.4.1 Cable Carrier Attachment Orientations 2 to 6 (Model: CT2 to CT6)”]

Refer to the table below for the availability of Single Slider and Double Slider.

Option Model	Attachment Orientation	Single Slider	Double Slider
UM1	Attachment Orientation 1	○	○
UM2	Attachment Orientation 2	○	×
UM3	Attachment Orientation 3	○	×
UM4	Attachment Orientation 4	○	×
UM5	Attachment Orientation 5	○	○
UM6	Attachment Orientation 6	○	×

[Dimensional Drawing for M Type User Cable]

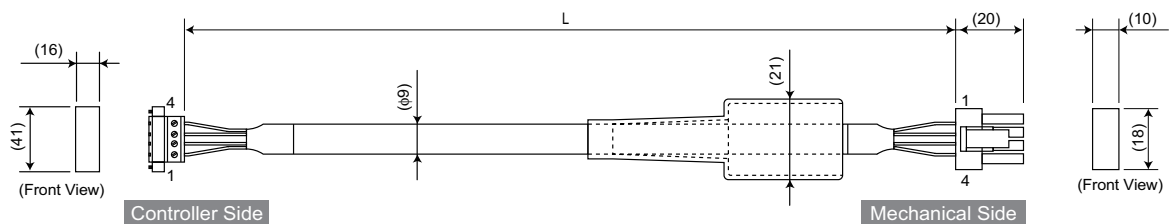


1.5 Motor • Encoder Cables

1.5.1 Motor • Encoder Cables for Linear Servo Actuator

[1] Motor Cable (Model : CB-X-MA□□□)

□□□ indicates the cable length (L) (Example: 080=8m),
Max. XSEL-P/Q : 30m, SSEL and SCON : 20m



Width	Electric Wire Color	Signal Abbreviation	Pin No.	Pin No.	Signal Abbreviation	Electric Wire Color	Width
AWG 19 (0.75mm ²)	Green	PE	1	1	U	Red	AWG 19 (0.75mm ²) (Solderless)
	Red	U	2	2	V	White	
	White	V	3	3	W	Black	
	Black	W	4	4	PE	Green	

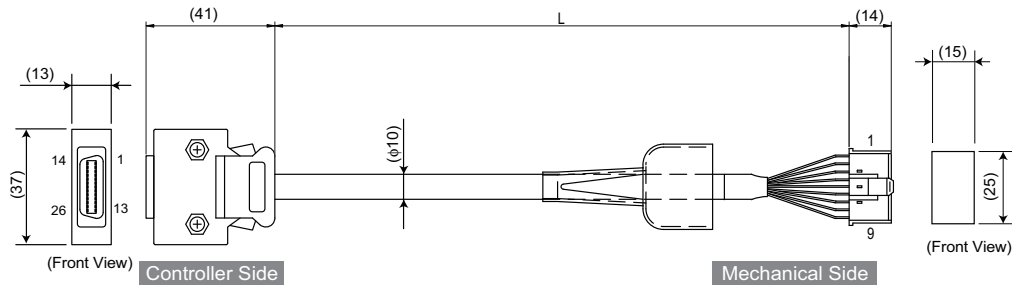
[Bending Radius]

When used under moving condition : 51mm

When used in fixed condition : 34mm

[2] Encoder Cable (Model : CB-X3-PA□□□)

□□□ indicates the cable length (L) (Example: 080=8m),
Max. XSEL-P/Q : 30m, SSEL and SCON : 20m



Width	Electric Wire Color	Signal Abbreviation	Pin No.
AWG26 (0.12mm ²) (Soldered)	-	-	10
	-	-	11
	-	E24V	12
	White/Green	0V	13
	White/Orange	LS	26
	-	CREEP	25
	-	OT	24
	-	RSV	23
	-	-	9
	-	-	18
	-	-	19
	White/Blue	A+	1
	White/Yellow	A-	2
	White/Red	B+	3
	White/Black	B-	4
	White/Purple	Z+	5
	White/Gray	Z-	6
	Orange	SRD+	7
	Green	SRD-	8
	Purple	BAT+	14
	Gray	BAT-	15
	Red	VCC	16
	Black	GND	17
	Blue	BKR-	20
	Yellow	BKR+	21
	-	-	22

The shield is clamped to the hood

Ground wire and braided shield wires

[Bending Radius]

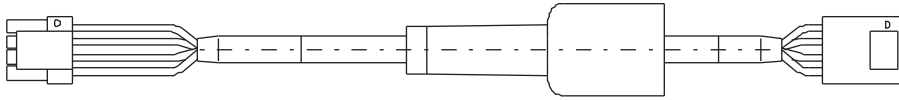
When used under moving condition : 58mm

When used in fixed condition : 38mm

Pin No.	Signal Abbreviation	Electric Wire Color	Width
1	A	White/Blue	AWG26 (0.12mm ²) (Solderless)
2	A	White/Yellow	
3	B	White/Red	
4	B	White/Black	
5	Z	White/Purple	
6	Z	White/Gray	
7	LS+	White/Orange	
8	-	-	
9	FG	Ground	
10	SD	Orange	
11	SD	Green	
12	BAT+	Purple	
13	BAT-	Gray	
14	VCC	Red	
15	GND	Black	
16	LS-	White/Green	
17	BK-	Blue	
18	BK+	Yellow	

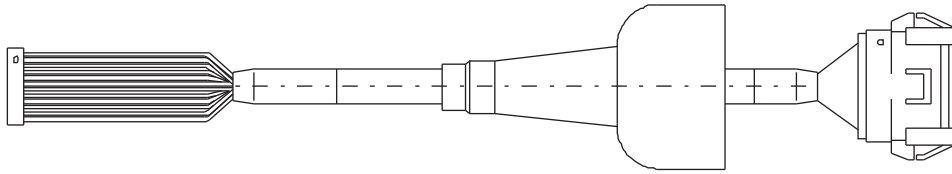
1.5.2 Cable in the bearer

[1] Motor cable



Width	Electric Wire Color	Signal Abbreviation	Pin No.	Pin No.	Signal Abbreviation	Electric Wire Color	Width
AWG 20 (0.5mm ²)	Red	U	1	1	U	Red	AWG 20 (0.5mm ²)
	White	V	2	2	V	White	
	Black	W	3	3	W	Black	
	Green	PE	4	4	PE	Green	

[2] Encoder cable



Width	Electric Wire Color	Signal Abbreviation	Pin No.	Pin No.	Signal Abbreviation	Electric Wire Color	Width
AWG 26 (0.12mm ²)	1B/Light blue	EN_A	1	1	EN_A	1B/Light blue	AWG 26 (0.12mm ²)
	1R/Light blue	EN_/A	2	2	EN_/A	1R/Light blue	
	1B/Pink	EN_B	3	3	EN_B	1B/Pink	
	1R/Pink	EN_/B	4	4	EN_/B	1R/Pink	
	1B/Light green	EN_Z	5	5	EN_Z	1B/Light green	
	1R/Light green	EN_/Z	6	6	EN_/Z	1R/Light green	
	1B/Orange	SD	7	7	NC	-	
	1R/Orange	/SD	8	8	NC	-	
	1B/Gray	5V	9	9	FG	Shield	
	-	NC	10	10	SD	1B/Orange	
	1R/Gray	GND	11	11	/SD	1R/Orange	
	Shield	FG	12	12	NC	-	
				13	NC	-	
				14	5V	1B/Gray	
				15	GND	1R/Gray	
				16	NC	-	
				17	NC	-	
				18	NC	-	

2. Installation

2.1 Transportation

 **Warning:** This actuator uses high-performance rare-earth permanent magnets. Therefore, those who are wearing a pacemaker or any other medical device must not come within 30cm of the actuator.

[1] Handling of the Actuator

Unless otherwise specified, the actuator is shipped with 1 axis unit packaged separately.

(1) Handling the Packed Unit

- Do not damage or drop. The package is not applied with any special treatment that enables it to resist an impact caused by a drop or crash.
- Transport a heavy package with at least more than two operators. Consider an appropriate method for transportation.
- Keep the unit in a horizontal orientation when placing it on the ground or transporting. Follow the instruction if there is any for the packaging condition.
- Do not step or sit on the package.
- Do not put any load that may cause a deformation or breakage of the package.

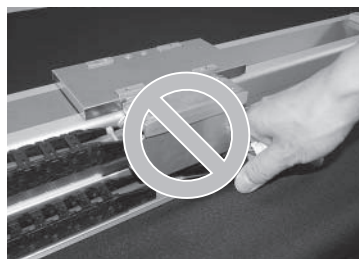
(2) Handling the Actuator After Unpacking

- Do not carry the actuator by its motor unit or its cable or attempt to move it by pulling the cable.
- Hold the base part or bracket part of the body when transporting the actuator main body.
- Do not hit or drop the actuator during transportation.
- Do not attempt to force any part of the actuator. Do not apply force especially on the stainless steel sheet.

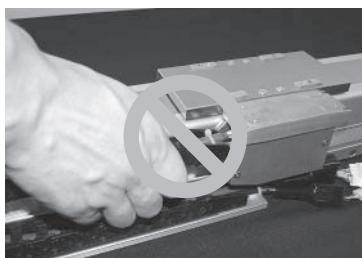
[Taboos in transportation]



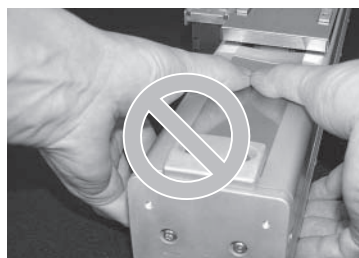
Do not transport the actuator by holding its slider.



Do not transport the actuator by holding its cables.



Do not transport the actuator by holding its cable carrier.



Do not transport the actuator by holding its stainless steel sheet.

[2] Handling in the Assembled Condition

This is the case when the product is delivered from our factory under a condition that it is assembled with other actuators. The combined axes are delivered in a package that the frame is nailed on the lumber base. The sliders are fixed so they would not accidentally move. The actuators are also fixed so the tip of it would not shake due to the external vibration.

(1) How to Handle the Package

- Do not hit or drop the package. No special treatment is conducted on this package to endure a drop or impact on it.
- Do not attempt to carry a heavy package with only one worker. Also, have an appropriate method for transportation.
- When hanging up with ropes, support on the reinforcement frame on the bottom of the lumber base. When bringing up the package with a forklift, also support on the bottom of the lumber base.
- Handle with care when putting the package down to avoid impact or bounce.
- Do not step on the package.
- Do not put anything on the package that could deform or damage it.

(2) How to Handle after Unpackaged

- Fix the slider so they would not accidentally move during transportation.
- If the tip of an actuator is overhanging, have an appropriate way to fix it to avoid shake due to the external vibration. In the transportation without the tip being fixed, do not apply any impact with 0.3G or more.
- When hanging up with ropes, have appropriate cushioning to avoid any deformation of the actuator body. Also keep it in stable horizontal orientation. Make a fixture utilizing the attachment holes and the tapped holes on the actuator body if necessary.
- Do not attempt to apply load on the actuators or the connector box. Also pay attention not to pinch cables and bend or deform them forcefully.

