ROBO CYLINDER

Slim Small ROBO Cylinder
Micro Slider

Slim Types
Single Slider Specification: RCL-SA1L, SA2L, SA3L
Long Stroke Types
Single Slider Specification: RCL-SA4L, SA5L, SA6L
Double Slider Specification: RCL-SM4L, SM5L, SM6L

Operation Manual

Second Edition

IAI America, Inc.

Please Read Before Use

Thank you for purchasing an IAI product.
To ensure safe use of the actuator, be sure to read this operating manual and handle the actuator correctly.
Do not handle or operate the actuator in any way not specified in this operation manual or the operation manual of your controller, by assuming that any such handling/use is prohibited.

[Applicable Models]

Micro Slider

Slim Types Single Slider Specification
- RCL-SA1L
- RCL-SA2L
- RCL-SA3L

Long Stroke Types Single Slider Specification
- RCL-SA4L
- RCL-SA5L
- RCL-SA6L

Long Stroke Types Double Slider Specification
- RCL-SM4L
- RCL-SM5L
- RCL-SM6L

ROBO CYLINDER | CAUTION

Supported Controller Versions

The micro slider supports controllers of or newer than the versions specified in the table below.
It will not work with controllers of older versions. Even if the micro slider does work with an older controller, increasing the push current in push-motion operation may cause the actuator to generate heat and consequently fail.
Never connect the micro slider to any controller of a version older than the applicable version specified below.
If you wish to upgrade the version of your controller, please consult IAI.

ACON/RACON controllers

Controller type	Version	
	SA1L, SA2L, SA3L	SA4L, SA5L, SA6L, SM4L, SM5L, SM6L
ACON-CY/SE/PO/PL	V0012 or later	V0016 or later
RACON (ROBONET)	V0012 or later	V0016 or later
ACON-C/CG (DIO specification)	V0015 or later	V0018 or later
ACON-C/CG (Fieldbus specification)	V0001 or later	V0004 or later

ASEL controllers

Controller type	Version	
	SA1L, SA2L, SA3L	SA4L, SA5L, SA6L, SM4L, SM5L, SM6L
ASEL	V0.17 or later	V0.18 or later

Table of Contents

Safety Precautions (Read This Section Before Use)

When designing and manufacturing a robot system, ensure safety by following the safety precautions provided below and taking the necessary measures.

1. Regulations and Standards Governing Industrial Robots

Safety measures on mechanical devices are generally classified into four categories under the International Industrial Standard ISO/DIS 12100, “Safety of machinery,” as follows:

- Safety measures
  - Inherent safety design
  - Protective guards --- Safety fence, etc.
  - Additional safety measures --- Emergency stop device, etc.
  - Information on use --- Danger sign, warnings, operation manual

Based on this classification, various standards are established in a hierarchical manner under the International Standards ISO/IEC. The safety standards that apply to industrial robots are as follows:

- Type C standards (individual safety standards)
  - → ISO10218 (Manipulating industrial robots – Safety)
  - → JIS B 8433 (Manipulating industrial robots – Safety)

Also, Japanese laws regulate the safety of industrial robots, as follows:

Industrial Safety and Health Law Article 59
Workers engaged in dangerous or harmful operations must receive special education.

Ordinance on Industrial Safety and Health
Article 36 --- Operations requiring special education

- No. 31 (Teaching, etc.) --- Teaching and other similar work involving industrial robots (exceptions apply)
- No. 32 (Inspection, etc.) --- Inspection, repair, adjustment and similar work involving industrial robots (exceptions apply)

Article 150 --- Measures to be taken by the user of an industrial robot

2. Requirements for Industrial Robots under Ordinance on Industrial Safety and Health

Work area	Work condition	Cutoff of drive source	Measure	Article
Outside movement range	During automatic operation	Not cut off	Signs for starting operation	Article 104
			Installation of railings, enclosures, etc.	Article 150-4
Inside movement range	During teaching, etc.	Cut off (including stopping of operation)	Sign, etc., indicating that work is in progress	Article 150-3
		Not cut off	Preparation of work rules	Article 150-3
			Measures to enable immediate stopping of operation	Article 150-3
			Sign, etc., indicating that work is in progress	Article 150-3
			Provision of special education	Article 36-31
			Checkup, etc., before commencement of work	Article 151
	During inspection, etc.	Cut off	To be performed after stopping the operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
		Not cut off (when inspection, etc., must be performed during operation)	Preparation of work rules	Article 150-5
			Measures to enable immediate stopping of operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
			Provision of special education (excluding cleaning and lubrication)	Article 36-32

3. Applicable Models of IAI's Industrial Robots

Machines meeting the following conditions are not classified as industrial robots according to Notice of Ministry of Labor No. 51 and Notice of Ministry of Labor/Labor Standards Office Director (Ki-Hatsu No. 340):

(1) Single-axis robot with a motor wattage of 80 W or less
(2) Combined multi-axis robot whose X, Y and Z-axes are 300 mm or shorter and whose rotating part, if any, has the maximum movement range of within 300 mm^3 including the tip of the rotating part
(3) Multi-joint robot whose movable radius and Z-axis are within 300 mm

Among the products featured in our catalogs, the following models are classified as industrial robots:

1. Single-axis ROBO Cylinders
   RCS2/RCS2CR-SS8□ whose stroke exceeds 300 mm
2. Single-axis robots
   The following models whose stroke exceeds 300 mm and whose motor capacity also exceeds 80 W:
   ISA/ISPA, ISDA/ISPDA, ISWA/ISPWA, IF, FS, NS
3. Linear servo actuators
   All models whose stroke exceeds 300 mm
4. Cartesian robots
   Any robot that uses at least one axis corresponding to one of the models specified in 1 to 3
5. IX SCARA robots
   IX-NNN (NNW, NNC) 3515
   IX-NNN (NNW, NNC) 50□□/60□□/70□□/80□□
   IX-NSN5016/6016
   IX-TNN (UNN) 3015/3515
   IX-HNN (INN) 50□□/60□□/70□□/80□□

4. Notes on Safety of Our Products

Common items you should note when performing each task on any IAI robot are explained below.

No.	Task	Note
1	Model selection	● This product is not planned or designed for uses requiring high degrees of safety. Accordingly, it cannot be used to sustain or support life and must not be used in the following applications: [1] Medical devices relating to maintenance, management, etc., of life or health [2] Mechanisms or mechanical devices (vehicles, railway facilities, aircraft facilities, etc.) intended to move or transport people [3] Important safety parts in mechanical devices (safety devices, etc.) ● Do not use this product in the following environments: [1] Place subject to flammable gases, ignitable objects, flammables, explosives, etc. [2] Place that may be exposed to radiation [3] Place where the surrounding air temperature or relative humidity exceeds the specified range [4] Place subject to direct sunlight or radiated heat from large heat sources [5] Place subject to sudden temperature shift and bedewing [6] Place subject to corrosive gases (sulfuric acid, hydrochloric acid, etc.) [7] Place subject to excessive dust, salt or iron powder [8] Place where the product receives direct vibration or impact ● Do not use this product outside the specified ranges. Doing so may significantly shorten the life of the product or result in product failure or facility stoppage.
2	Transportation	● When transporting the product, exercise due caution not to bump or drop the product. ● Use appropriate means for transportation. ● Do not step on the package. ● Do not place on the package any heavy article that may deform the package.
3	Storage	● The storage environment should conform to the installation environment. Among others, be careful not to cause bedewing.
4	Installation/ startup	(1) Installing the robot, controller, etc. ● Be sure to firmly secure and affix the product (including its load). If the product tips over, drops, malfunctions, etc., damage or injury may result. ● Do not step on the product or place any article on top. The product may tips over or the article may drop, resulting in injury, product damage, loss of/drop in product performance, shorter life, etc. ● If the product is used in any of the following places, provide sufficient shielding measures: [1] Place subject to electrical noise [2] Place subject to a strong electric or magnetic field [3] Place where power lines or drive lines are wired nearby [4] Place subject to splashed water, oil or chemicals
		(2) Wiring the cables ● Use IAI's genuine cables to connect the actuator and controller or connect a teaching tool, etc. ● Do not damage, forcibly bend, pull, loop round an object or pinch the cables or place heavy articles on top. Current leak or poor electrical continuity may occur, resulting in fire, electric shock or malfunction. ● Wire the product correctly after turning off the power. ● When wiring a DC power supply (+24 V), pay attention to the positive and negative polarities. Connecting the wires in wrong polarities may result in fire, product failure or malfunction. ● Be sure to connect the cable connectors without fail and firmly. Failing to do so may result in fire, electric shock or product malfunction. ● Do not cut and reconnect the cables of the product to extend or shorten the cables. Doing so may result in fire or product malfunction.
		(3) Grounding ● Be sure to provide class D (former class 3) grounding for the controller. Grounding is required to prevent electric shock and electrostatic charges, improve noise resistance and suppress unnecessary electromagnetic radiation.
	Installation/ startup	(4) Safety measures ● Implement safety measures (such as installing safety fences, etc.) to prevent entry into the movement range of the robot when the product is moving or can be moved. Contacting the moving robot may result in death or serious injury. ● Be sure to provide an emergency stop circuit so that the product can be stopped immediately in case of emergency during operation.

No.	Task	Note
4	Installation/ startup	● Implement safety measures so that the product cannot be started only by turning on the power. If the product starts suddenly, injury or product damage may result. ● Implement safety measures so that the product will not start upon cancellation of an emergency stop or recovery of power following a power outage. Failure to do so may result in injury, equipment damage, etc. ● Put up a sign saying “WORK IN PROGRESS. DO NOT TURN ON POWER,” etc., during installation, adjustment, etc. If the power is accidently turned on, electric shock or injury may result. ● Implement measures to prevent the load, etc., from dropping due to a power outage or emergency stop. ● Ensure safety by wearing protective gloves, protective goggles and/or safety shoes, as necessary. ● Do not insert fingers and objects into openings in the product. Doing so may result in injury, electric shock, product damage, fire, etc.
5	Teaching	● Whenever possible, perform teaching from outside the safety fences. If teaching must be performed inside the safety fences, prepare “work rules” and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying “WORK IN PROGRESS” in a conspicuous location. * Safety fences --- Indicate the movement range if safety fences are not provided.
6	Confirmation operation	● After teaching or programming, carry out step-by-step confirmation operation before switching to automatic operation. ● When carrying out confirmation operation inside the safety fences, follow the specified work procedure just like during teaching. ● When confirming the program operation, use the safety speed. Failure to do so may result in an unexpected movement due to programming errors, etc., causing injury. ● Do not touch the terminal blocks and various setting switches while the power is supplied. Touching these parts may result in electric shock or malfunction.
7	Automatic operation	● Before commencing automatic operation, make sure no one is inside the safety fences. ● Before commencing automatic operation, make sure all related peripherals are ready to operate in the auto mode and no abnormalities are displayed or indicated. ● Be sure to start automatic operation from outside the safety fences. ● If the product generated abnormal heat, smoke, odor or noise, stop the product immediately and turn off the power switch. Failure to do so may result in fire or product damage. ● If a power outage occurred, turn off the power switch. Otherwise, the product may move suddenly when the power is restored, resulting in injury or product damage.
8	Maintenance/ inspection	● Whenever possible, work from outside the safety fences. If work must be performed inside the safety fences, prepare “work rules” and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, turn off the power switch, as a rule. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying “WORK IN PROGRESS” in a conspicuous location. ● Use appropriate grease for the guides and ball screws by checking the operation manual for each model. ● Do not perform a withstand voltage test. Conducting this test may result in product damage. * Safety fences --- Indicate the movement range if safety fences are not provided.
9	Modification	● The customer must not modify or disassemble/assemble the product or use maintenance parts not specified in the manual without first consulting IAI. ● Any damage or loss resulting from the above actions will be excluded from the scope of warranty.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When disposing of the product, do not throw it into fire. The product may explode or generate toxic gases.

5. Notes on Permanent Magnets

This actuator houses high-performance permanent magnets made of rare metal (neodymium magnets). Accordingly, the actuator may cause medical devices, particularly pacemakers, to malfunction. Anyone using or wearing a pacemaker or other medical device must not come near this product.

6. Indication of Cautionary Information

The operation manual for each model denotes safety precautions under “Danger,” “Warning,” “Caution” and “Note,” as specified below.

Level	Degree of danger/loss	Symbol
Danger	Failure to observe the instruction will result in an imminent danger leading to death or serious injury.	 Danger
Warning	Failure to observe the instruction may result in death or serious injury.	 Warning
Caution	Failure to observe the instruction may result in injury or property damage.	 Caution
Note	The user should take heed of this information to ensure the proper use of the product, although failure to do so will not result in injury.	 Note

Handling Precaution

1. Handling a Single Actuator

Please adhere to the following when handling a single actuator.