[3] Handling in Condition of being assembled in Machinery Equipment (System)

These are some caution notes for when transporting the actuator being assembled in the machinery equipment (system):

- Fix the actuator so it would not move during transportation.
- If the tip of an actuator is overhanging, have an appropriate way to fix it to avoid shake due to the external vibration. In the transportation without the tip being fixed, do not apply any impact with 0.3G or more.
- When hanging up the machinery equipment (system) with ropes, do not attempt to apply load on the actuators or the connector box. Also pay attention not to pinch cables and bend or deform them forcefully.

2.2 Installation and Storage • Preservation Environment

[1] Installation Environment

The actuator should be installed in a location other than those specified below.
Also provide sufficient work space required for maintenance inspection.

- Where the actuator receives radiant heat from strong heat sources such as heat treatment furnaces
- Where the ambient temperature exceeds the range of 0 to 40°C
- Where the temperature changes rapidly and condensation occurs
- Where the relative humidity exceeds 85% RH
- Where the actuator receives direct sunlight
- Where the actuator is exposed to corrosive or combustible gases
- Where the ambient air contains a large amount of powder dust, salt or iron (at level exceeding what is normally expected in an assembly plant)
- Where the actuator is subject to splashed water, oil (including oil mist or cutting fluid) or chemical solutions
- Where the actuator receives impact or vibration

If the actuator is used in any of the following locations, provide sufficient shielding measures:

- Where noise generates due to static electricity, etc.
- Where the actuator is subject to a strong electric or magnetic field
- Where the actuator is subject to ultraviolet ray or radiation

[2] Storage • Preservation Environment

- The storage and preservation environment should comply with the same standards as those for the installation environment. In particular, when the machine is to be stored for a long time, pay close attention to environmental conditions so that no dew condensation forms.
- Unless specially specified, moisture absorbency protection is not included in the package when the machine is delivered. In the case that the machine is to be stored and preserved in an environment where dew condensation is anticipated, take the condensation preventive measures from outside of the entire package, or directly after opening the package.
- For storage and preservation temperature, the machine withstands temperatures up to 60°C for a short time, but in the case of the storage and preservation period of 1 month or more, control the temperature to 50°C or less.
- Storage and preservation should be performed in the horizontal condition. In the case it is stored in the packaged condition, follow the posture instruction if any displayed on the package.

2.3 How to Install



Warning: This actuator uses high-performance rare-earth permanent magnets. Therefore, those who are wearing a pacemaker or any other medical device must not come within 30 cm of the actuator.

This chapter explains how to install the actuator on your mechanical system.

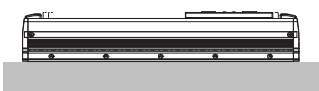
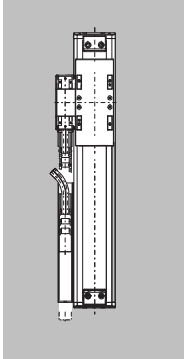
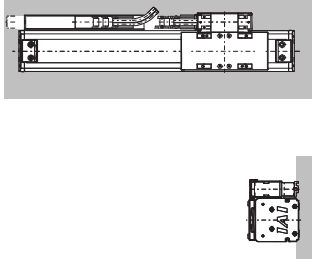
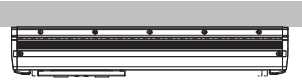
2.3.1 Installation

Follow the information below when installing the actuator, as a rule.
Do pay attention to these items (except with custom-order models).

○ : Possible × : Not possible

Type	Horizontal installation	Vertical installation	Horizontally Oriented Wall Mount installation	Ceiling Mount installation
H8SS, H8SM H8HS, H8HM	○	×	○	×
L15SS, L15SM	○	×	×	×

Installation Orientation

Horizontal	Vertical	Horizontally Oriented Wall Mount	Ceiling Mount
			

2.3.2 Installation of Main Unit

 **Caution:** The stainless steel sheet is designed very thin (thickness: 0.1 mm) in order to ensure flexibility. Therefore, the stainless steel sheet is easily dented or scratched.
When installing the stainless steel sheet, pay attention to the following points:

1. Do not press the sheet directly with hands.



2. Be careful not to drop a tool or a work piece on the sheet and make a dent mark.



3. Do not generate powder dust or iron powder around the stainless steel sheet.
There are magnets attached on the side cover to grip the stainless steel sheet. Handle the product with special care so the magnets would not grip metal pieces and dusts.
If dust/powder has generated, thoroughly remove attached dust/powder from the stainless steel sheet after the operation.
If the actuator is operated with the stainless steel sheet carrying foreign particles, the particles may enter the slider and damage the sheet or cause the sheet to deform, lift or present other problems.

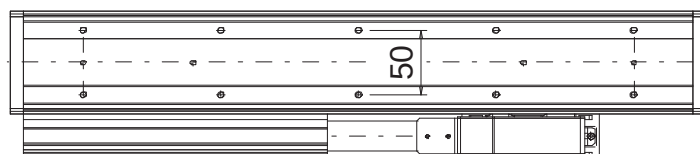
The surface to mount the main unit should be a machined surface or a plane that possesses an equivalent accuracy and the flatness should be within 0.05mm/m.

The side surfaces and bottom surface of the base of the body have good parallelism to the guide. Utilize these surfaces when accuracy in the actuator drive is required.

©Small Type H8SS, H8SM, H8HS, H8HM

This actuator base has tapped mounting holes that can be used to affix the actuator from its back (take note that the tap size is different depending on the model: Refer to the figure below and “8. External Dimensions”).

There are also reamed holes for accepting positioning pins.



Tapped Hole Size	Tapped Holes Depth	Tightening Torque		Pitch [mm]	Reamed Hole [mm]
		In the case that steel is used for the bolt seating surface:	In the case that aluminum is used for the bolt seating surface:		
M5	5mm or more 10mm or less	7.27N·m (0.74kgf·m)	3.42N·m (0.35kgf·m)	50	φ4H7, depth 5

About Tightening Screws

- Use a hex socket head cap bolt for the attachment to the base.
- It is recommended to use high-tensile bolts with ISO-10.9 or more.
- Make sure to have the effective length of bolt engagement described below or more for the tightening of a bolt and a female screw.

When female screw is on steel → Thread length same as nominal diameter

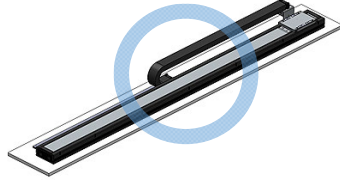
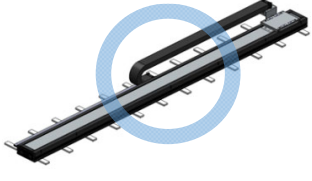
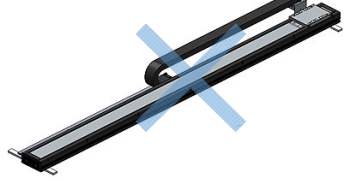
When female screw is on aluminum → Thread length 1.8 times longer than nominal diameter



Caution: Pay special attention when selecting the bolt length. In case that an inappropriate length of a bolt is applied, it may cause damage on the tapped holes or insufficiency in attachment strength, which may result in a drop in the operation accuracy or an unexpected accident.

◎ Caution for Installation of Main Unit

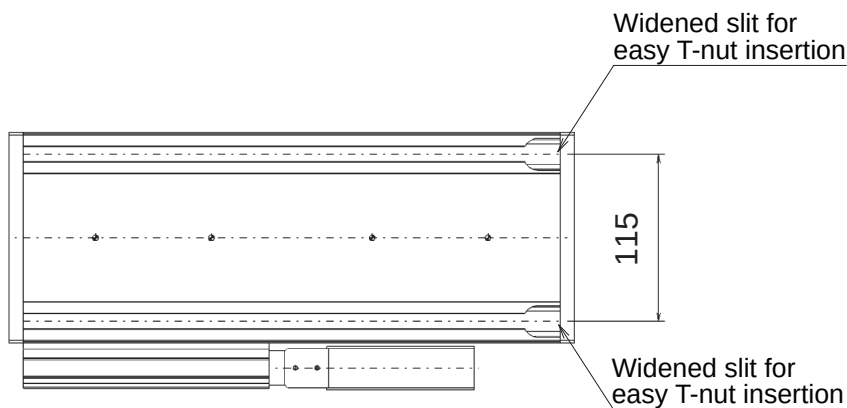
- Basically, all of the tapped holes should be used in order to hold on the whole area.
- In case that the accuracy in drive is not required, it is available to make foot brackets to hold the unit. In this case also, all the tapped holes are to be used to hold the unit.
- Do not attempt to hold only on ends. It could make the base warped and sliding resistance may get high on ends. It could cause an error.

Hold on Whole Area Use All of Tapped Holes	Hold with Foot Brackets Use All of Tapped Holes	Hold Only on Ends
		

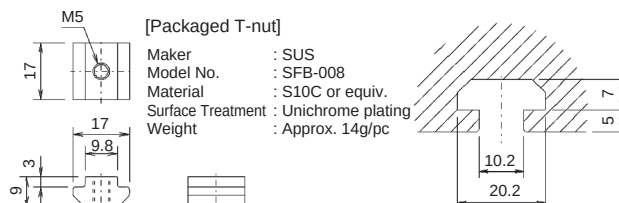
©Flat Type L15SS, L15SM

The actuator base is equipped with T-shaped grooves at the back for installation. Use the T-shaped grooves on the base and the enclosed nuts for installation. Also, pay attention so the tip of a bolt would not touch the bottom of the T-shaped groove.

There are also reamed holes for accepting positioning pins.



Reamed Hole [mm]
φ4H10, depth 6mm



About Tightening Screws

- Use a hex socket head cap bolt for the attachment to the base.
- It is recommended to use high-tensile bolts with ISO-10.9 or more.
- Make sure to have the effective length of bolt engagement described below or more for the tightening of a bolt and a female screw.

When female screw is on steel → Thread length same as nominal diameter

When female screw is on aluminum → Thread length 1.8 times longer than nominal diameter

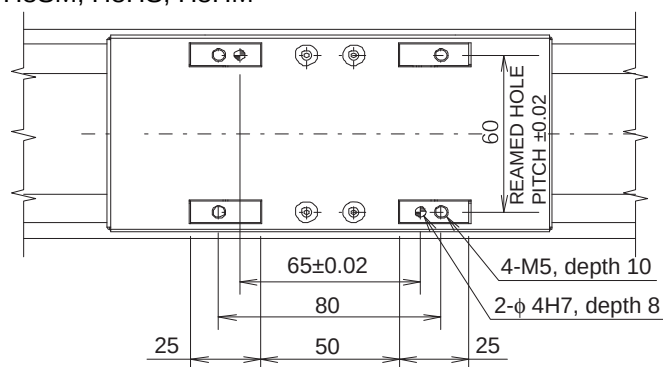


Caution: Pay special attention when selecting the bolt length. In case that an inappropriate length of a bolt is applied, it may cause damage on the tapped holes or insufficiency in attachment strength, which may result in a drop in the operation accuracy or an unexpected accident.