1.1 Handling the Packed Unit

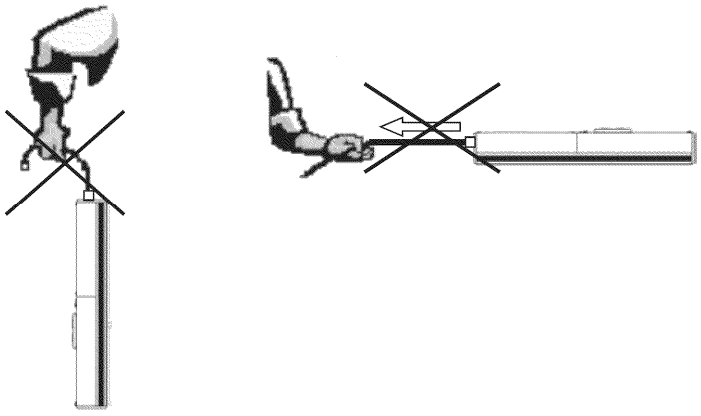
Unless otherwise specified, single-axis actuators are shipped in individual packaging.
Please handle packages carefully during transport to ensure that product is not damaged by bumping or dropping.

- Always set packages down on a level surface.
- Never climb on top of packages.
- Never place heavy objects or objects where weight is concentrated in one place on top of packages, as this may cause deformation.

1.2 Handling the Actuator After Unpacking

When handling the unpacked actuator, hold it by the base.

- When transporting the actuator, be careful not to bump or drop the actuator or otherwise cause it to receive an impact or excessive force.
- Do not transport the actuator by holding the cables or move it by pulling the cables.



- Do not press the covers or stainless sheet with a strong force or apply an impact on them. The covers and internal parts will be damaged.

2. Handling the Actuator Assembly

When transporting the actuator with its axes already assembled, take note of the following items.

2.1 Shipping from IAI Already Assembled

After assembly at IAI, your machine undergoes a shipping inspection, is packed in a crate with skids, and finally shipped.
If any of the combined actuators is a slider, the slider is securely fastened in place to prevent unexpected movement during shipping. Combined units have the ends of their actuators fastened so as to prevent them from moving significantly due to external vibration.

- The crate is not designed to withstand dropping or collision. Please handle it carefully. It is also not built to have items stacked on it, so please avoid placing heavy objects on top of the crate.
- When lifting the package using belts or the like, be sure to pass the belts around the reinforcement frames under the skids. The same applies for lifting the package with a forklift; please ensure that the forks are placed under the skids.
- When setting the package down, do not let the package receive an impact upon contacting the floor.

2.2 Handling After Unpacking

Please adhere to the following instructions when handling the assembled unit, whether it was shipped pre-assembled at IAI or assembled on your site.

- Secure the slider so that it does not move unexpectedly during transport.
- If the end of the actuator is protruding, fasten it down properly so that it does not move significantly due to external vibration. When transporting the assembly without the ends of the actuators fastened, do not subject the assembly to an impact of 0.3 G or more.
- When using belts or the like to lift an assembly consisting of an actuator and peripheral equipment, make sure the belts are not passed around the actuator itself or otherwise do not touch the actuator.
- Make sure the belts support the actuator load by its base by using appropriate cushioning materials.
- Lift the end of the Y-axis with a separate belt, ensuring that the assembly remains level. At this time, also make sure weight is not placed on the screw cover.
- Make sure weight is not placed on the brackets, covers, or connector box.
  Also make sure the cables are not pinched or deformed excessively.

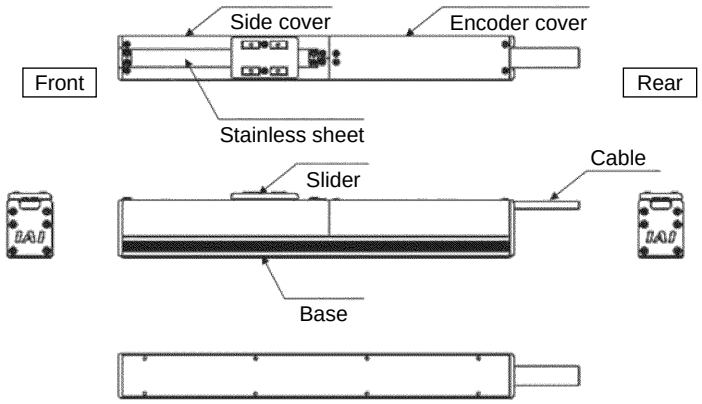
3. Handling after Assembly with Peripheral Equipment

When the machine assembled at IAI is transported as an assembly, also follow the handling precautions in 2.2, “Handling after Unpacking.”

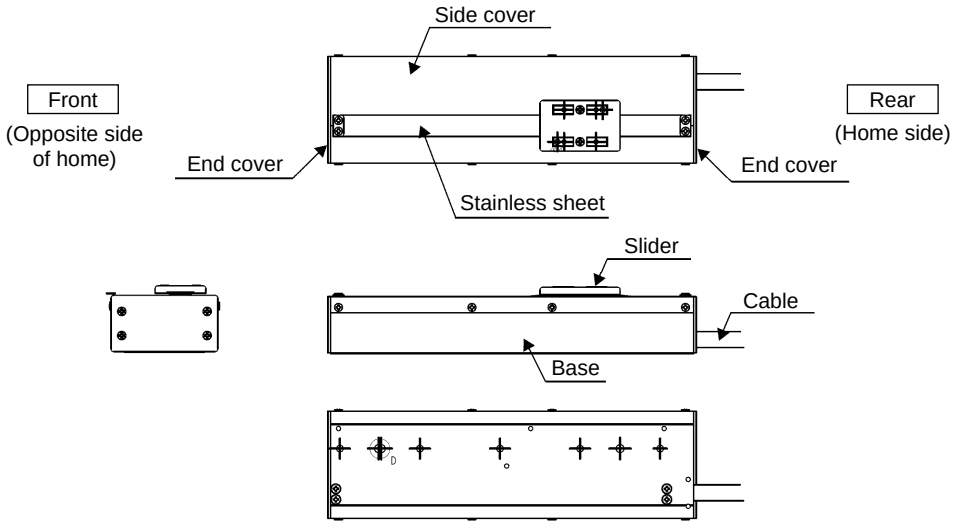
1. Part Names

The names of the actuator parts are indicated below.

1.1 Slim Types SA1L, SA2L, SA3L



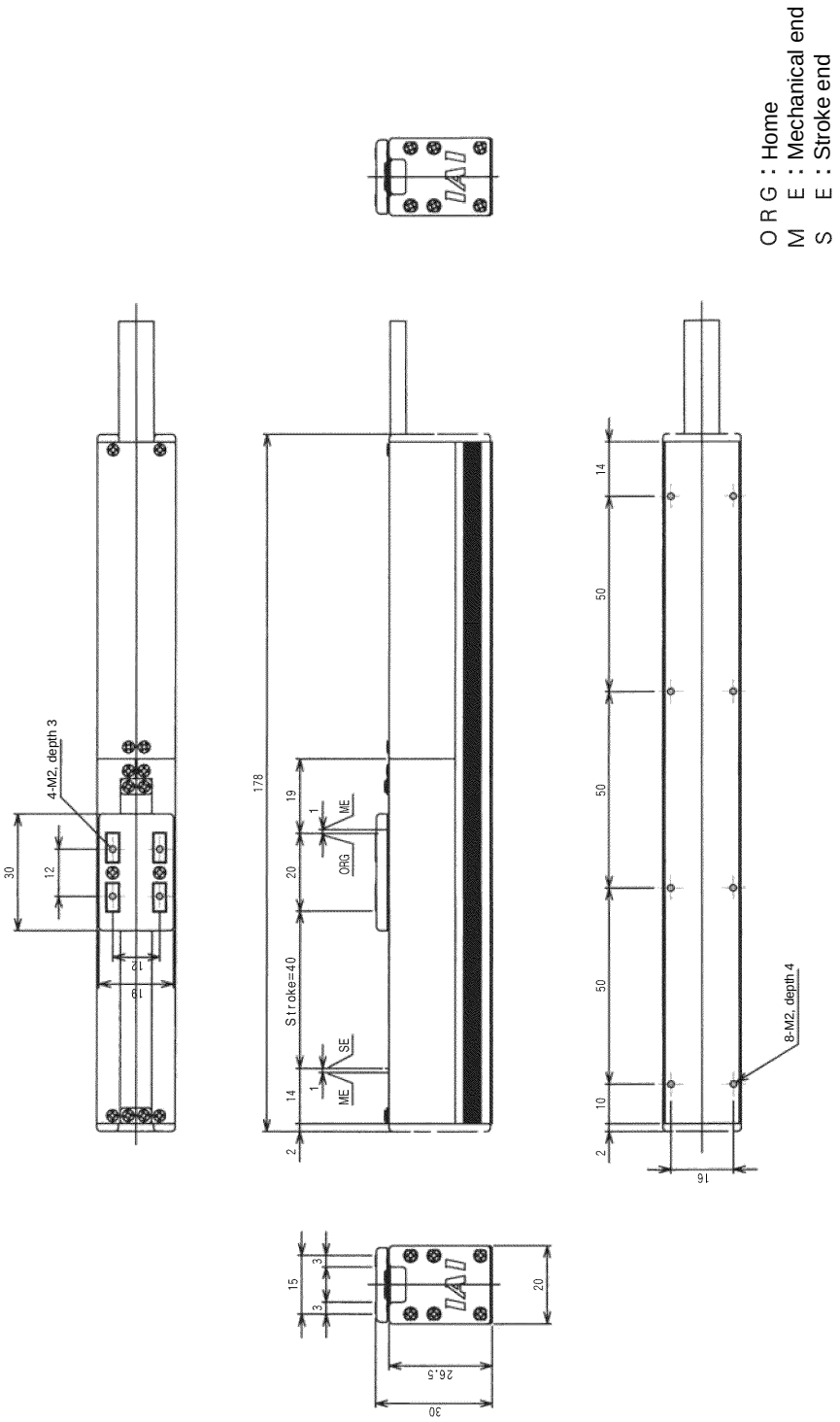
1.2 Long Stroke Types SA4L, SA5L, SA6L, SM4L, SM5L, SM6L



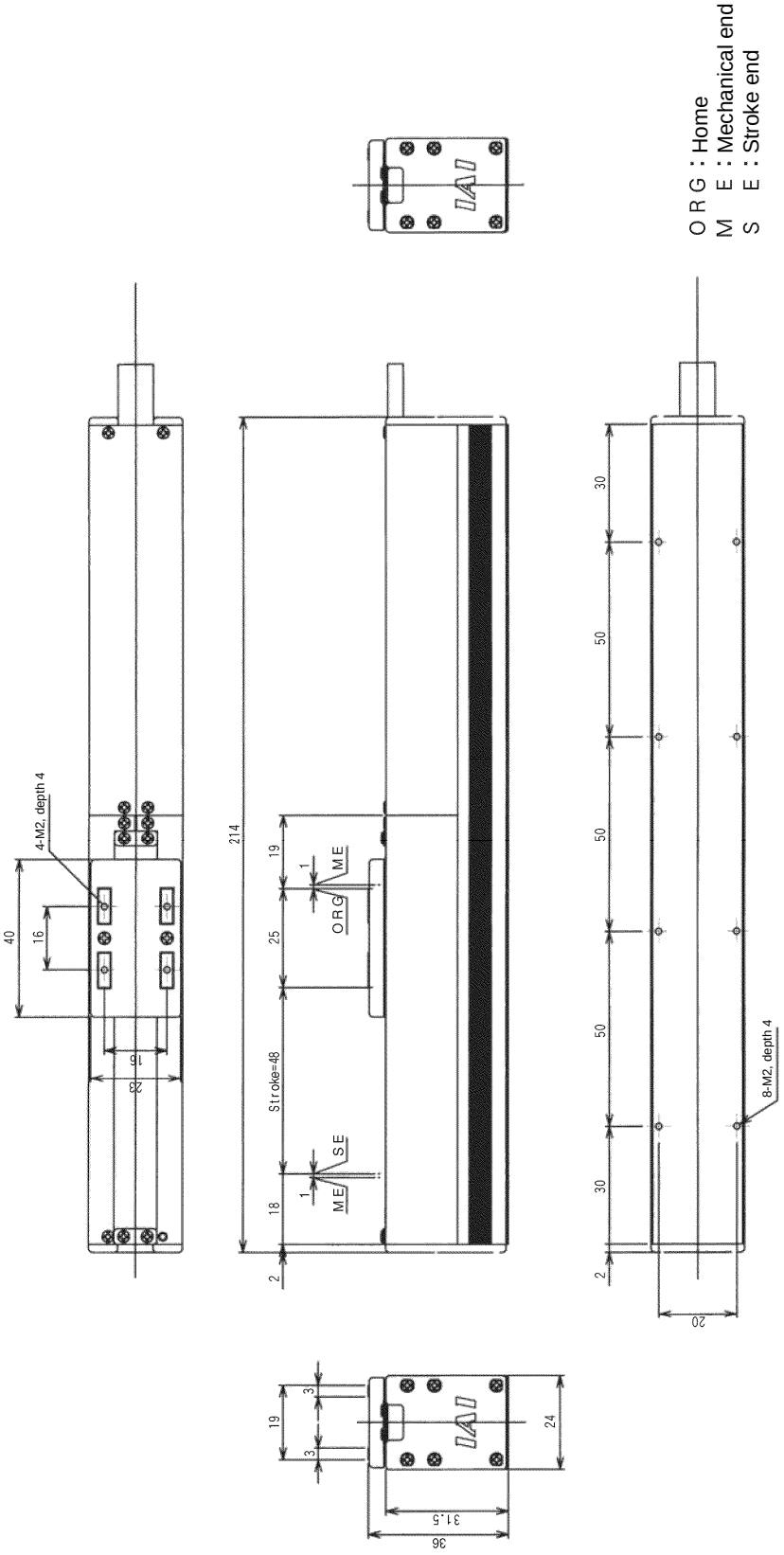
2. External Drawings

2.1 Slim Types, Single Slider Specification

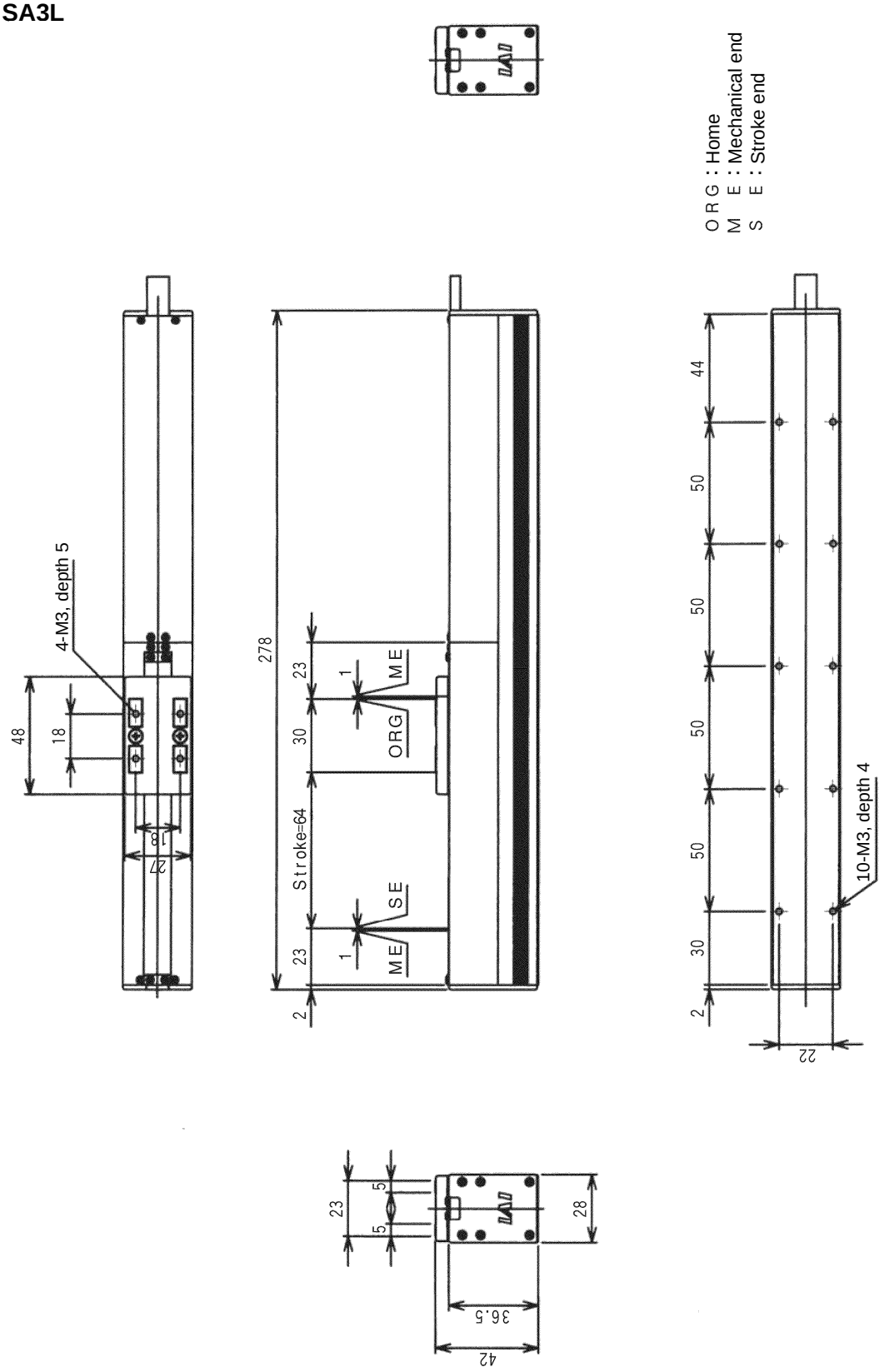
2.1.1 SA1L



2.1.2 SA2L

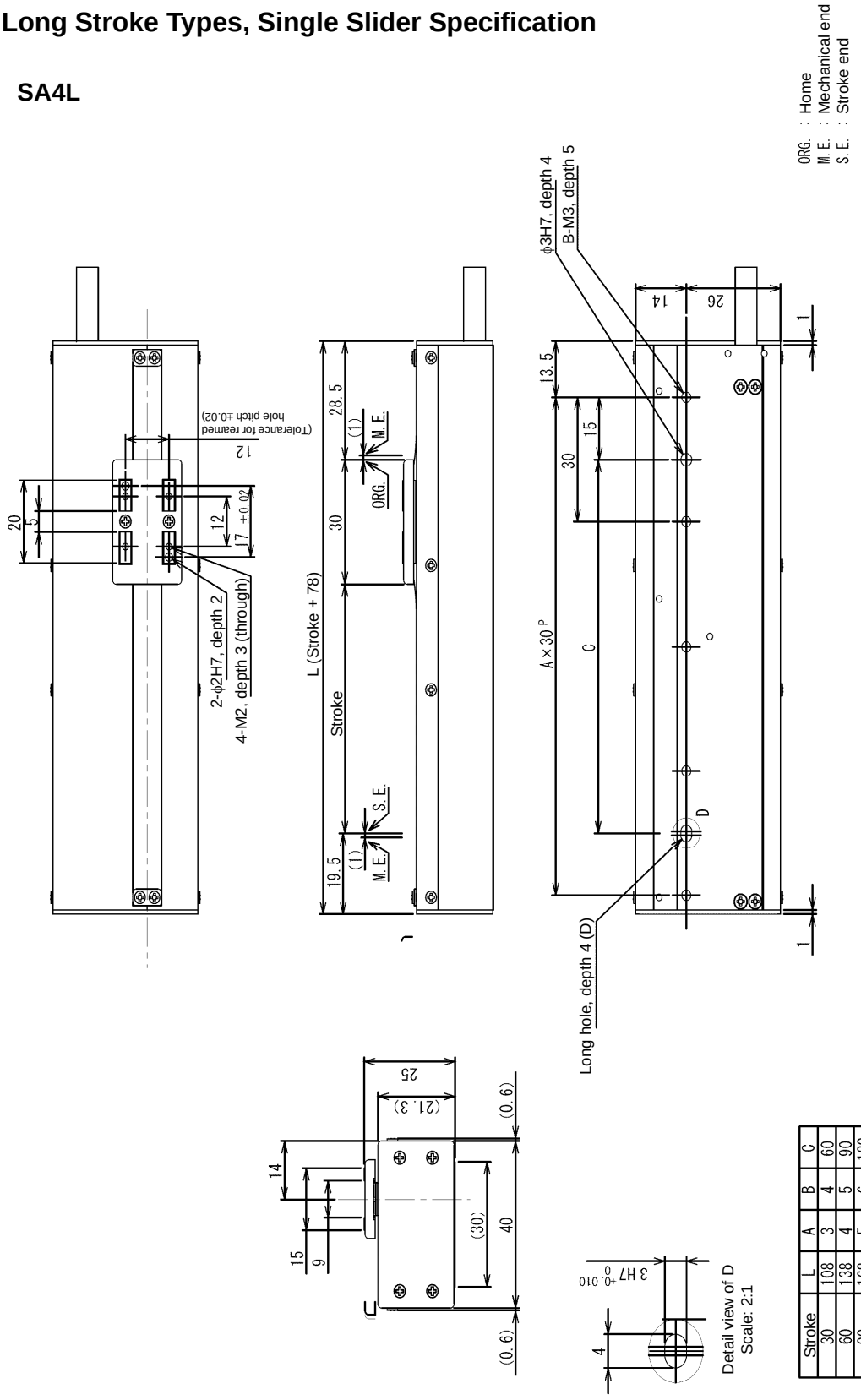

ORG : Home
ME : Mechanical end
SE : Stroke end
4-M2. depth 4
40
16
15
23
214
19
1
ME
ORG
25
Stroke=48
SE
ME
18
2
30
50
50
50
30
2
8-M2. depth 4
20
IAI
IAI
19
3
3
24
31.5
36

2.1.3 SA3L


ORG : Home
ME : Mechanical end
SE : Stroke end
4-M3, depth 5
48
18
27
18
278
23
1
ME
30
ORG
Stroke=64
SE
ME
23
1
2
44
50
50
50
50
30
2
10-M3, depth 4
22
23
5
5
28
36.5
42

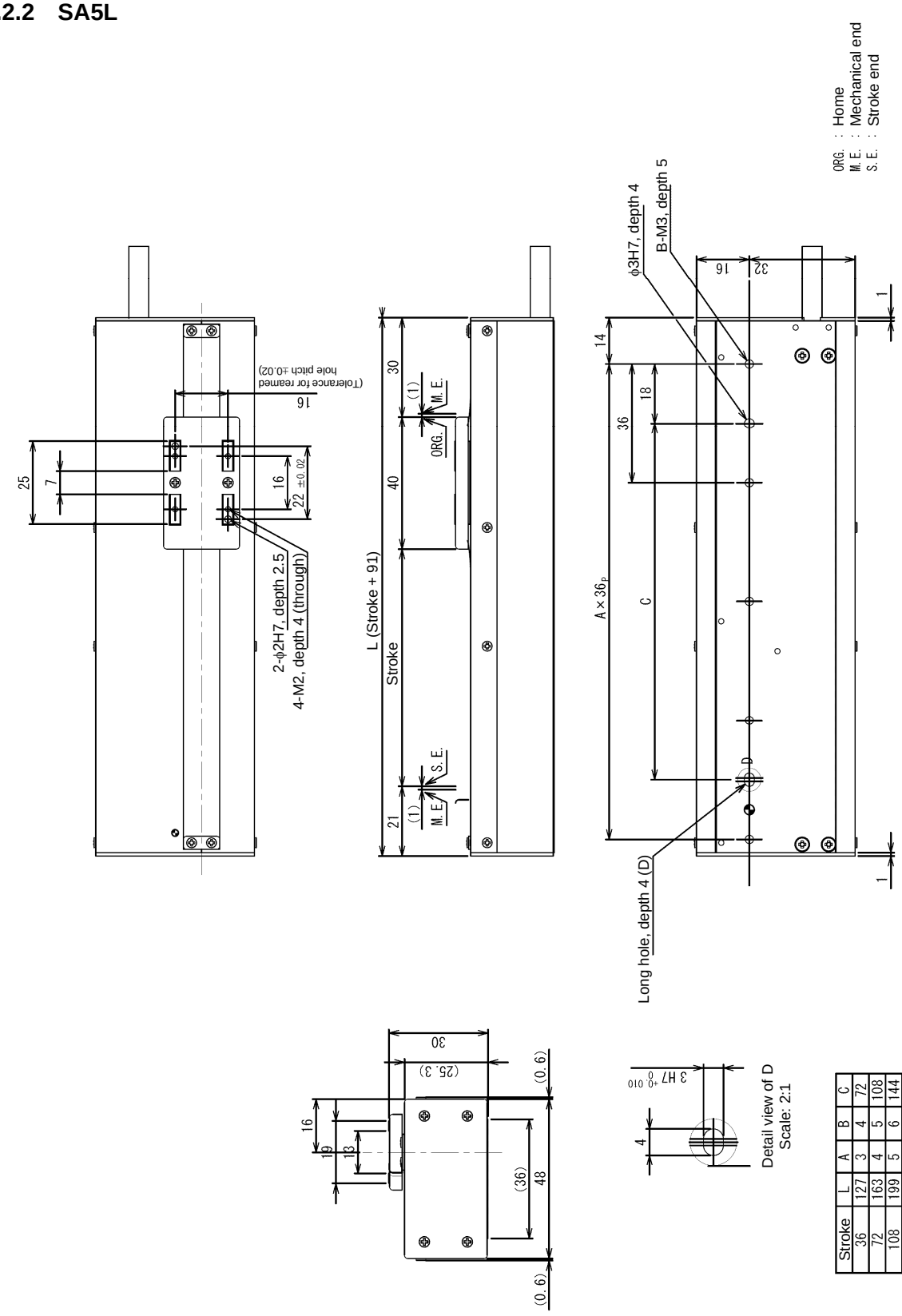
2.2 Long Stroke Types, Single Slider Specification