2.3.3 Attachment of Transported Object

- There are tapped holes on the top surface of the slider. Affix the work part (transported object) here.
- The procedure to affix a load on the slider shall conform to the actuator installation procedure.
- There are two reamed holes on the top surface of the slider. Use these reamed holes if repeatability of attaching and detaching is required. Also, if small tuning such as perpendicularity is required, use one of the reamed holes for the tuning.
- Refer to the following table for the screwed depth and reamed depth. Screwing further than indicated in the table may destroy the tapped hole or lower the reinforcement of the attachment of the work part, result in the drop of the accuracy or an unexpected accident.

◎Small Type H8SS, H8SM, H8HS, H8HM



Tapped Hole Size	Mounting Bolt		Reamed Hole
	Nominal Bolt Diameter	Tightening Torque	
M5, depth 10	M5	3.42N·m (0.35kgf·m)	φ4H7, depth 8

About Tightening Screws

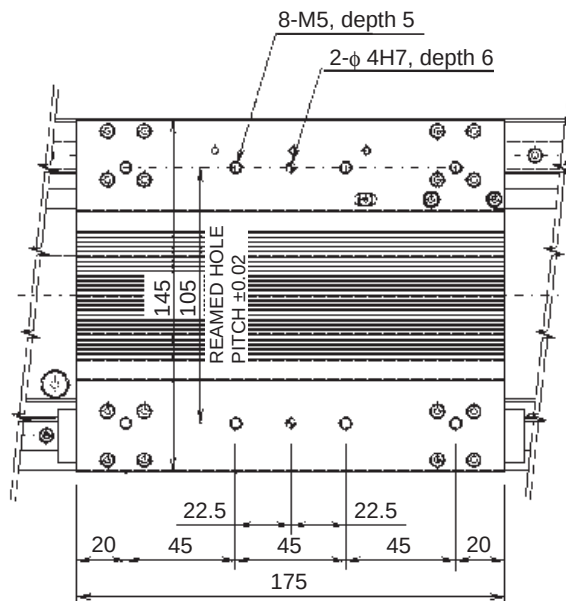
- Use a hex socket head cap bolt for the attachment to the base.
- It is recommended to use high-tensile bolts with ISO-10.9 or more.
- Make sure to have the effective length of bolt engagement described below or more for the tightening of a bolt and a female screw.
When female screw is on steel → Thread length same as nominal diameter
When female screw is on aluminum → Thread length 1.8 times longer than nominal diameter



Caution: • Pay special attention when selecting the bolt length. In case that an inappropriate length of a bolt is applied, it may cause damage on the tapped holes or insufficiency in attachment strength, which may result in a drop in the operation accuracy or an unexpected accident.

- When attaching a transported object, pay attention not to apply a viscous liquid such as glue or paint on the stainless steel sheet, or not to apply force on a spot, which could make a dent mark. Doing so may cause an operation error of the slider or damage on the sheet.

©Flat Type L15SS, L15SM



Tapped Hole Size	Mounting Bolt		Reamed Hole
	Nominal Bolt Diameter	Tightening Torque	
M5, depth 5	M5	3.42N·m (0.35kgf·m)	φ4H7, depth 6

About Tightening Screws

- Use a hex socket head cap bolt for the attachment to the base.
- It is recommended to use high-tensile bolts with ISO-10.9 or more.
- Make sure to have the effective length of bolt engagement described below or more for the tightening of a bolt and a female screw.

When female screw is on steel → Thread length same as nominal diameter

When female screw is on aluminum → Thread length 1.8 times longer than nominal diameter



Caution: • Pay special attention when selecting the bolt length. In case that an inappropriate length of a bolt is applied, it may cause damage on the tapped holes or insufficiency in attachment strength, which may result in a drop in the operation accuracy or an unexpected accident.

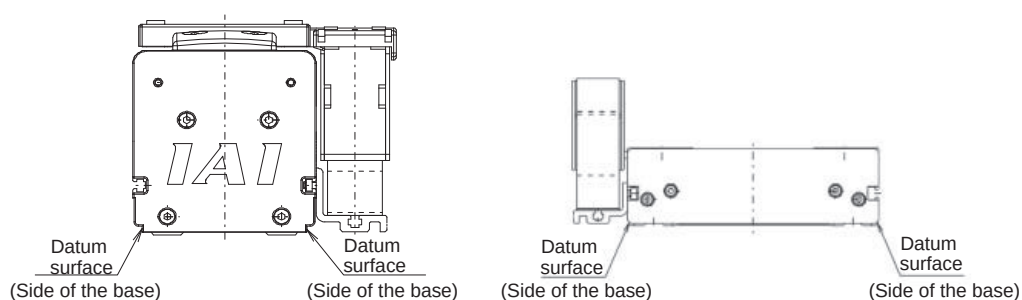
- When attaching a transported object, pay attention not to apply a viscous liquid such as glue or paint on the stainless steel sheet, or not to apply force on a spot, which could make a dent mark. Doing so may cause an operation error of the slider or damage on the sheet.

2.3.4 Installation Surface

- For the platform to install the actuator, ensure the structure that possesses enough stiffness to avoid vibration being generated.
- Install the actuator on a machined surface or other flat surface of equivalent accuracy. The flatness of the installation surface must be 0.05 mm/m or less.
- Provide sufficient space to allow for maintenance work.
- The side and bottom surfaces of the actuator base provide datum surfaces used for alignment of slider travel.
- If you require higher traveling accuracy, install the actuator using these datum surfaces.

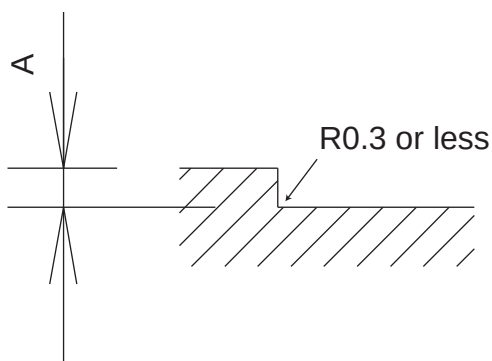
Small Type H8SS, H8SM, H8HS, H8HM

Flat Type L15SS, L15SM



As shown above, each side surface of the base provides a datum surface used for alignment of slider travel. If you require higher traveling accuracy, therefore, install the actuator with reference to either side surface of the base.

When installing the actuator on the frame using the base datum surfaces, provide the necessary machining by following the drawing below.



Model	Dimension A (mm)
Small Type H8SS, H8SM, H8HS, H8HM	2 ~ 3.5 or less
Flat Type L15SS, S15SM	2.5 ~ 4 or less

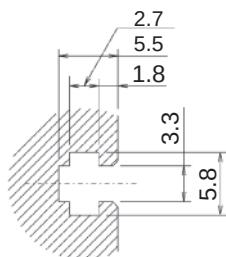


2.3.5 Mount of Connector Box and Others

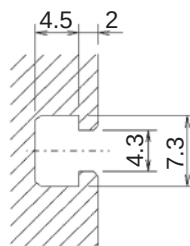
T-slots are provided on the side faces of the actuator for installation of a connector box or other external equipment. If you are using a wiring kit, install a connector box using these T-slots. T-slots can also be used for other purposes, such as installing sensors or securing cables. The T-slot dimensions are specified below.

- Use of square nuts is recommended in T-slots, but hex nuts can also be used.
- When installing an object using T-slots, select bolts of an appropriate length so that the tip of the bolt will not contact the bottom of the T-slot.

Small Type H8SS, H8SM, H8HS, H8HM



Flat Type L15SS, L15SM



T-slot Dimensions

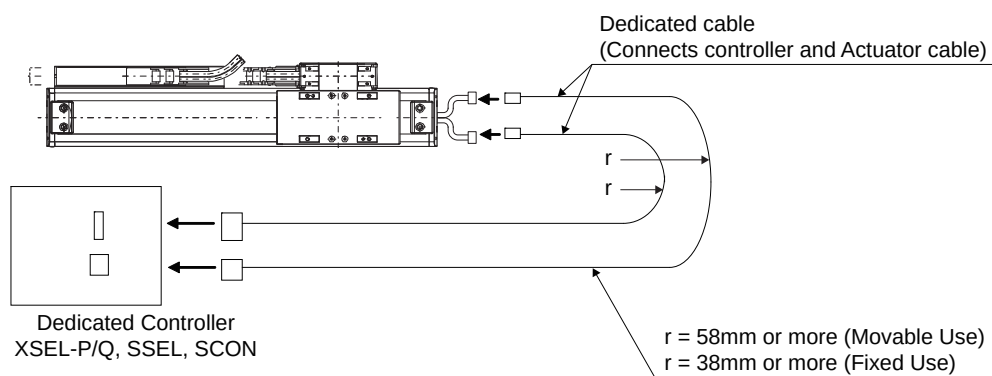
Model	T-slot Nut Diameter
Small Type H8SS, H8SM, H8HS, H8HM	M3
Flat Type L15SS, L15SM	M4

3. Connecting with the Controller

Use the IAI dedicated connection cable for the connection of the actuator to the controller.

- If the dedicated connection cable cannot be secured, reduce the load on the cable by allowing it to deflect only by the weight of the cable or wire it in a self-standing cable hose, etc., having a large radius.
- Do not cut and reconnect the dedicated connection cable for extension or shorten the cable.
- Do not pull on the dedicated connection cable or bend it forcibly.
- The actuator cable coming out of the motor unit is not meant to be bent. Fix the cable so it would not be bent repeatedly.

Please consult with IAI if you require a different kind of cable than the one supplied.



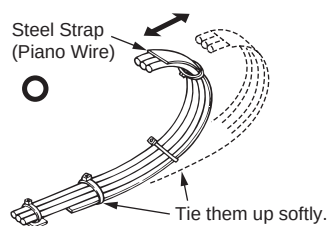
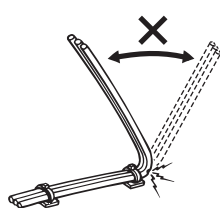
Dedicated cables

- Motor cable (Robot cable) CB-X-MA□□□
 - Encoder cable CB-X3-PA□□□
- indicates the cable length.
30m at the maximum can be applied to XSEL-P/Q.
20m at the maximum can be applied to SSEL and SCON.
Example) 080 = 8m



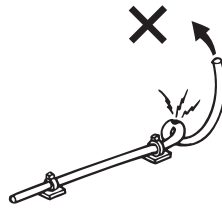
Warning: For wiring, please follow the warnings stated below. When constructing a system as the machinery equipment, pay attention to the wiring and connection of each cable so they are conducted properly. Not following them may cause not only a malfunction such as cable breakage or connection failure, or an operation error, but also electric shock or electric leakage, or may even cause a fire.

- Use dedicated cables of IAI indicated in this operating manual. Contact us if you wish to have a change to the specifications of the dedicated cables.
- Make sure to turn the power off in the process of power line or cable connection or disconnection.
- Do not attempt to cut a dedicated cable with connectors on both ends to extend, shorten or re-joint it.
- Hold the dedicated cable to avoid mechanical force being applied to the terminals and connectors.
- Use a cable pipe or duct to have an appropriate protection when there is a possibility of mechanical damage on a dedicated cable.
- In case a dedicated cable is to be used at a moving part, make sure to lay out the cable without applying any force to pull the connector or extreme bend on the cable. Do not attempt to use the cable with a bending radius below the allowable value.
- Make certain that the connectors are plugged properly. Insufficient connection may cause an operation error, thus it is extremely risky.
- Do not lay out the cables to where the machine runs over them.
- Pay attention to the cable layout so it would not hit peripherals during an operation. In case it does, have an appropriate protection such as a cable carrier.
- When a cable is used hanging on the ceiling, prevent an environment that the cable swings with acceleration or wind velocity.
- Make sure there is not too much friction inside the cable storage equipment.
- Do not apply radiated heat to power line or cables.
- Have a sufficient radius for bending, and avoid a bend concentrating on one point.

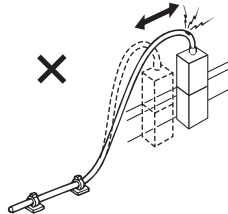




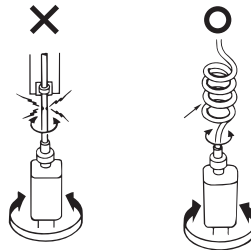
- Do not let the cable bend, kink or twist.



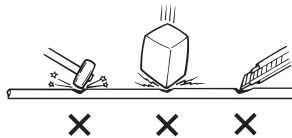
- Do not pull the cable with a strong force.



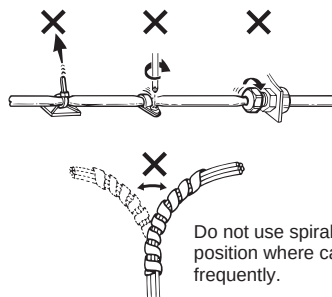
- Pay attention not to concentrate the twisting force to one point on a cable.



- Do not pinch, drop a heavy object onto or cut the cable.

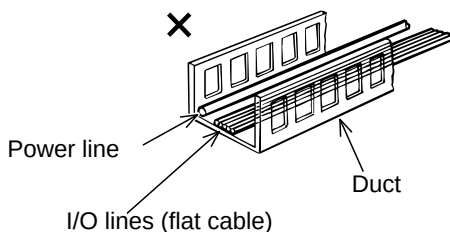


- When a cable is fastened to affix, make sure to have an appropriate force and do not tighten too much.



Do not use spiral tube in any position where cables are bent frequently.

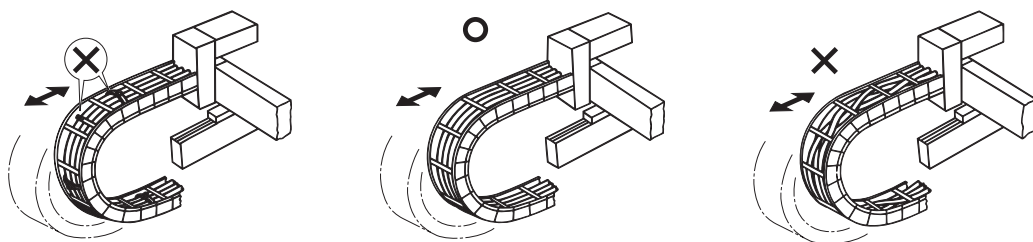
- PIO line, communication line, power and driving lines are to be put separately from each other and do not tie them together. Arrange so that such lines are independently routed in the duct.



Follow the instructions below when using a cable carrier.

- If there is an indication to the cable for the space factor in a cable carrier, refer to the wiring instruction given by the supplier when storing the cable in the cable carrier.
- Avoid the cables to get twined or twisted in the cable carrier, and also to have the cables move freely and do not tie them up. (Avoid tension being applied when the cables are bent.)

Do not pile up cables. It may cause faster abrasion of the sheaths or cable breakage.



4. Operation

4.1 Home Return

4.1.1 Principle of Home-Return Operation

Home return is performed in the sequence specified below.

- 1) When a home return command is issued, the moving direction is determined from the specified parameter.
- 2) During home return, the mechanical end is detected via the software.
- 3) The actuator reverses upon contacting the mechanical end, after which it detects a Z phase signal and recognizes this position as the reference point.
- 4) The actuator moves further by the offset specified by the applicable parameter and recognizes the achieved position as the home.

4.1.2 Fine-tuning the Home Position

The actuator is shipped with its motor travel after the actuator contacts the stopper until a Z phase signal is output pre-adjusted. The table below lists the standard reversing distance for each model, where the reversing distance indicates the distance moved by the slider after it contacts the stopper and reverses, until it stops at the home position.

Model	Reversing distance from mechanical stopper
Small type H8SS, H8SM, H8HS, H8HM	Approx. 10mm
Flat type L15SS, L15SM	Approx. 15mm

If the home return direction remains the same, changing the parameter based on this value allows you to fine-tune the home position of your actuator. Perform this fine-tuning by following the procedure below.

- 1) Perform home return to check the home.
- 2) Thereafter, move the actuator to a desired home. Check the difference and correct the parameter accordingly. The parameter accepts a positive value to set an offset in the moving direction of the actuator. (Negative values cannot be set.)
- 3) Increasing the offset reduces the moving range by the amount incremented. If you have specified an offset exceeding 1mm, also adjust the soft limits.
[Refer to PC Software Instruction Manual for details of how to set up the parameters]

4.1.3 Changing the Home Direction

Changing the factory-set home direction after the delivery requires the moving direction parameter to be changed and the encoder readjusted. Please consult IAI.



Warning: The encoder not only detects position and home signals, but it also plays an important role in the switching of AC-servo power phases. Since the AC-servo power phases have been adjusted precisely, never touch the encoder to change the home.