2.2.1 SA4L



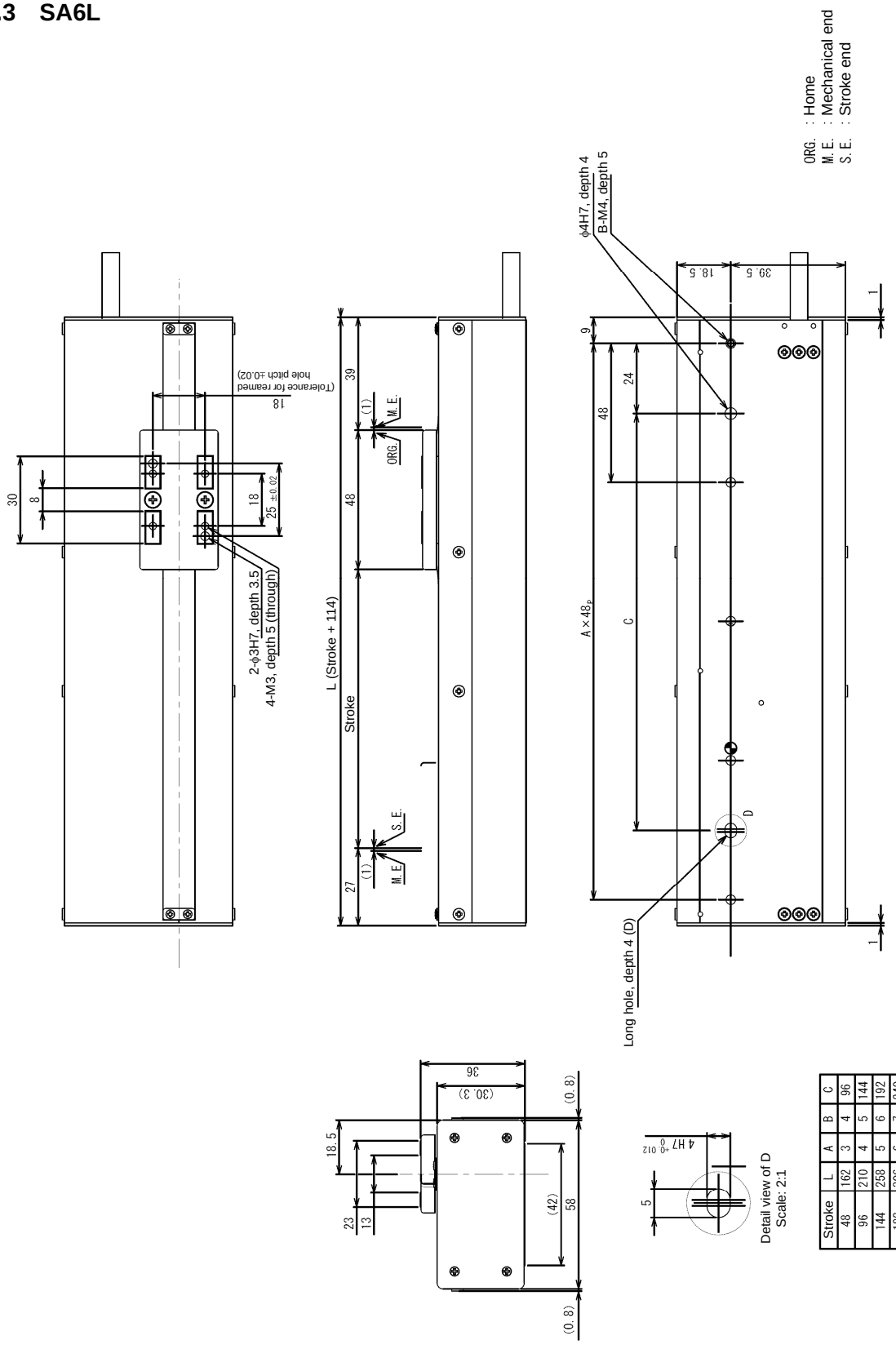
Stroke	L	A	B	C
30	108	3	4	60
60	138	4	5	90
90	168	5	6	120
120	198	6	7	150
150	228	7	8	180
180	258	8	9	210

2.2.2 SA5L



Stroke	L	A	B	C
36	127	3	4	72
72	163	4	5	108
108	199	5	6	144
144	235	6	7	180
180	271	7	8	216
216	307	8	9	252

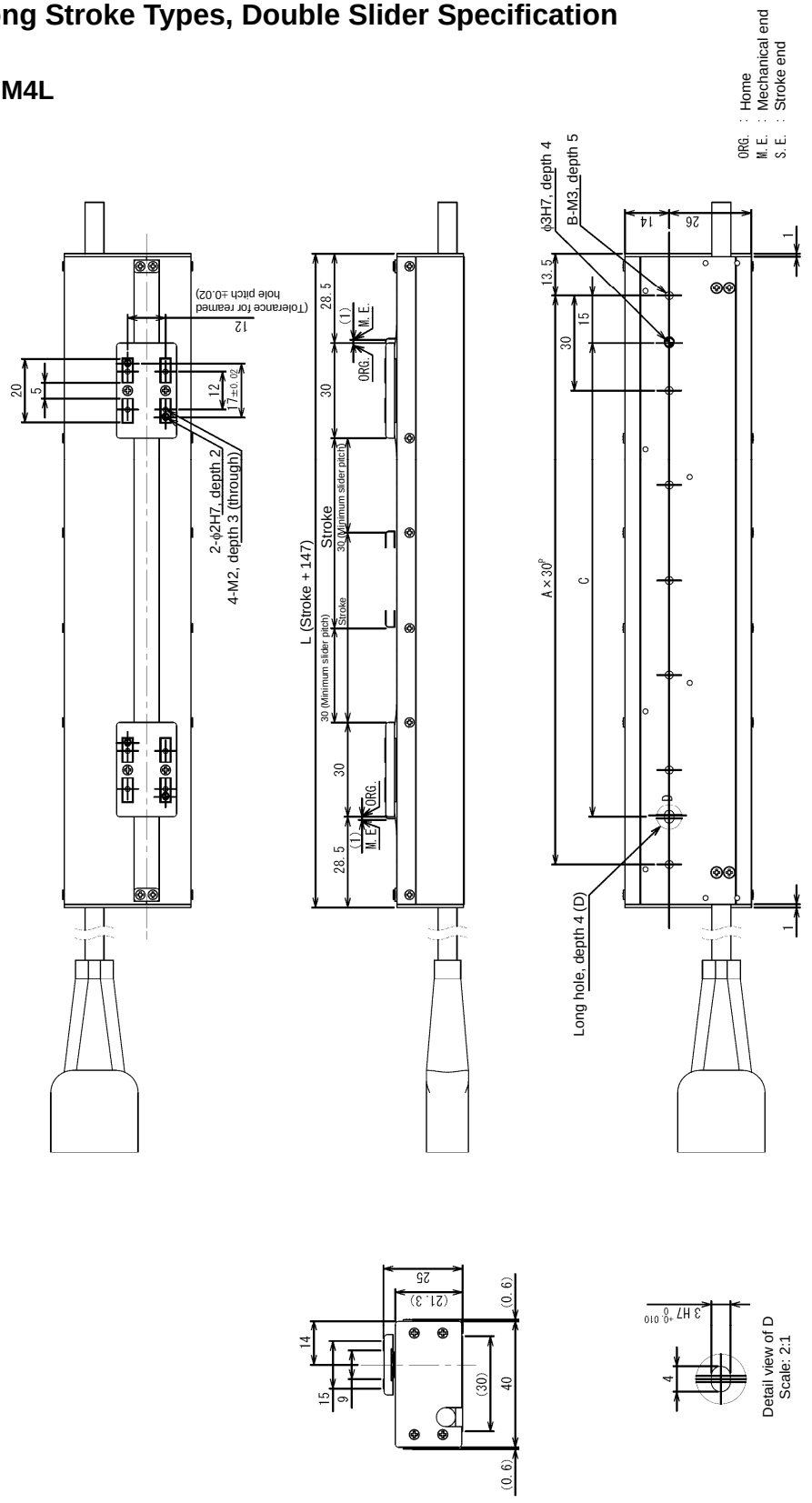
2.2.3 SA6L



Stroke	L	A	B	C
48	162	3	4	96
96	210	4	5	144
144	258	5	6	192
192	306	6	7	240
240	354	7	8	288
288	402	8	9	336

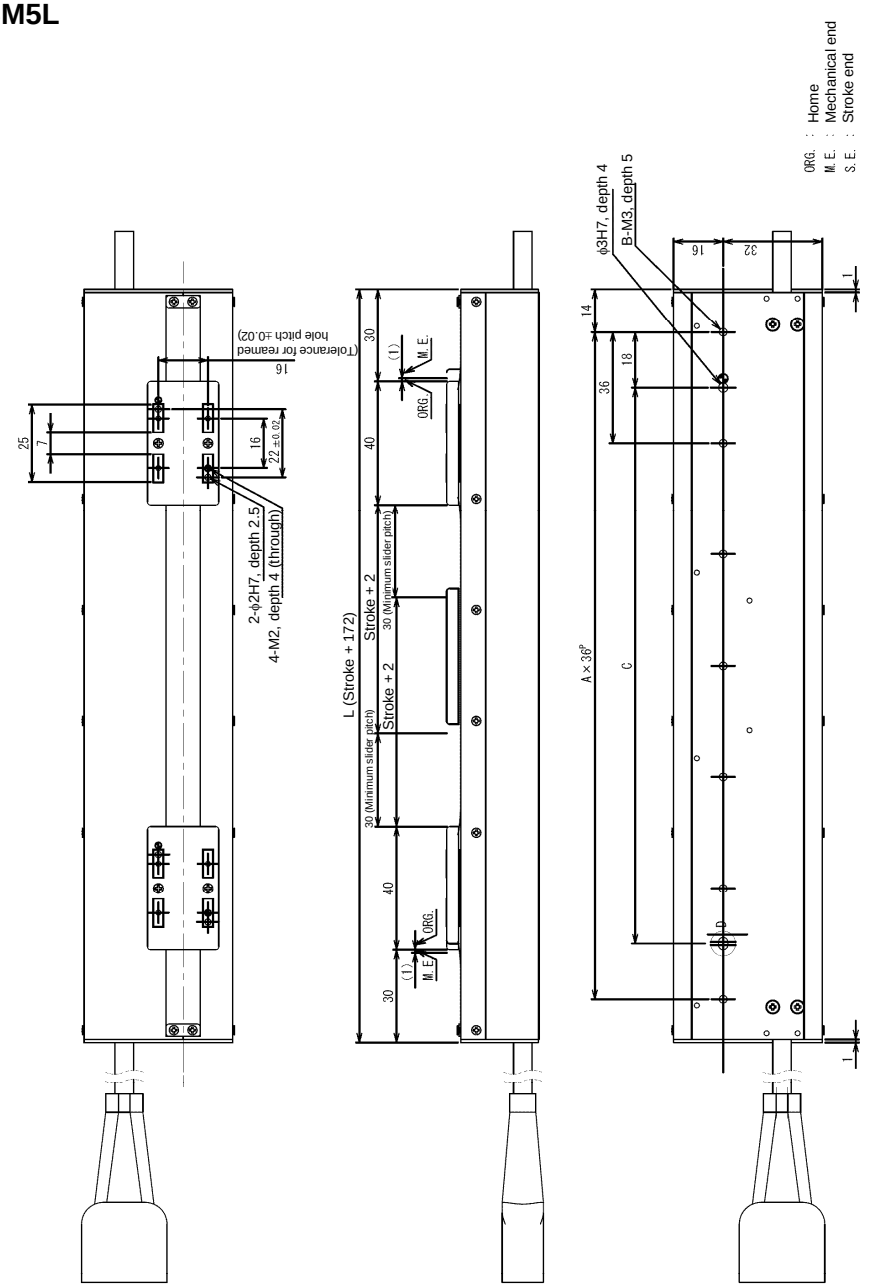
2.3 Long Stroke Types, Double Slider Specification