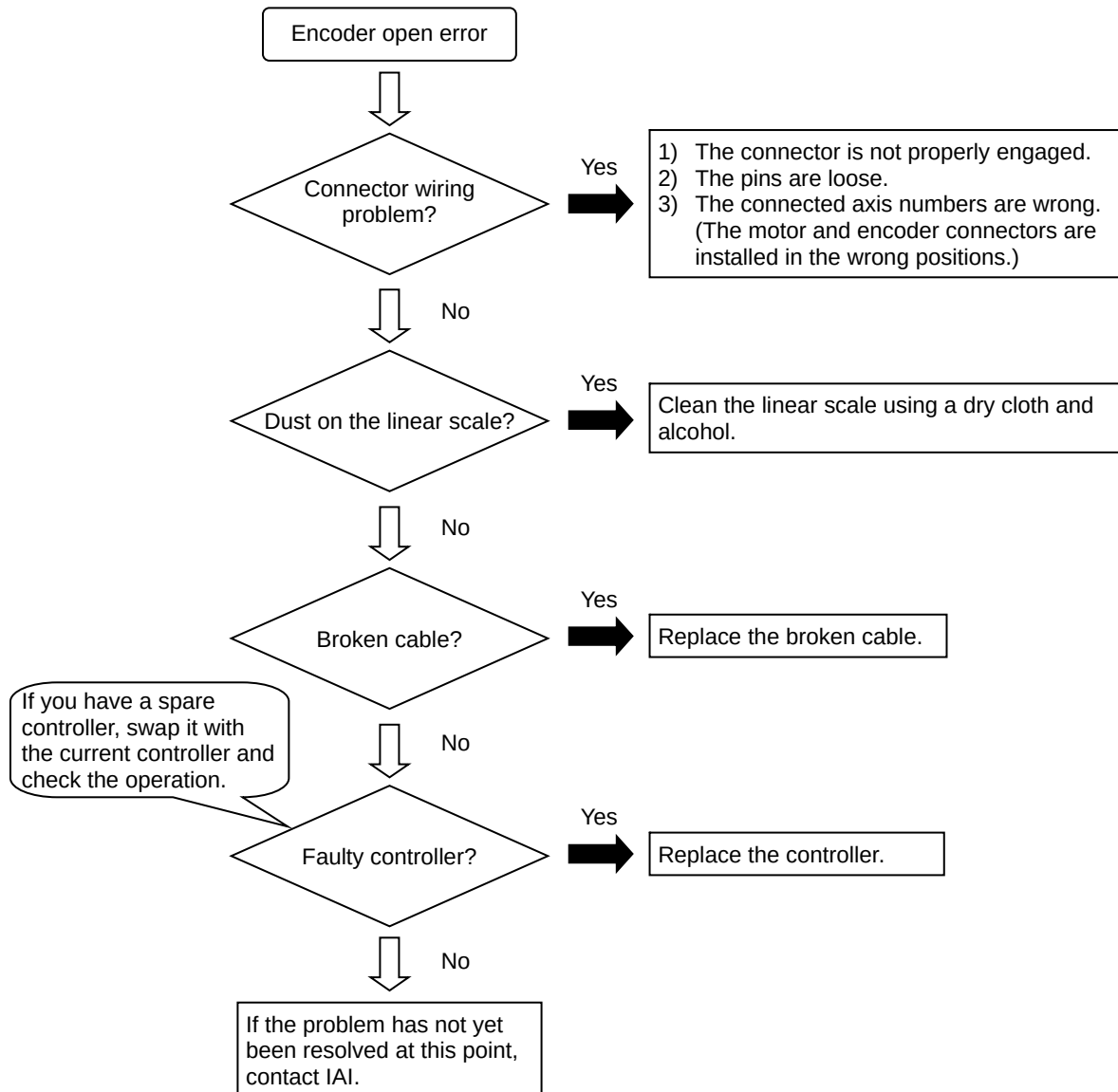


INTELLIGENT ACTUATOR

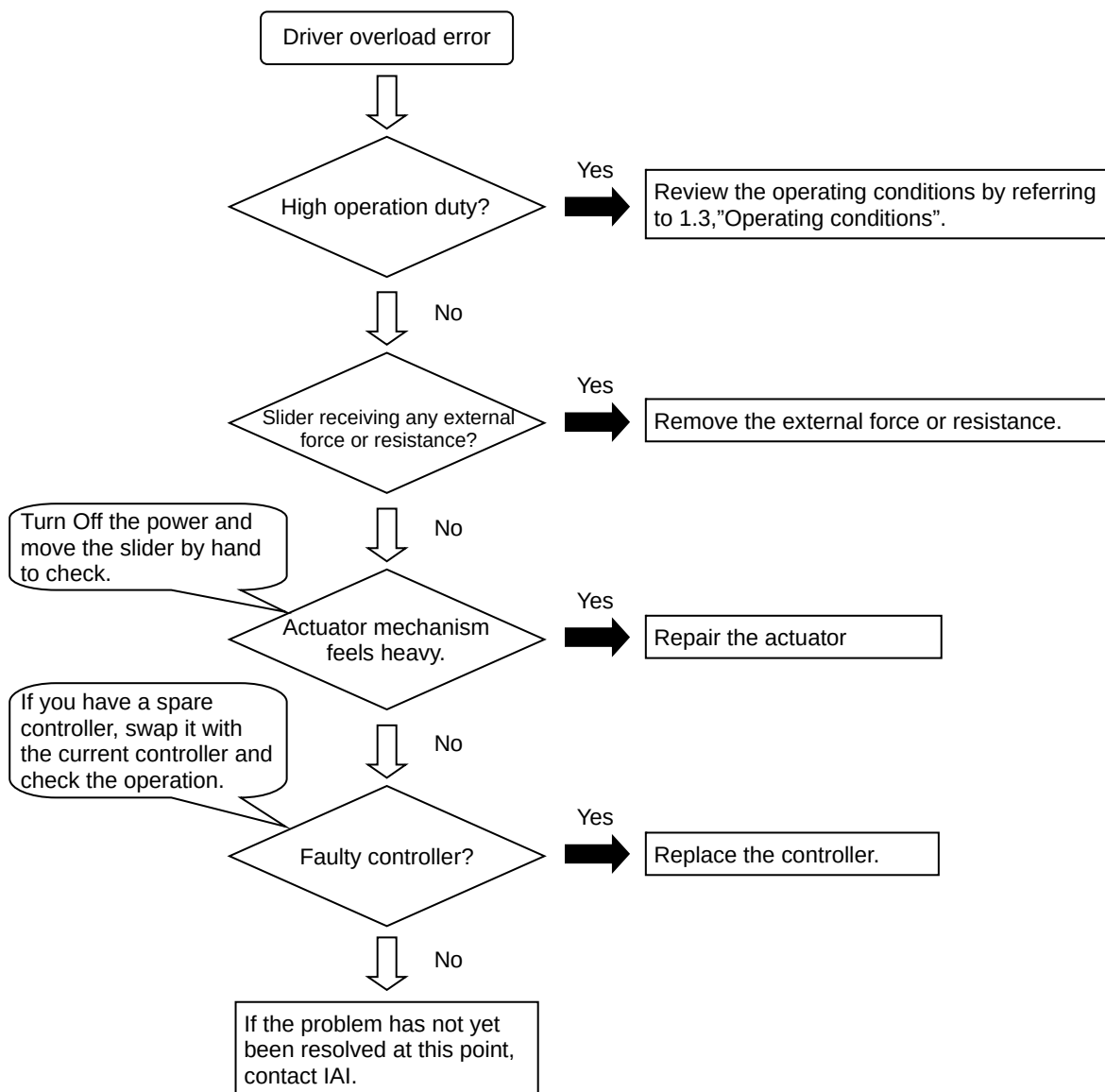
5. Troubleshooting

If the actuator has experienced an encoder open error, driver overload error, deviation overflow error or any other error, check the procedures explained below before concluding that the robot or controller is faulty. If the problem persists after the applicable measures have been taken, contact IAI with the detailed condition.

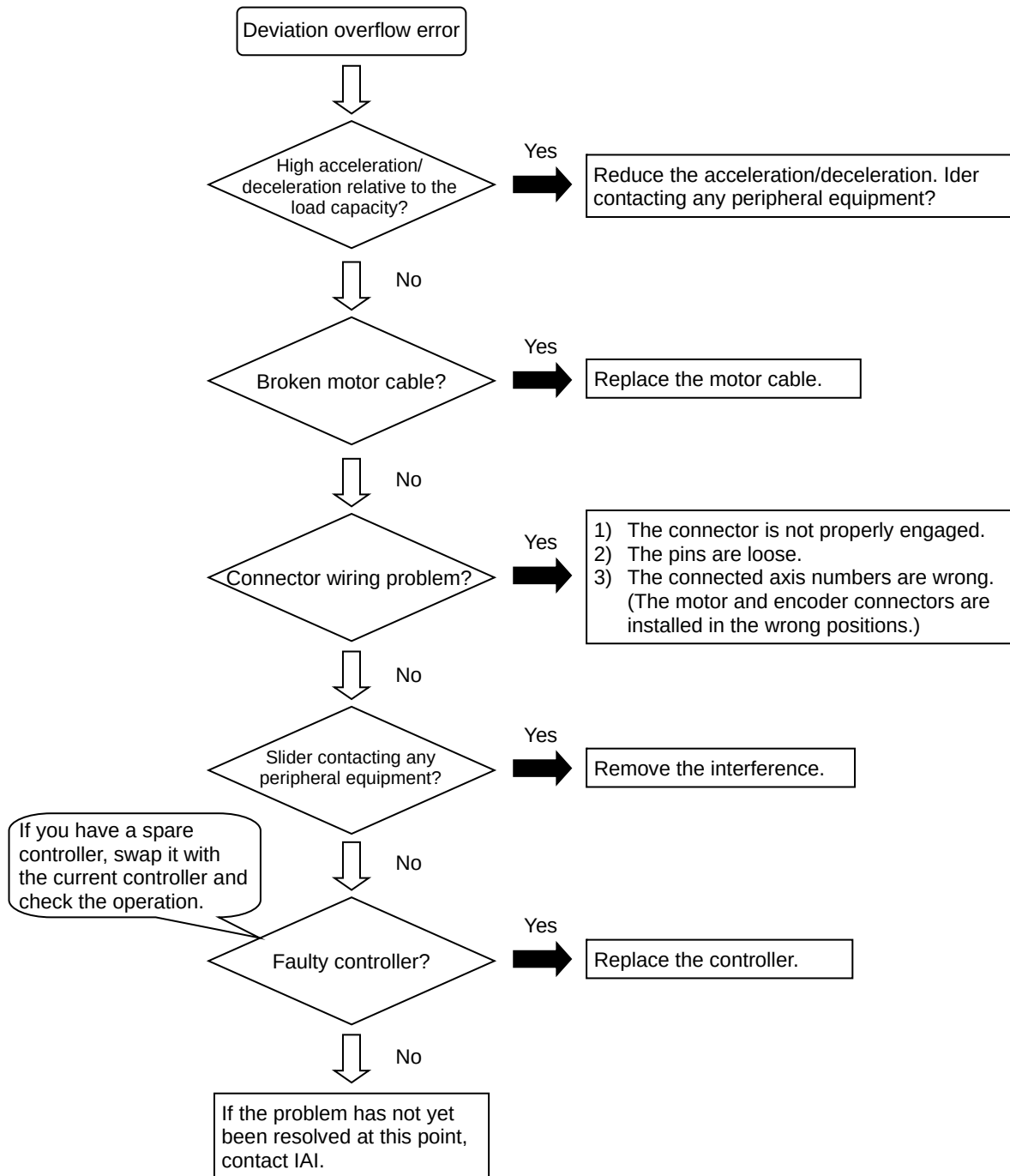
5.1 Encoder Open Error (Error Code: D12)



5.2 Driver Overload Error (Error Code: D0A)



5.3 Deviation Overflow Error (Error Code: C6B)





INTELLIGENT ACTUATOR

6. Maintenance and Inspection

 **Warning:** This actuator uses high-performance rare-earth permanent magnets. Do not get closer than 30cm if you are a person who needs a support of a medical device such as a pacemaker.

6.1 Inspection Items and Schedule

Perform maintenance and inspection at the intervals specified below.

This schedule assumes that the actuator is operated eight hours a day.

If the actuator is operated at a higher utilization, such as when the machine is used continuously day and night, reduce the inspection intervals accordingly.

	Visual inspection of exterior	Inspection of interior
Start-up inspection	○	
After 1 month of operation	○	
After 6 months of operation	○	○
After 1 year of operation	○	○
Every 6 months thereafter	○	
Every 1 year	○	○

6.2 External Visual Inspection

An external visual inspection should check the following things.

Actuator	Loosening of actuator mounting bolts, etc.
Cables	Scratches, connector engagement
Stainless steel sheet	Scratches, deviation, slack
Overall	Noise, vibration

- Adjust the tension of the stainless steel sheet in case it is deviated or slacked.
[Refer to 6.5.2 “Adjusting the Stainless Steel Sheet Tension” and 6.5.3 “Operation Check”.]
- The life of the stainless steel sheet should be 5000km of driving distance as a reference. However, replace the stainless steel sheet when it is necessary depending on the condition of use.

The sheet can be replaced by the user, but make sure there is no deviated or slacked on the stainless steel sheet. Deviated or slacked on the stainless steel sheet may damage the sheet. It is recommended that you bring the unit to us or have our service engineer visit your site for replacement work if you have any concern in the work.

6.3 Cleaning

- Clean the exterior surface as necessary.
- Wipe dirty areas using a soft cloth, etc.
- Do not blow highly compressed air onto the actuator, as it may cause dust to enter the actuator through gaps between parts.
- Do not use petroleum-based solvent as it damages resin and coated surfaces.
- To remove stubborn stains, take neutral detergent or alcohol into a soft cloth, etc., and wipe the area gently.

6.4 Interior Inspection

6.4.1 Small Type H8SS, H8SM, H8HS, H8HM

With the power supply turned OFF, turn up the stainless steel sheet and visually inspect the interior. Check the following items inside the actuator.

Actuator	Loosening of actuator mounting bolts, etc.
Guide	Lubrication condition, soiling, looseness

Visually check the interior condition. Focus on entry of dust and other foreign matters and the lubrication condition.

Even if grease has turned brown, the actuator is lubricated properly if its traveling surface is glossy. Contact IAI if an abnormality is found on the guide part.

The procedure to check the interior is specified below:

- 1) Move the slider toward the home side.
- 2) Remove the screws securing the sheet using a hex wrench with a width across flats of 7mm.
- 3) Turn up the sheet and check the interior.
- 4) After the check, assemble the parts by following the same steps in the reverse order.



Caution:

- When peeling off the stainless steel sheet, be careful not to get pulled in the body by the strong magnetic force of the magnets inside.
In case of getting pulled by the magnets inside, the stainless steel sheet may get damaged and may not be used any more. Contact IAI if the sheet is damaged.
- Do not attempt to change the mounting condition by pulling the sheet. Change in the mounting condition may give an impact to the alignment of the sheet or the life of it.
- When working with the stainless steel sheet, wear gloves or take other appropriate precautions to prevent cuts by the edges of the sheet.

6.4.2 Flat Type L15SS, L15SM

Turn the power off, and check the following items inside the actuator.

Actuator	Loosening of actuator mounting bolts, etc.
Guide	Lubrication condition, soiling, looseness

Visually check the interior condition. Focus on entry of dust and other foreign matters and the lubrication condition.

Even if grease has turned brown, the actuator is lubricated properly if its traveling surface is glossy. Contact IAI if an abnormality is found on the guide part.

6.5 Procedures for Replacement and Adjustment of Stainless Steel Sheet

Described below explains how to replace and adjust the stainless steel sheet.

Those parts such as screws taken off for replacement work are necessary when assembling the product back. It is recommended to prepare a storage box in advance to starting the work, so the taken off parts can be kept in it.

[Required Items]

- Replacement stainless steel sheet
- Scale
- Box-end wrench (7mm)
- Adhesive tape
- Oil-based marker
- Tension gauge (having two forked hooks)

[Notes]

(1) Stainless steel sheet tension

Improper tension of the stainless steel sheet can promote deterioration and wear of the sheet. If the stainless steel sheet is too taut and the clearance from the slider cover becomes exceeds 1mm, the stainless steel sheet may undergo fatigue failure.

On the other hand, excessive slacks cause the stainless steel sheet to contact the back of the slider cover.

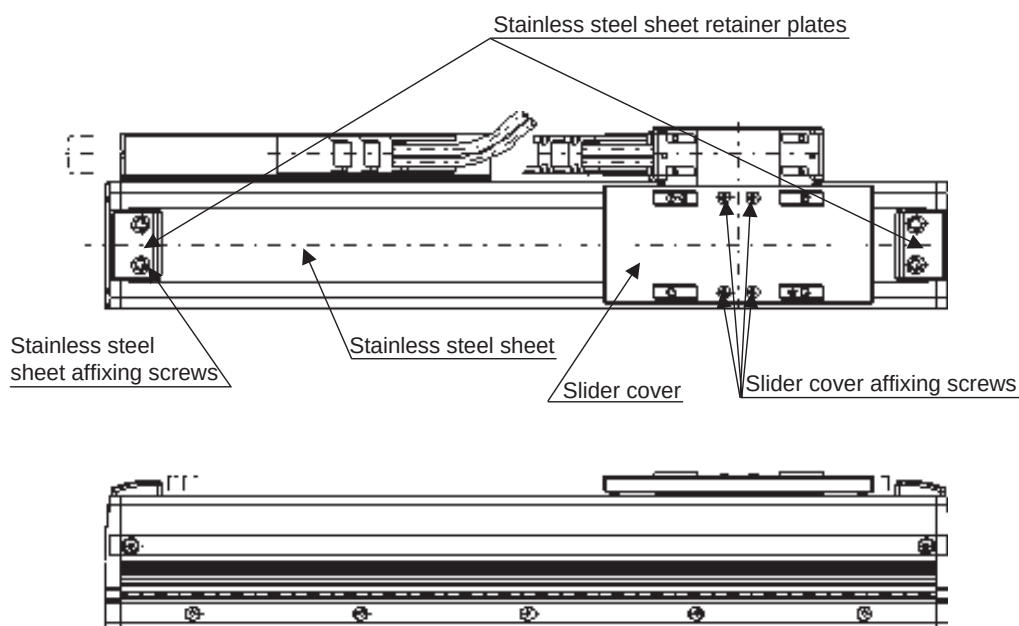
(2) Checking the clearance between the stainless steel sheet and the back of the slider cover

The stainless steel sheet is replaced without removing the slider cover.

Therefore, the clearance between the stainless steel sheet and the back of the slider cover cannot be measured or checked directly.

The stainless steel sheet must be tensioned so that this clearance becomes 1mm.

[Name of each part]

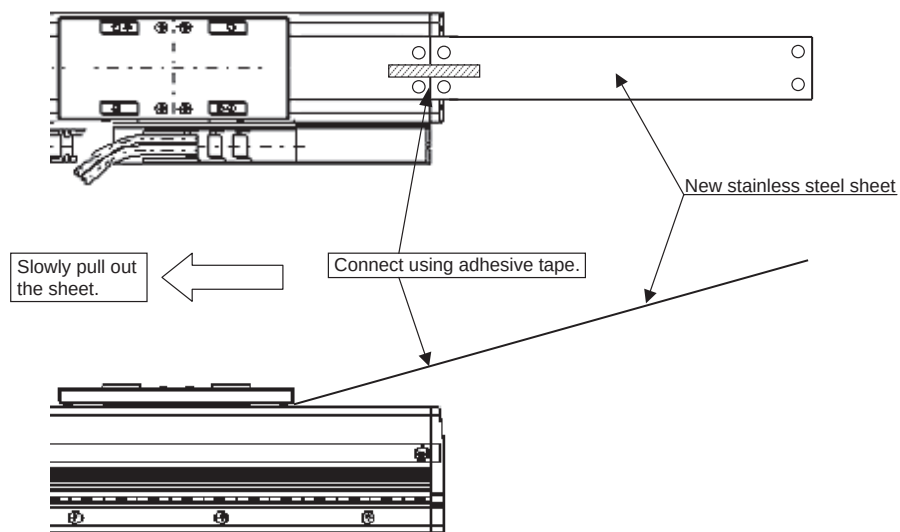


Replace the stainless steel sheet with the procedures from 6.5.1 to 6.5.3.
Adjust the tension of the stainless steel sheet with the procedures in 6.5.2 and 6.5.3.

6.5.1 Replacement Procedure for Stainless Steel Sheet

Replace the degraded stainless steel sheet with a new one by following the steps described below.

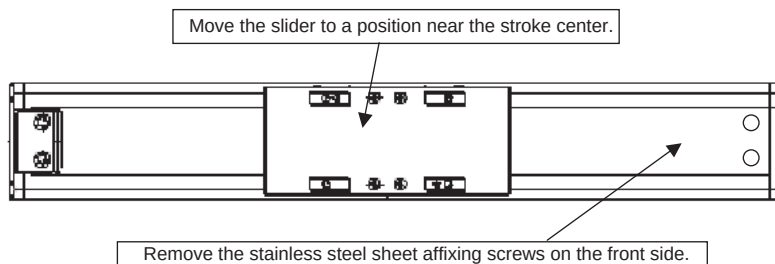
- 1) Check a new stainless steel sheet to confirm absence of scratches or soiling.
- 2) Loosen the screws affixing the damaged stainless steel sheet with a 7mm-sized hex wrench, and remove the retainer plates.
- 3) Connect the damaged stainless steel sheet and new stainless steel sheet using adhesive tape.
- 4) Slowly pull out the damaged stainless steel sheet.
- 5) Confirm that the new stainless steel sheet has been installed in the slider.



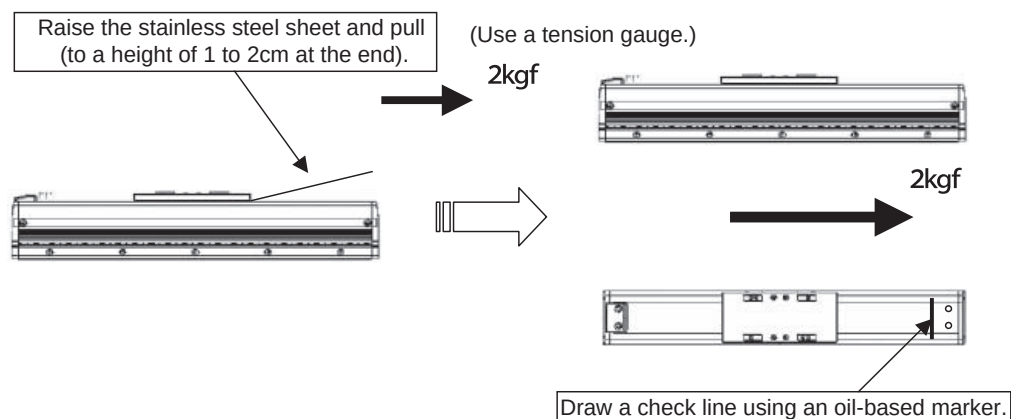
Connect the damaged stainless steel sheet and new stainless steel sheet using adhesive tape, and then slowly pull out the damaged stainless steel sheet so that the new sheet takes its position.

6.5.2 Adjusting the Stainless Steel Sheet Tension

- 1) First, affix the stainless steel sheet uniformly on the right and left in a manner free from meandering.
(The stainless steel sheet is gripped on with the magnets. Detach the sheet in a manner of peeling it once from one edge. Also adjust the stainless steel sheet from the slider center toward both ends.)
- 2) Move the slider to a position near the stroke center, and unscrew the screws holding the stainless steel sheet with a 7mm-sized hex wrench on one side and remove the retainer plate.



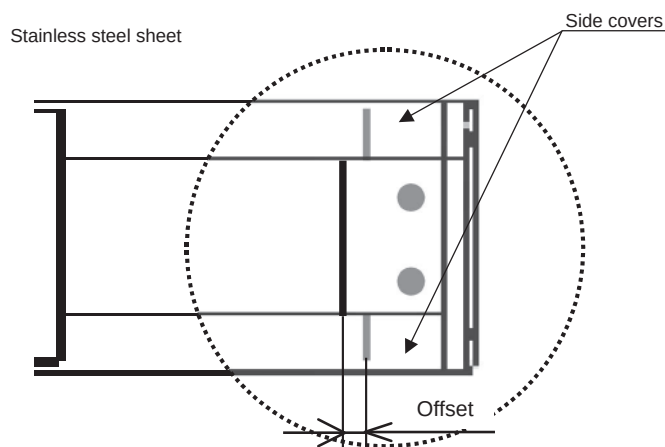
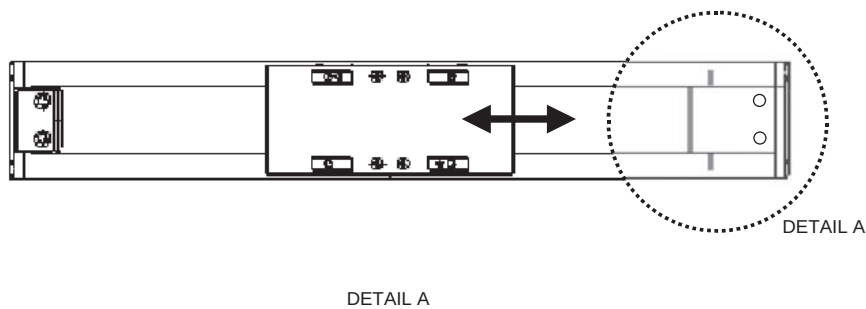
- 3) Prepare for tension adjustment of the stainless steel sheet.
 - As shown below, raise the stainless steel sheet by 1 to 2cm at the end where the screws were removed in step 2), and then by using a tension gauge, pull the sheet in the direction of the free end with a force of 2kg. (Use a tension gauge having two forked hooks at its tips and hook the gauge at two locations on the stainless steel sheet.)
 - With the stainless steel sheet tensioned by a force of 2kg, allow the stainless steel sheet to be attracted to the magnets from the slider end toward the other end, and then remove the tension gauge.
(Once attracted to the magnets, the stainless steel sheet will not move.)
 - Use an oil-based marker and ruler to draw a straight check line that crosses over the side covers and stainless steel sheet. [Refer to the figure below.]