2.3.1 SM4L



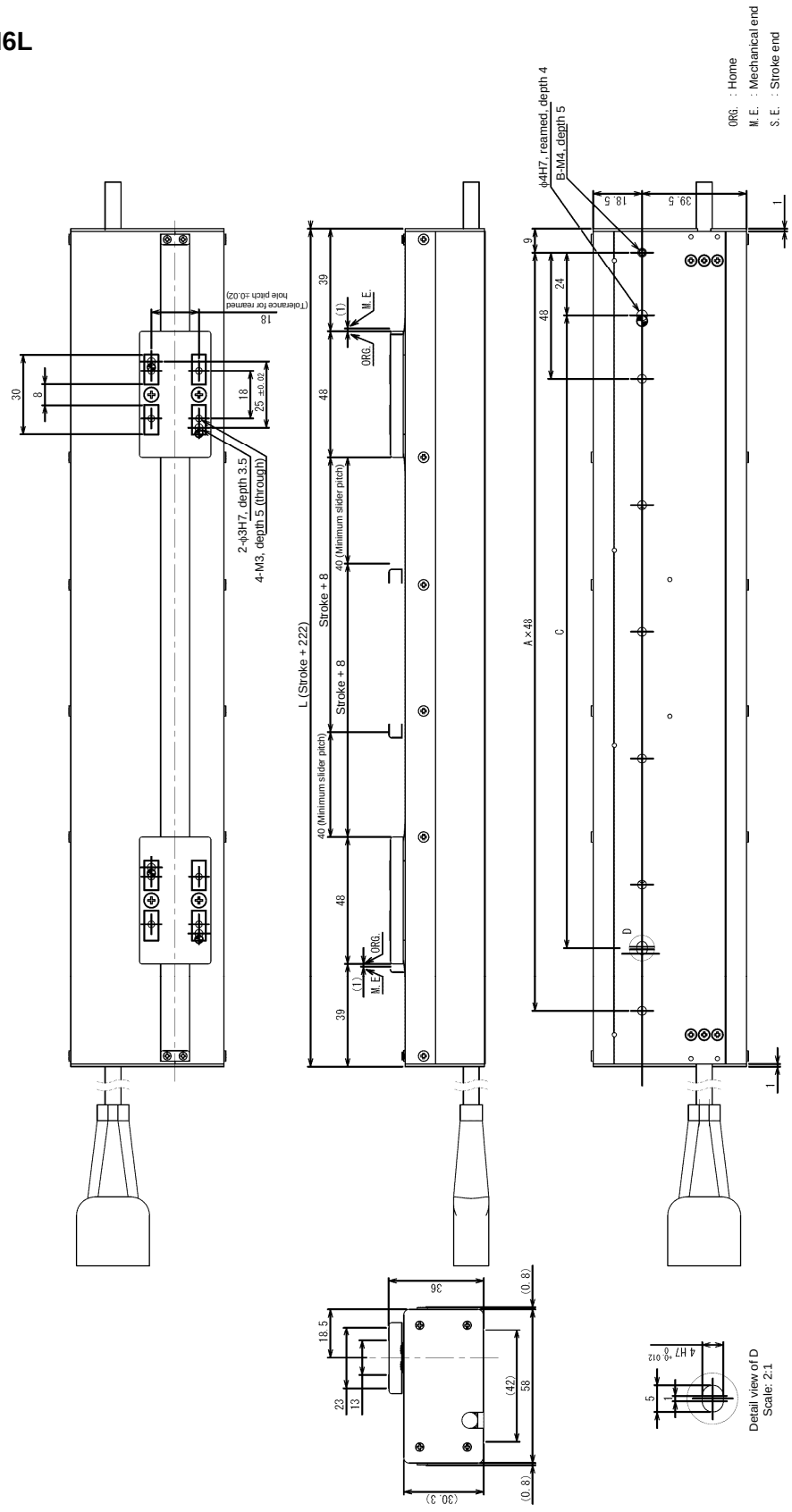
Stroke	L	A	B	C
30	177	5	6	120
60	207	6	7	150
90	237	7	8	180
120	267	8	9	210

2.3.2 SM5L



Stroke	Effective stroke	L	A	B	C
36	38	208	5	6	144
72	74	244	6	7	180
108	110	280	7	8	216
144	146	316	8	9	252

2.3.3 SM6L



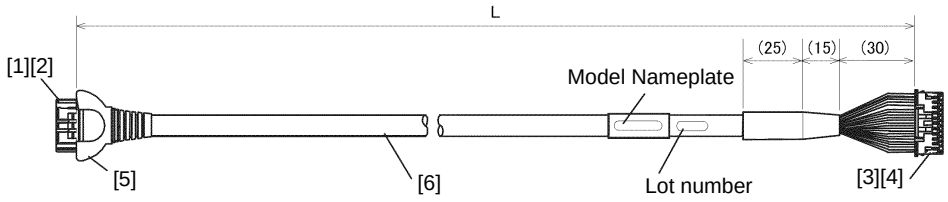
Stroke	Effective stroke	L	A	B	C
48	56	270	5	6	192
96	104	318	6	7	240
144	152	366	7	8	288
192	200	414	8	9	336

3. Cable Drawings

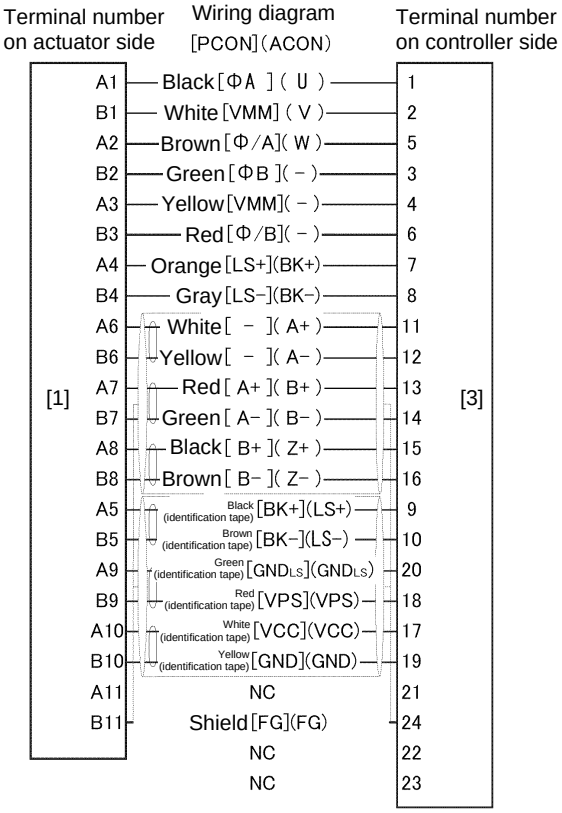
3.1 ASEP Controller Cables

Integrated motor/encoder cable
(CB-APSEP-MPA***)

*** indicates the cable length (L). Up to 10 m can be specified.
Example) 080 = 8 m



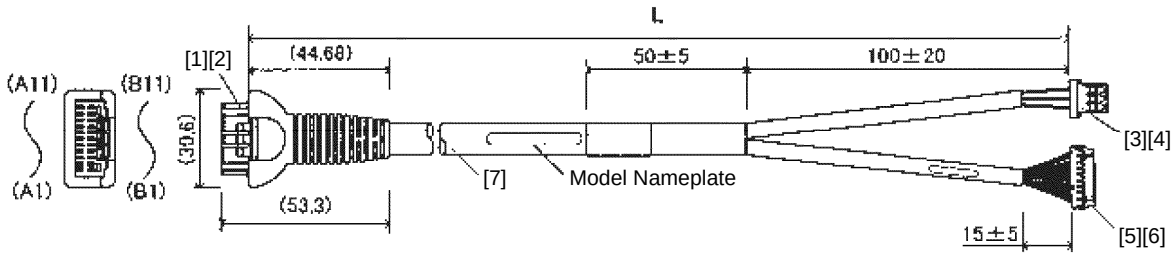
No.	Item	Model number	Manufacturer
1	Housing	D-1100D 1-1827863-1 (black, 2.0-mm pitch, 22 poles)	AMP
2	Contact	D-1 1827570-2 (AWG 22 to 18, 1.08 to 1.6 ϕ)	
3	Housing	PADP-24V-1-S (white, 2.0-mm pitch, 24 poles)	J.S.T, Mfg.
4	Contact	SPND-001T-C0.5 (AWG 26 to 22, 1.0 to 1.5 ϕ)	
5	Coupler cover	TMS-4ZB008	TATSUTA ELECTRIC WIRE & CABLE
6	ZUL2854-OHFRPCVVSW	25AWG x 6P + 25AWG x 2C + 22AWG x 6C, TS08V0350	TATSUTA ELECTRIC WIRE & CABLE



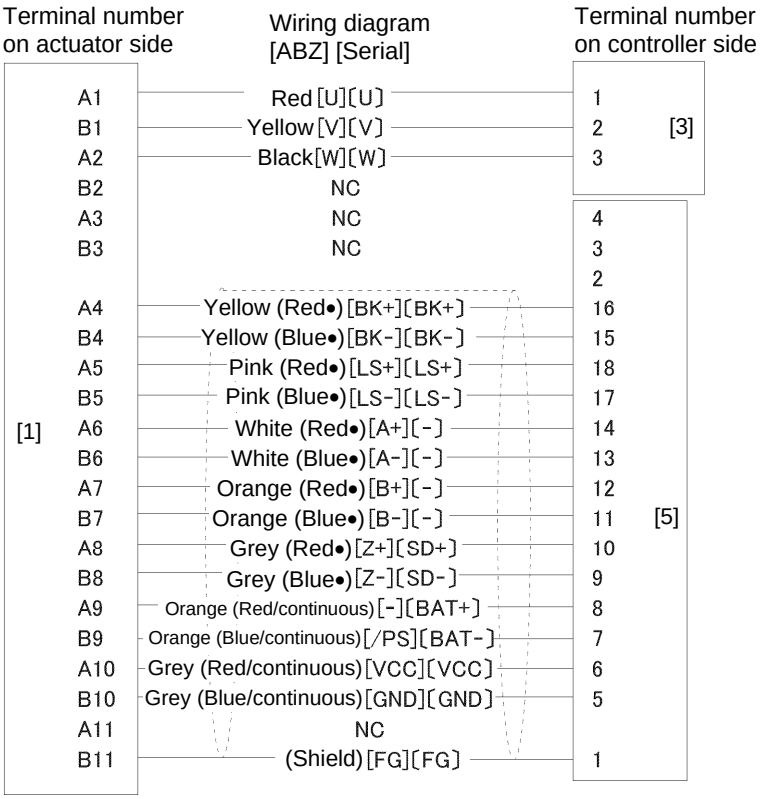
3.2 ACON, ASEL Controller Cables

RCA2 Integrated motor/encoder cable
(CB-ACS-MPA***)

*** indicates the cable length (L). Up to 10 m can be specified.
Example) 080 = 8 m



No.	Item	Model number	Manufacturer
[1]	Receptacle housing	D-1100D 1-1827863-1	AMP
[2]	Receptacle contact	D-1 1827570-2	AMP
[3]	Socket	DF1E-3S-2.5C	Hirose
[4]	Socket contact	DF1E-2022SCF	Hirose
[5]	Housing	PHDR-18VR	JST
[6]	Contact	SPHD-001T-P0.5	JST
[7]	UL2854-VVSWKA	TS06V1200 (25AWG x 7P + 22AWG x 6C)	TATSUTA ELECTRIC WIRE & CABLE



4. Options

4.1 Reversed-home Specification

On the long stroke types of single slider specification (SA4L, SA5L, SA6L), the standard home position is on the rear side. If you wish to reverse the home direction due to the system layout, etc., you can do so by selecting an applicable option.

5. Checking after Unpacking

After unpacking, check the manual for proper binding and also check the included items.

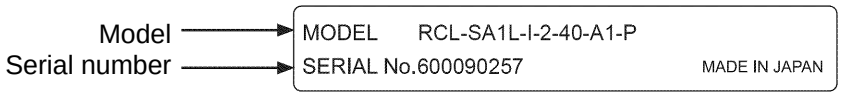
5.1 Included Items

No.	Item	Remarks
1	Actuator	Refer to 5.3, “How to Read Model Nameplate” and 5.4, “How to Read Model.”
Accessories		
2	RCA integrated motor/encoder cable	CB-APSEP-MPA□□□: ASEP type
		CB-ACS-MPA□□□: ACON, ASEL type
3	Operation manual	