4) Adjusting the Stainless Steel Sheet Tension

Adjust the stainless steel sheet in the direction of the arrow until the check lines on the side covers are offset from the check line on the stainless steel sheet by 0.5mm. (Refer to the enlarged view of A.)

(The stainless steel sheet is gripped on with the magnets. Detach the sheet in a manner of peeling it once from one edge.)

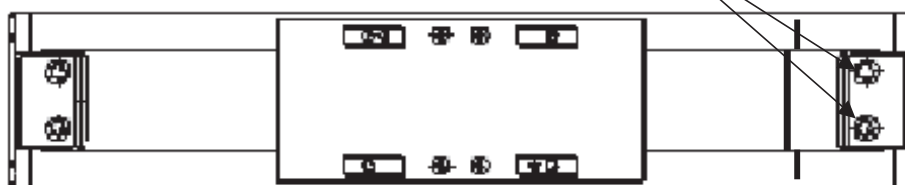


Move the stainless steel sheet in the direction of the arrow to fine-tune the sheet position until the check lines on the side covers are offset from the check line on the stainless steel sheet by 0.5mm.

Once this adjustment is complete, an approximately 1mm clearance has been achieved between the top surface of the stainless steel sheet and the back of the slider cover at the center of the slider cover.

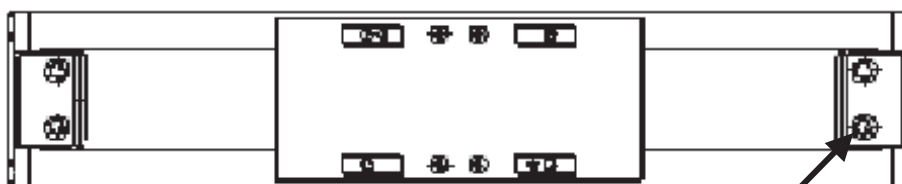
5) After the sheet has been positioned, loosely tighten the fixed screws removed earlier until the stainless steel sheet no longer moves.

Loosely tighten the fixed screws removed earlier just to hold the stainless steel sheet movement.



6.5.3 Operation Check

- 1) Move the slider to check the tension of the stainless steel sheet.
Move the slider to check the tension. Specifically, check if the stainless steel sheet is positioned uniformly on the right and left without presenting meandering or waving over the entire stroke range.
If the stainless steel sheet is not uniformly positioned on the right and left or is waving, repeat the adjustment.
- 2) Securely tighten the thin-head screws that have been loosened with a 7mm-sized hex wrench to affix the stainless steel sheet in position.



Alternately tighten the two fixed screws that have been temporarily tightened and finally tighten them with the even torque. If the tightness on the two nuts is uneven, the sheet may meander or lift up.

Tightening torque for fixed screws	359N•cm (36.7kgf•cm)
------------------------------------	----------------------

Move the slider to check once again if the stainless steel sheet is tensioned properly. Lastly, remove the check lines using alcohol, etc.



INTELLIGENT ACTUATOR

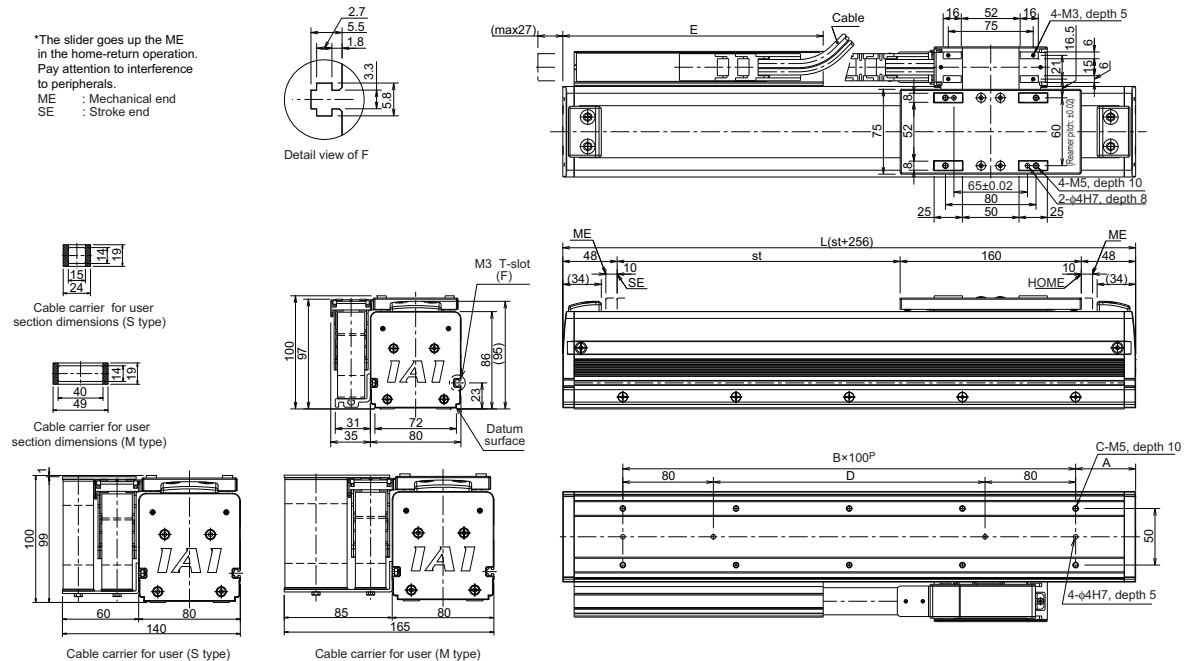


7. Life

The product life is assumed to be 10,000km (reference) under the condition that it runs with maximum load capacity and maximum acceleration/deceleration.

8. External Dimensions

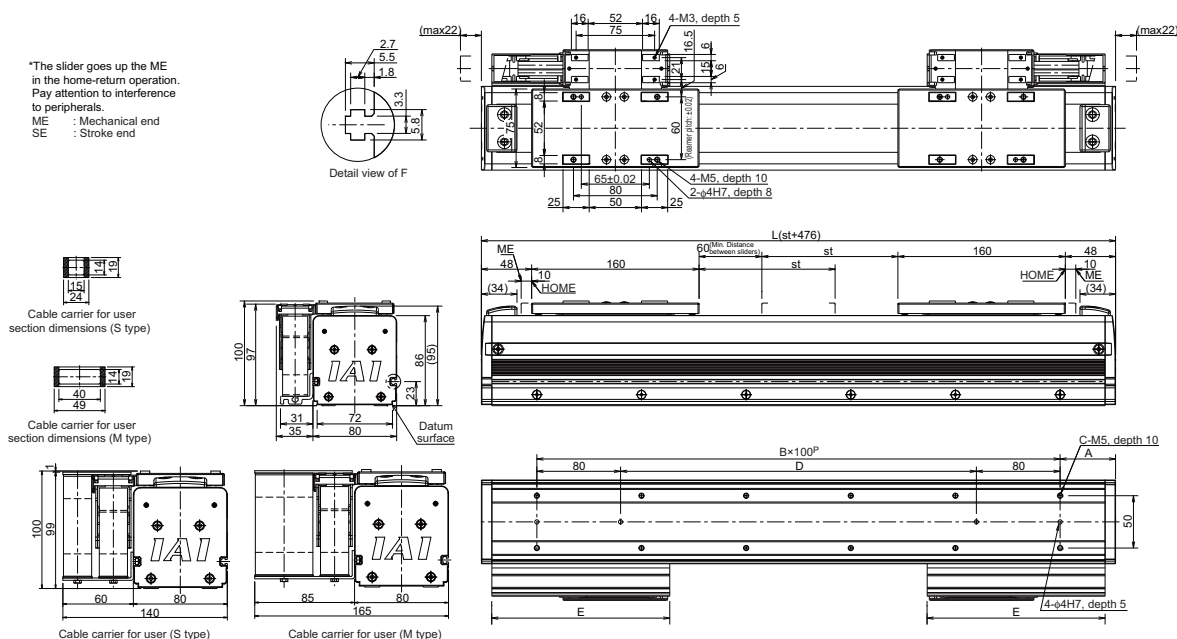
8.1 Small Type H8SS



Effective Stroke	50	150	250	350	450	550	650	750	850
L	306	406	506	606	706	806	906	1006	1106
A	53	53	53	53	53	53	53	53	53
B	2	3	4	5	6	7	8	9	10
C	6	8	10	12	14	16	18	20	22
D	40	140	240	340	440	540	640	740	840
E	130	180	230	280	330	380	430	480	530
Weight (kg)	5.0	6.2	7.4	8.6	9.8	11.0	12.2	13.4	14.6

Effective Stroke	950	1050	1150	1250	1350	1450	1550	1650
L	1206	1306	1406	1506	1606	1706	1803	1906
A	53	53	53	53	53	53	53	53
B	11	12	13	14	15	16	17	18
C	24	26	28	30	32	34	36	38
D	940	1040	1140	1240	1340	1440	1540	1640
E	580	630	680	730	780	830	880	930
Weight (kg)	15.8	17.0	18.2	19.4	20.6	21.8	23.0	24.2