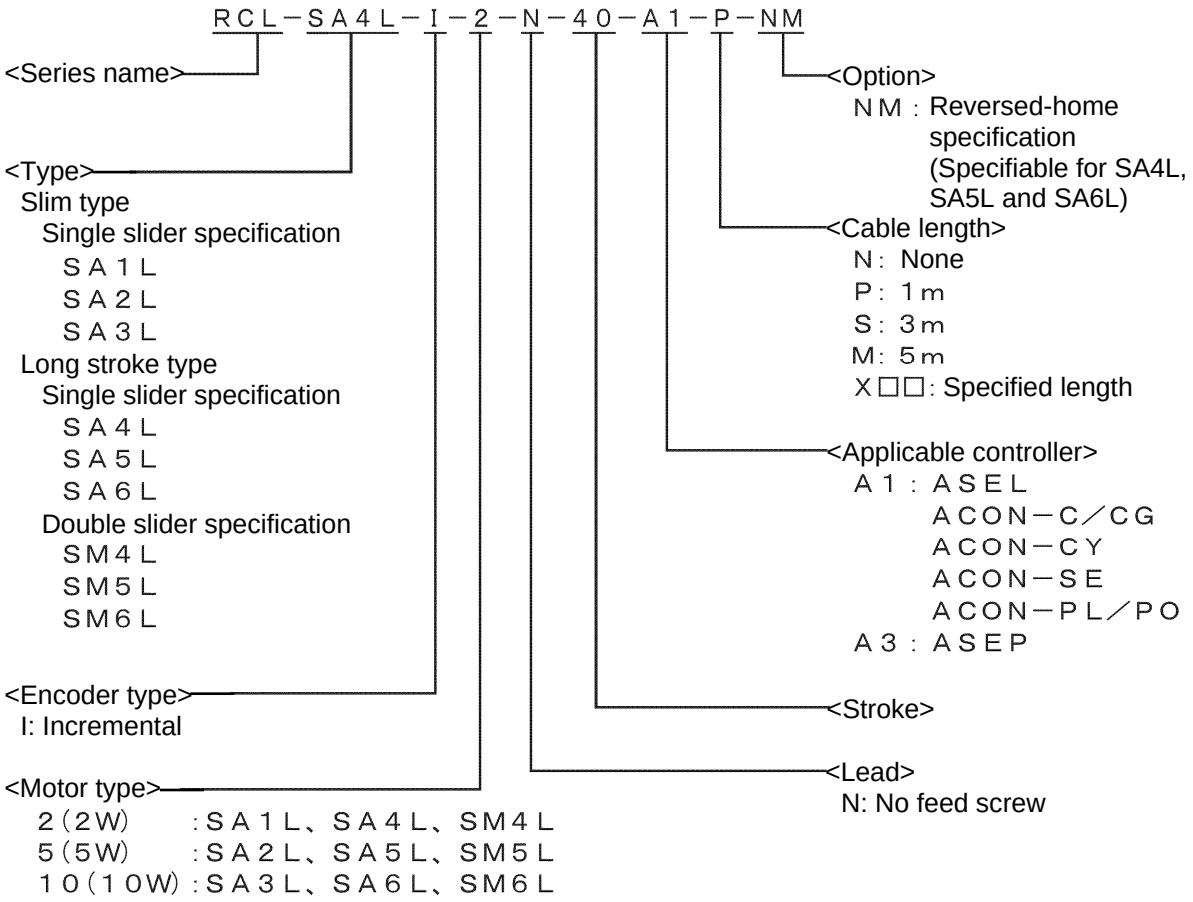
5.2 Operation Manuals Relating to This Product

No.	Name	Control No.
1	Operation Manual for ASEL Controller	MJ0165
2	Operation Manual for ACON-C/CG/CF Controller	MJ0176
3	Operation Manual for ACON-CY Controller	MJ0167
4	Operation Manual for ACON-SE Controller	MJ0171
5	Operation Manual for ACON-PL/PO Controller	MJ0166
6	Operation Manual for ASEP/PSEP Controller	MJ0216
7	Operation Manual for PC Software RCM-101MW/RCM-101-USB	MJ0155
8	Operation Manual for Teaching Pendant CON-T/TG	MJ0178
9	Operation Manual for Dedicated PSEP/ASEP Touch Panel SET-PT	MJ0217
10	Operation Manual for Simple Teaching Pendant RCM-E	MJ0174
11	Operation Manual for Data Setter RCM-P	MJ0175
12	Operation Manual for Touch Panel Display RCM-PM-01	MJ0182

5.3 How to Read Model Nameplate



5.4 How to Read Model



6. Specifications

6.1 Slim Types, Single Slider Specification

Item	Unit	SA1L	SA2L	SA3L
Stroke	mm	40	48	64
Rated thrust	N	2	4	8
Maximum loading capacity	kg	See the table below.		
Momentary maximum thrust	N	10	18	30
Maximum acceleration	G	2		
Maximum speed	mm/s	420	460	600
Positioning repeatability	mm	±0.1		

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

[kg]

Acceleration [G]	SA1L	SA2L	SA3L
0.1	0.5	1	2
0.3			
0.5	0.42	0.85	1.8
1	0.25	0.5	1
1.5	0.18	0.36	0.65
2	0.15	0.3	0.5

For the loading capacity (horizontal) and acceleration at a duty of 70%, refer to 10.1, “Setting the Acceleration.”

6.2 Long Stroke Types

6.2.1 Single Slider Specification

Item	Unit	SA4L					
Stroke	mm	30	60	90	120	150	180
Rated thrust	N	2.5					
Maximum loading capacity	kg	See the table below.					
Momentary maximum thrust	N	10					
Maximum acceleration	G	2					
Maximum speed	mm/s	1200					
Positioning repeatability	mm	±0.1					

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	0.8
0.5	0.5
1	0.25
1.5	0.18
2	0.14

Item	Unit	SA5L					
Stroke	mm	36	72	108	144	180	216
Rated thrust	N	5					
Maximum loading capacity	kg	See the table below.					
Momentary maximum thrust	N	18					
Maximum acceleration	G	2					
Maximum speed	mm/s	1400					
Positioning repeatability	mm	±0.1					

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	1.6
0.5	1
1	0.5
1.5	0.35
2	0.25

Item	Unit	SA6L					
Stroke	mm	48	96	144	192	240	288
Rated thrust	N	10					
Maximum loading capacity	kg	See the table below.					
Momentary maximum thrust	N	30					
Maximum acceleration	G	2					
Maximum speed	mm/s	1600					
Positioning repeatability	mm	±0.1					

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	3.2
0.5	2
1	1
1.5	0.65
2	0.5

6.2.2 Double Slider Specification

Item	Unit	SM4L			
Stroke	mm	30	60	90	120
Rated thrust	N	2.5			
Maximum loading capacity	kg	See the table below.			
Momentary maximum thrust	N	10			
Maximum acceleration	G	2			
Maximum speed	mm/s	1200			
Positioning repeatability	mm	±0.1			

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	0.8
0.5	0.5
1	0.25
1.5	0.18
2	0.14

Item	Unit	SM5L			
Stroke	mm	36	72	108	144
Rated thrust	N	5			
Maximum loading capacity	kg	See the table below.			
Momentary maximum thrust	N	18			
Maximum acceleration	G	2			
Maximum speed	mm/s	1400			
Positioning repeatability	mm	±0.1			

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	1.6
0.5	1
1	0.5
1.5	0.35
2	0.25

Item	Unit	SM6L			
Stroke	mm	48	96	144	192
Rated thrust	N	10			
Maximum loading capacity	kg	See the table below.			
Momentary maximum thrust	N	30			
Maximum acceleration	G	2			
Maximum speed	mm/s	1600			
Positioning repeatability	mm	±0.1			

Loading capacity (Horizontal) and Accelerations Supporting Continuous Operation

Acceleration [G]	Loading capacity [kg]
0.3	3.2
0.5	2
1	1
1.5	0.65
2	0.5

7. Installation Environment and Storage Environment

7.1 Installation Environment

Install the actuator in an environment meeting the following conditions:

- Not exposed to direct sunlight
- The machine does not receive radiated heat from large heat sources such as heat treatment furnaces.
- Surrounding air temperature of 0 to 40°C
- Humidity of 85% or below, non-condensing
- Not subject to corrosive or flammable gases
- Normal assembly environment not subject to excessive dust *1
- Not subject to water droplets, oil mist or cutting fluid
- Not subject to impact or vibration
- Not subject to significant electromagnetic waves, ultraviolet light or radiation
- This product is not designed to provide chemical resistance.

In general, the environment shall be one where the operator can work without wearing protective gears.

*1 The actuator houses high-performance magnets. Accordingly, do not use the actuator in an environment subject to fine magnetic particles such as iron powder.

7.2 Storage Environment

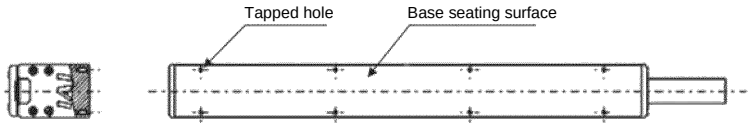
The storage environment should conform to the installation environment. Particularly when the actuator is stored for a long period of time, give consideration to prevent bedewing.
Unless specified, the actuator is shipped without any drying agent placed in the package. If the actuator is stored in an environment subject to bedewing, implement anti-bedewing measures over the entire package or directly on the actuator after unpacking.
The maximum storage temperature is 60°C for a short period. If the storage period exceeds 1 month, make sure the storage temperature dose not exceed 50°C.

8. Installation

8.1 Installation of Actuator

The actuator should be installed on a machined surface or other flat surface having equivalent precision, and the flatness of the installation surface should be within ±0.05 mm/m.
Secure the actuator using the tapped holes provided at the back of the base. For the detail dimensions, refer to “External Dimensions.”

8.1.1 Slim Types

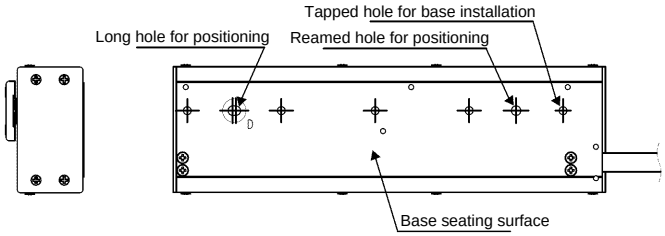


Tapped holes in base for installation

Type	Tapped hole diameter	Effective thread depth	Recommended tightening torque	
			(Seating surface: Steel)	(Seating surface: Aluminum)
SA1L	M2	4 mm	42.4 N-cm (4.32 kgf-cm)	25.4 N-cm (2.59 kgf-cm)
SA2L				
SA3L	M3		154 N-cm (15.8 kgf-cm)	83 N-cm (8.47 kgf-cm)

⚠ Caution: Use bolts of lengths appropriate for the effective thread depth. Use of inappropriate bolts may damage the tapped holes or result in insufficient installation strength, etc.

8.1.2 Long Stroke Types SA4L, SA5L, SA6L, SM4L, SM5L, SM6L



Tapped Holes for Base Installation and Reamed Holes

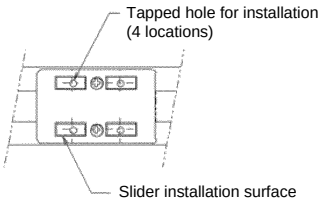
Type	Tapped hole diameter	Effective tapping depth	Recommended tightening torque		Reamed hole diameter	Effective reaming depth
			(Bearing surface: Steel)	(Bearing surface: Aluminum)		
SA4L SM4L	M3	5 mm	154 N-cm (15.8 kgf-cm)	83 N-cm (8.47 kgf-cm)	ϕ3H7	4 mm
SA5L SM5L						
SA6L SM6L	M4		359 N-cm (36.7 kgf-cm)	176 N-cm (18 kgf-cm)	ϕ4H7	

⚠ Caution: Use bolts of lengths appropriate for the effective thread depth. Use of inappropriate bolts may damage the tapped holes or result in insufficient installation strength, etc.

8.2 Installing the Load

8.2.1 Slim Types

Install the load using the tapped holes provided on the top face of the slider.
For the detail dimensions, refer to “External Dimensions.”



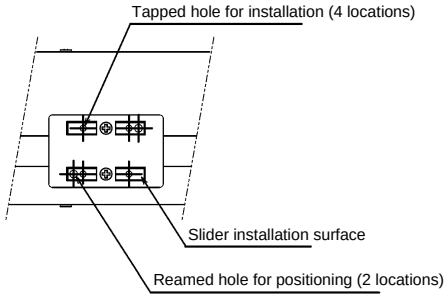
Tapped hole for load installation

Type	Tapped hole diameter	Effective thread depth	Recommended tightening torque (Seating surface: Steel)	Effective thread depth (Seating surface: Aluminum)
SA1L	M2	3 mm	42.4 N·cm (4.32 kgf·cm)	25.4 N·cm (2.59 kgf·cm)
SA2L		4 mm		
SA3L	M3	5 mm	154 N·cm (15.8 kgf·cm)	83 N·cm (8.47 kgf·cm)

⚠ Caution: Use bolts of lengths appropriate for the effective thread depth. Use of inappropriate bolts may damage the tapped holes or result in insufficient installation strength, malfunction due to bolt contact with the cover, etc.

8.2.2 Long Stroke Types SA4L, SA5L, SA6L, SM4L, SM5L, SM6L

Install the load using the tapped/reamed holes provided in the top face of the slider.
Refer to the external view for the detailed dimensions.



Tapped Holes for Load Installation and Reamed Holes

Type	Tapped hole diameter	Effective tapping depth	Recommended tightening torque (Bearing surface: Steel)	Recommended tightening torque (Bearing surface: Aluminum)	Reamed hole diameter	Effective reaming depth
SA4L SM4L	M2	3 mm	42.4 N-cm (4.32 kgf-cm)	25.4 N-cm (2.59 kgf-cm)	ϕ2H7	2 mm
SA5L SM5L		4 mm				2.5 mm
SA6L SM6L	M3	5 mm	154 N-cm (15.8 kgf-cm)	83 N-cm (8.47 kgf-cm)	ϕ3H7	3.5 mm

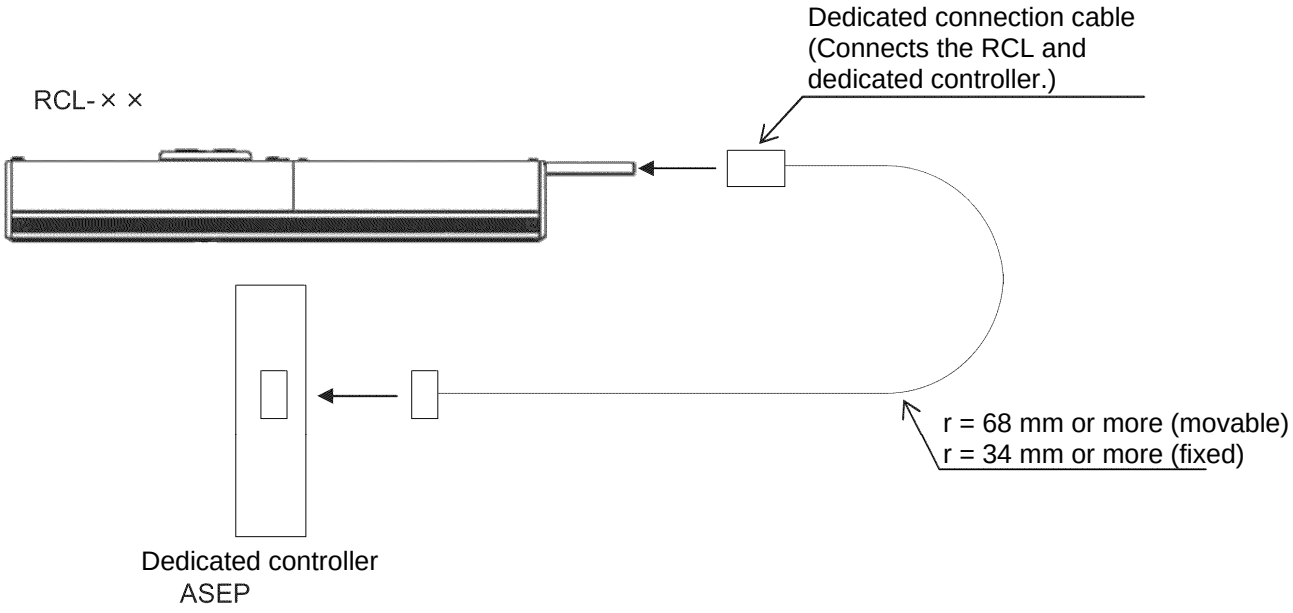
⚠ Caution: Use bolts of lengths appropriate for the effective thread depth. Use of inappropriate bolts may damage the tapped holes or result in insufficient installation strength, malfunction due to bolt contact with the cover, etc.

9. Connection with Controller

For the controller and the connection cable between the RCL (this actuator) and controller, use IAI's dedicated controller and dedicated connection cable.
This chapter explains the wiring method based on single-axis use.

- In applications where the dedicated connection cable cannot be secured, make sure the cable does not flex more than it does due to the dead weight, or use a self-supporting cable hose or increase the wiring radius to minimize the load received by the dedicated connection cable.
- Do not cut and extend, shorten or reconnect the dedicated connection cable.
- Do not pull or forcibly bend the dedicated connection cable.

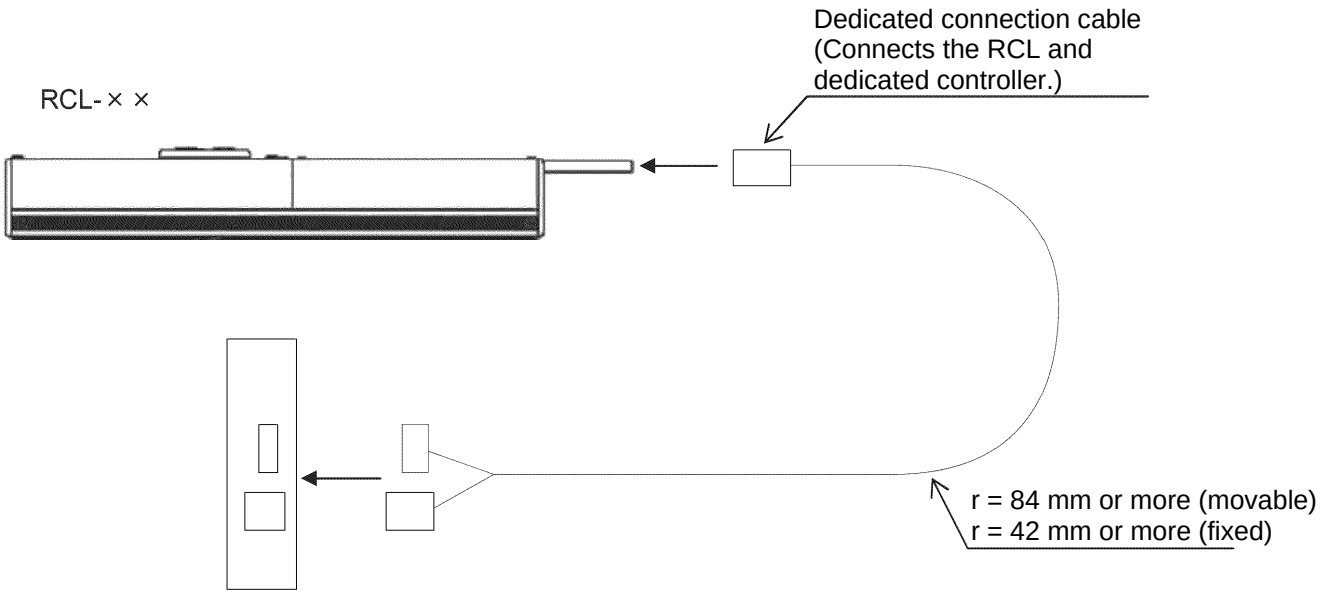
If you wish to change the specification of the dedicated connection cable, consult IAI.



Dedicated connection cable
- Servo motor cable: CB-APSEP-MPA***

* *** indicates the cable length (L). Up to 10 m can be specified.
Example) 080 = 8 m

(Note) Take note that micro sliders of simple absolute type cannot be used.



Dedicated controller

ACON
ASEP

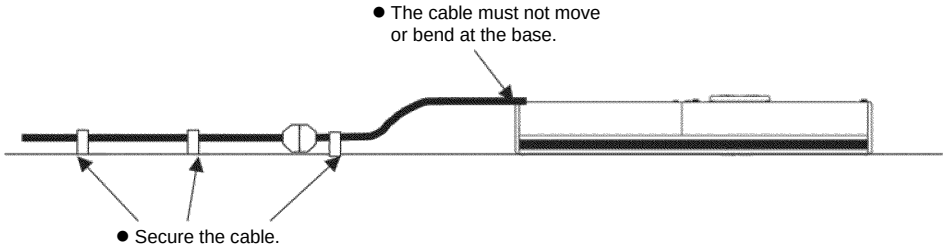
Dedicated connection cable

- Servo motor cable: CB-ACS-MPA***

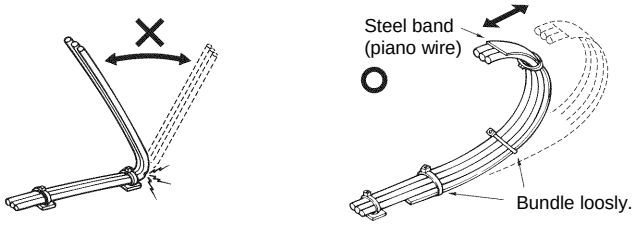
* *** indicates the cable length (L). Up to 10 m can be specified.
Example) 080 = 8 m

When building an application system using the actuator and controller, incorrect wiring or connection of each cable may cause broken wire, poor contact or other unexpected problem. The prohibited items relating to cable wiring are explained below.

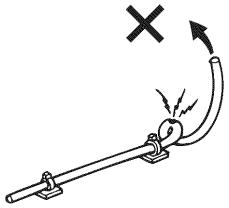
- Secure the cable and prevent it from moving or bending at the base of the actuator.



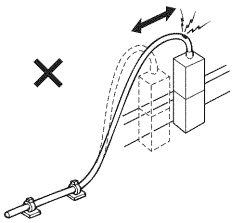
- Do not cut and reconnect the cable for extension or shorten the cable.
- If the cable cannot be secured, reduce the load on the cable by allowing it to deflect only by the weight of the cable or wire it in a self-standing cable hose, etc., having a large radius.
- Prevent the cable from bending at the same point.



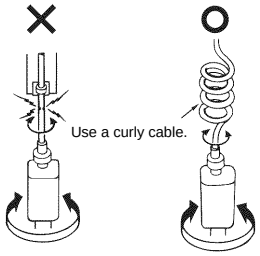
- Do not let the cable bend, kink or twist.



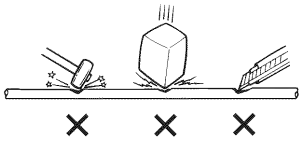
- Do not pull the cable with a strong force.



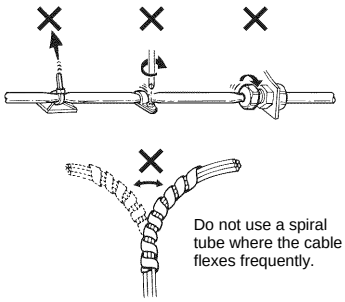
- Do not let the cable receive a turning force at a single point.



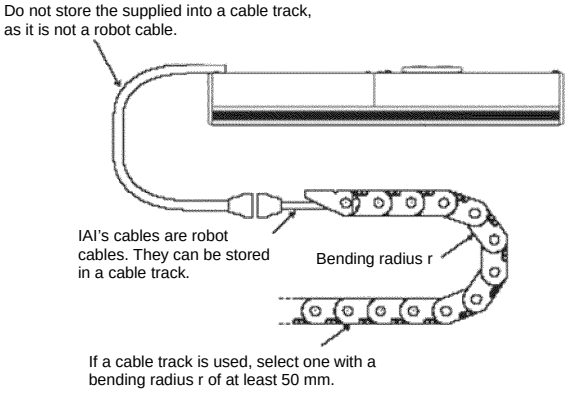
- Do not pinch, drop a heavy object onto or cut the cable.



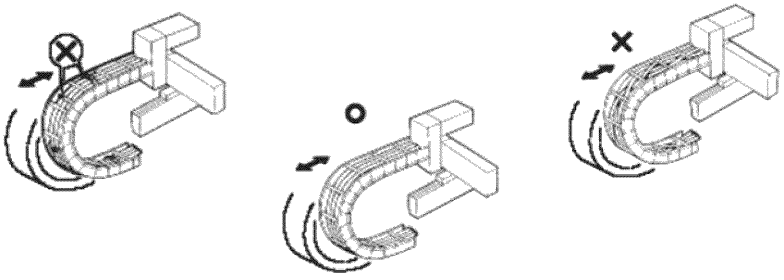
- When fixing the cable, provide a moderate slack and do not tension it too tight.



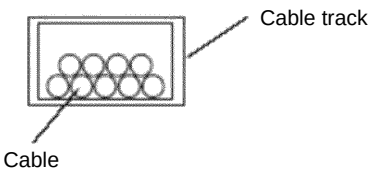
- Pay attention to the following points when using a cable track.



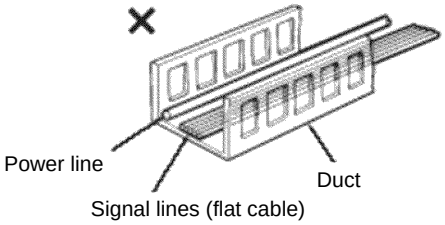
Do not let the cable get tangled or kinked in a cable track or flexible tube. When bundling the cable, keep a certain degree of flexibility (so that the cable will not become too taut when bent).



Do not cause the cables to occupy more than 60% of the space in the cable track.



Do not lay signal lines together with circuit lines that create a strong electric field.



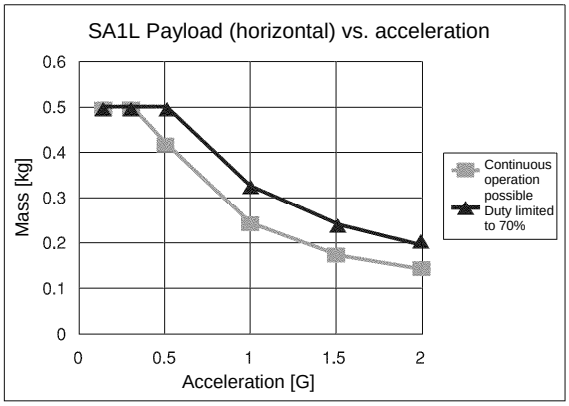
10. Operation Adjustments

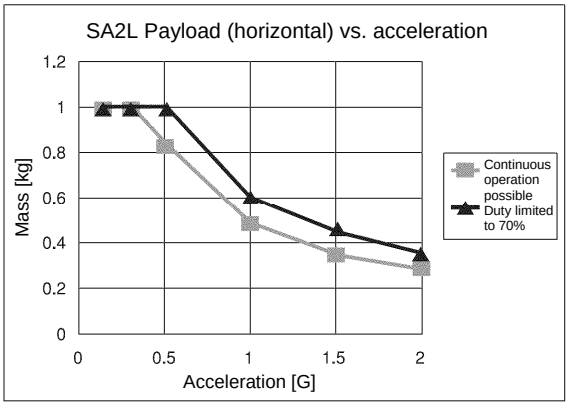
When using the actuator, perform the settings explained below.