8.2 Small Type H8SM

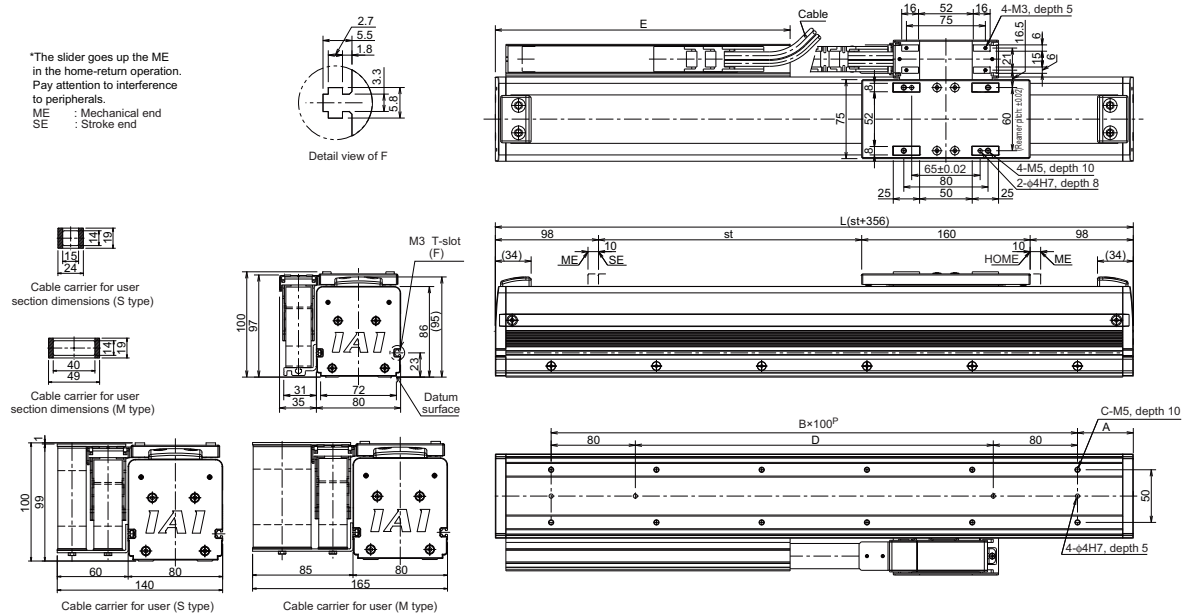


8. External Dimensions

Effective Stroke	130	230	330	430	530	630	730	830	930
L	606	706	806	906	1006	1106	1206	1306	1406
A	53	53	53	53	53	53	53	53	53
B	5	6	7	8	9	10	11	12	13
C	12	14	16	18	20	22	24	26	28
D	340	440	540	640	740	840	940	1040	1140
E	180	230	280	330	380	430	480	530	580
Weight (kg)	10.7	11.9	13.1	14.3	15.5	16.7	17.9	19.1	20.3

Effective Stroke	1030	1130	1230	1330	1430
L	1506	1606	1706	1806	1906
A	53	53	53	53	53
B	14	15	16	17	18
C	30	32	34	36	38
D	1240	1340	1440	1540	1640
E	630	680	730	780	830
Weight (kg)	21.5	22.7	23.9	25.1	26.3

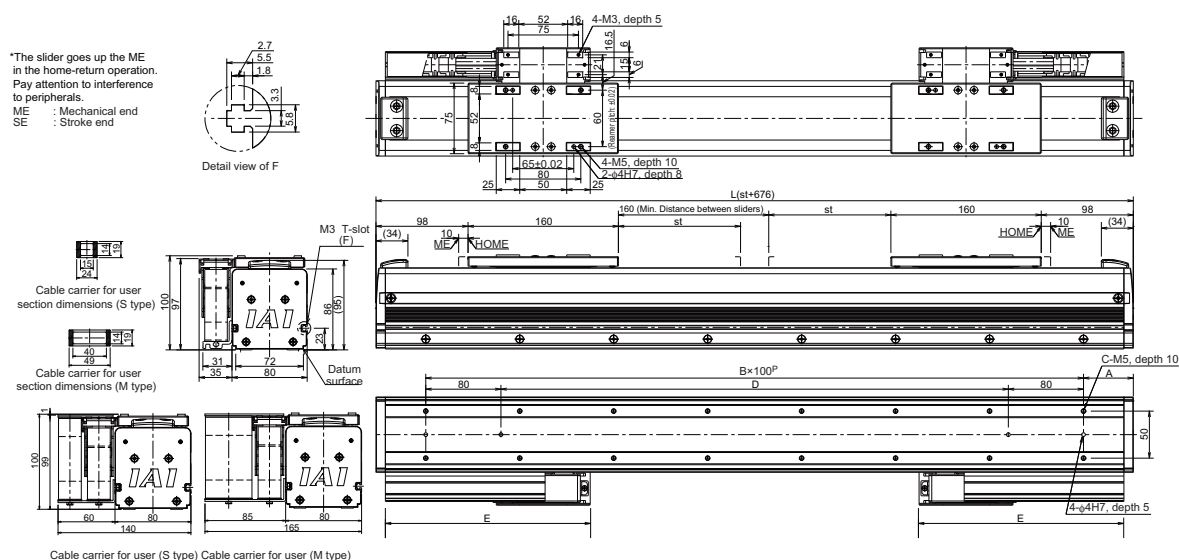
8.3 Small Type H8HS



Effective Stroke	50	150	250	350	450	550	650	750	850	950	1050
L	406	506	606	706	806	906	1006	1106	1206	1306	1406
A	53	53	53	53	53	53	53	53	53	53	53
B	3	4	5	6	7	8	9	10	11	12	13
C	8	10	12	14	16	18	20	22	24	26	28
D	140	240	340	440	540	640	740	840	940	1040	1140
E	180	230	280	330	380	430	480	530	580	630	680
Weight (kg)	6.5	7.7	8.9	10.1	11.3	12.5	13.7	14.9	16.1	17.3	18.5

Effective Stroke	1150	1250	1350	1450	1550
L	1506	1606	1706	1806	1906
A	53	53	53	53	53
B	14	15	16	17	18
C	30	32	34	36	38
D	1240	1340	1440	1540	1640
E	730	780	830	880	930
Weight (kg)	19.7	20.9	22.1	23.3	24.5

8.4 Small Type H8HM

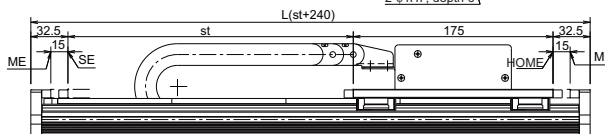
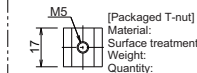


Effective Stroke	130	230	330	430	530	630	730	830	930
L	806	906	1006	1106	1206	1306	1406	1506	1606
A	53	53	53	53	53	53	53	53	53
B	7	8	9	10	11	12	13	14	15
C	16	18	20	22	24	26	28	30	32
D	540	640	740	840	940	1040	1140	1240	1340
E	180	230	280	330	380	430	480	530	580
Weight (kg)	13.8	15.0	16.2	17.4	18.6	19.8	21.0	22.2	23.4

Effective Stroke	1030	1130	1230
L	1706	1806	1906
A	53	53	53
B	16	17	18
C	34	36	38
D	1440	1540	1640
E	630	680	730
Weight (kg)	24.6	25.8	27.0

8.5 Flat Type L15SS

ME : Mechanical end
SE : Stroke end



Effective Stroke	150	250	350	450	550	650	750	850
L	390	490	590	690	790	890	990	1090
A	111	211	311	411	511	611	711	811
B	179.5	229.5	279.5	329.5	379.5	429.5	479.5	529.5
C	8	10	12	14	16	18	20	22
Weight (kg)	6.5	7.9	9.3	10.6	12.0	13.4	14.8	16.2

Effective Stroke	950	1050	1150	1250	1350	1450	1550	1650
L	1190	1290	1390	1490	1590	1690	1790	1890
A	911	1011	1111	1211	1311	1411	1511	1611
B	579.5	629.5	679.5	729.5	779.5	829.5	879.5	929.5
C	24	26	28	30	32	34	36	38
Weight (kg)	17.5	18.9	20.3	21.7	23.1	24.4	25.8	27.2



Effective Stroke	950	1050	1150	1250	1350	1450
L	1390	1490	1590	1690	1790	1890
A	1111	1211	1311	1411	1511	1611
B	629.5	679.5	729.5	779.5	829.5	879.5
C	28	30	32	34	36	38
Weight (kg)	22.6	24.0	25.4	26.8	28.3	29.7

9. Warranty

9.1 Warranty Period

One of the following periods, whichever is shorter:

- 18 months after shipment from IAI
- 12 months after delivery to the specified location
- 2,500 hours of operation

9.2 Scope of the Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:

- (1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.
- (2) The breakdown or problem in question occurred during the warranty period.
- (3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the instruction manual and catalog.
- (4) The breakdown of problem in question was caused by a specification defect or problem, or by a quality issue with our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:

- Anything other than our product
- Modification or repair performed by a party other than us (unless we have approved such modification or repair)
- Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
- A natural disaster, man-made disaster, incident or accident for which we are not liable
- Natural fading of paint or other symptoms of aging
- Wear, depletion or other expected result of use
- Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

9.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

9.4 Limited Liability

- (1) We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
- (2) We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

9.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

- (1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.
- (2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:
 - Medical equipment pertaining to maintenance or management of human life or health
 - A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
 - Important safety parts of mechanical equipment (such as safety devices)
 - Equipment used to handle cultural assets, art or other irreplaceable items
- (3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or instruction manual.

9.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

- Guidance for installation/adjustment and witnessing of test operation
- Maintenance and inspection
- Technical guidance and education on operating/wiring methods, etc.
- Technical guidance and education on programming and other items related to programs

Change History

Revision Date	Description of Revision
February 2013	Third edition Revised overall
November 2016	Edition 3C Pg. 26, 27, 40 Note added stating cable length is 20m at maximum for SSEL and SCON
February 2017	Edition 3D Pg. 48 Change made in the caution note for stainless steel sheet external visual inspection
March 2019	Edition 3E Pg. 35 Note added for caution for installation of main unit
July 2026	Edition 3F Changes due to discontinuation of including the Instruction Manual DVD Changes due to discontinuation of including the First Step Guide Terms integrated (cable carrier)



IAI Corporation

Head Office: 1210 Ihara Shimizu-KU Shizuoka City Shizuoka 424-0114, Japan
TEL +81-54-364-5105 FAX +81-54-364-2589
website: www.iai-robot.co.jp/

IAI America, Inc.

Head Office: 2690 W. 237th Street, Torrance, CA 90505
TEL +1-310-891-6015 FAX +1-310-891-0815
Chicago Office: 110 East State Parkway, Schaumburg, IL 60173
TEL +1-847- 908-1400 FAX +1-847-908-1399
Atlanta Office: 1220 Kennestone Circle, Suite 108, Marietta, GA 30066
TEL +1-678-354-9470 FAX +1-678-354-9471
website: www.intelligentactuator.com

Technical Support available in Europe

IAI Industrieroboter GmbH

Ober der Röth 4, D-65824 Schwalbach am Taunus, Germany
TEL +49(0)6196-88950 FAX +49(0)6196-889524
website: www.iai-automation.com

Technical Support available in Great Britain



Duttons Way, Shadsworth Business Park, Blackburn, Lancashire, BB1 2QR, United Kingdom
TEL +44(0) 1254-685900
website: www.lcautomation.com

IAI (Shanghai) Co., Ltd.

SHANGHAI JIAHUA BUSINESS CENTER A8-303, 808, Hongqiao Rd. Shang hai 200030, China
TEL +86-21-6448-4753 FAX +86-21-6448-3992
website: www.iai-robot.com

IAI Robot (Thailand) Co., Ltd.

825 PhairojKijja Tower 7th Floor, Debaratana RD., Bangna Nuea, Bangna, Bangkok 10260, Thailand
TEL +66-2-361-4458 FAX +66-2-361-4456
website: www.iai-robot.co.th