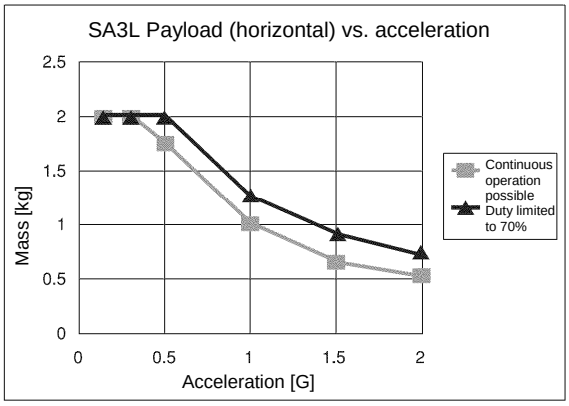
10.1 Setting the Acceleration

10.1.1 Slim Types

The acceleration is determined by the payload and duty.
The graphs show the maximum acceleration at each combination of payload and duty.
If the duty exceeds 70% but not more than 100%, set the acceleration along the “Continuous operation possible” (100%) line. If the duty is 70% or less, set the acceleration along the 70% line.







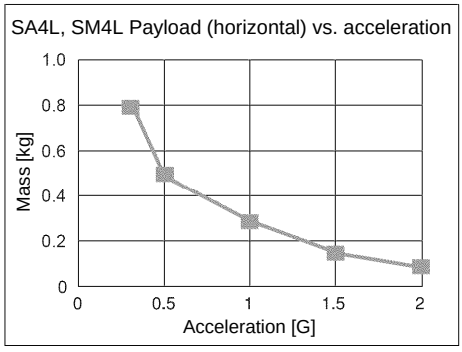
Payload (horizontal) vs. acceleration [kg]

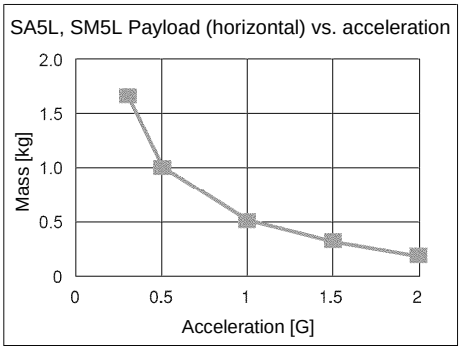
Model	SA1L		SA2L		SA3L	
Acceleration [G]	Continuous operation possible	Duty limited to 70%	Continuous operation possible	Duty limited to 70%	Continuous operation possible	Duty limited to 70%
0.1	0.5	0.5	1	1	2	2
0.3						
0.5	0.42		0.85		1.8	
1	0.25	0.32	0.5	0.6	1	1.2
1.5	0.18	0.24	0.36	0.45	0.65	0.8
2	0.15	0.2	0.3	0.36	0.5	0.6

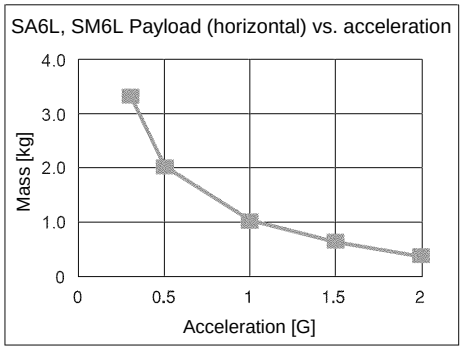
Duty = Operating time / Operating time + Stopped time x 100

10.1.2 Long Stroke Types

The graph shows the upper limits of loading capacity and acceleration at which continuous operation can be performed.



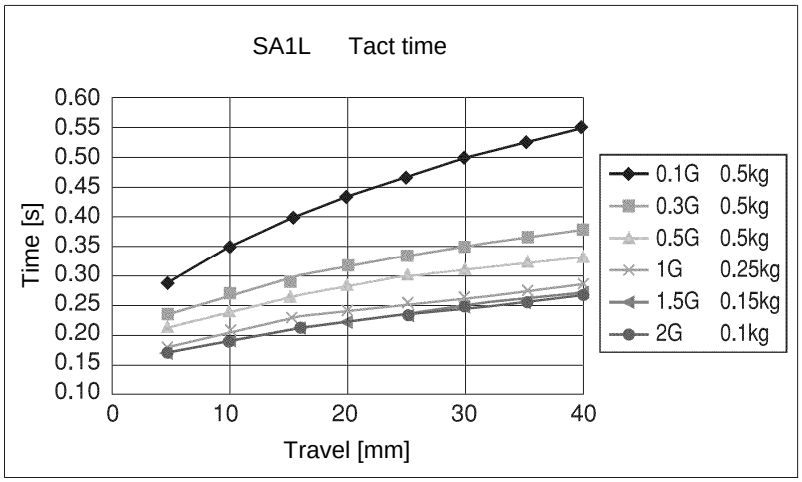


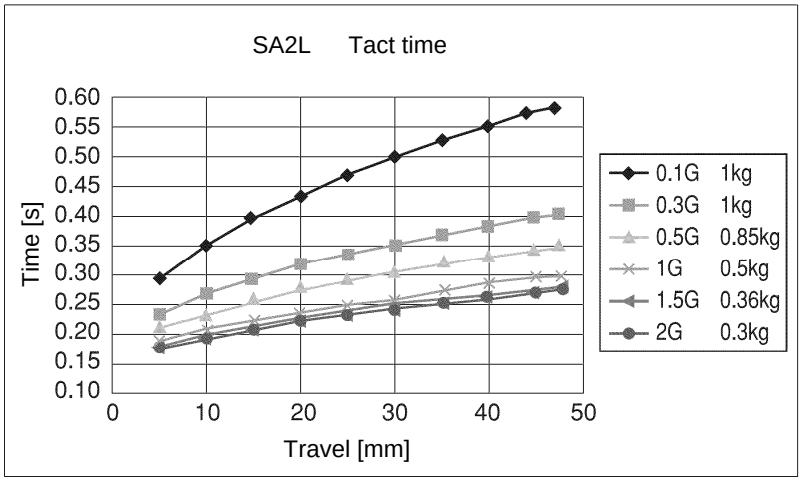


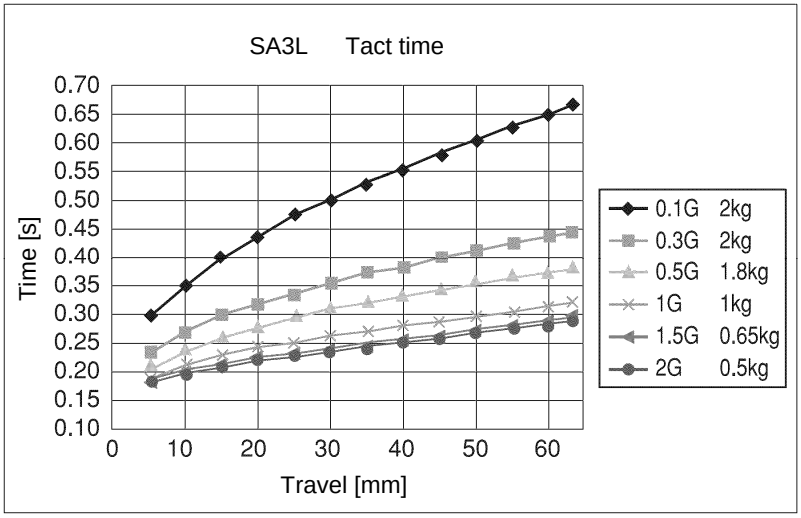
Model	SA4L, SM4L	SA5L, SM5L	SA6L, SM6L
Acceleration [G]	Continuous operation possible	Continuous operation possible	Continuous operation possible
0.3	0.8	1.6	3.2
0.5	0.5	1	2
1	0.25	0.5	1
1.5	0.18	0.35	0.65
2	0.14	0.25	0.5

10.2 Reference on Tact Time

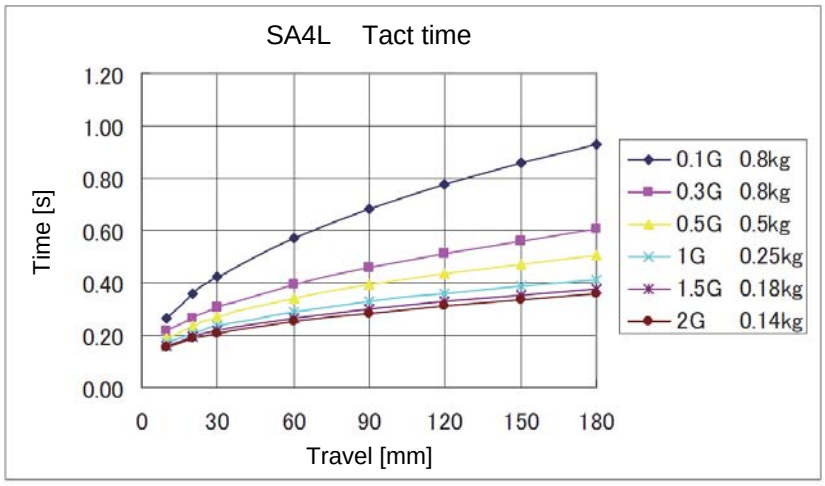
The graphs show the tact time at each maximum speed.
Use these graphs as a reference when determining the traveling time.

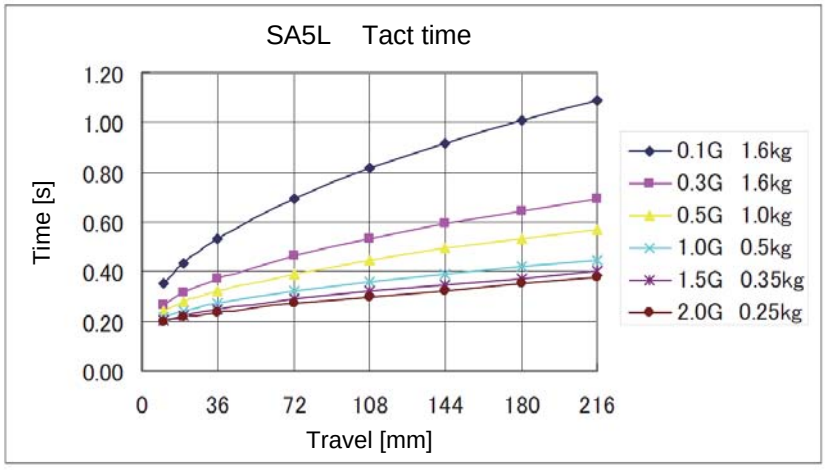


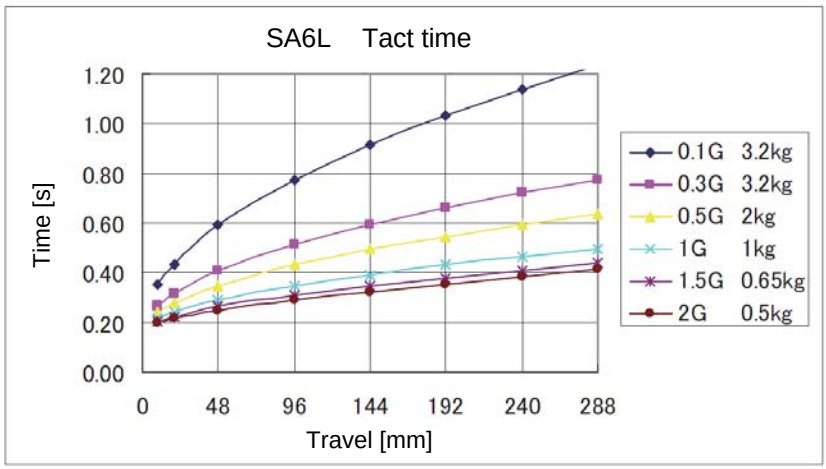




The tact times of the SA4L, SA5L and SA6L are reference values that have been gain-adjusted (using servo parameters) according to the load.
[Refer to 11.9, “Gain Adjustments for Long Stroke Types (Servo Parameters).”]







11. Notes on Operation

11.1 Actuator Installation Position

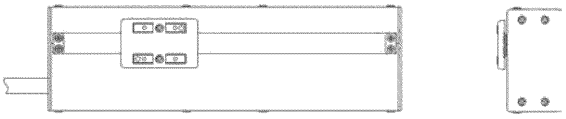
11.1.1 Slim Types (SA1L, SA2L, SA3L)

Use the actuator in a horizontal position.

(Note) Do not use the actuator by positioning it on its side or erecting it vertically.
Vibration, noises or malfunction may occur.

11.1.2 Long Stroke Types (SA4L, SA5L, SA6L, SM4L, SM5L, SM6L)

Use the actuator by positioning it horizontally or on its side or suspending it from the ceiling.
If the actuator is positioned on its side, make sure the slider is on top as shown below.



(Note) Do not use the actuator in a vertical position.
Vibration, noises or malfunction may occur.

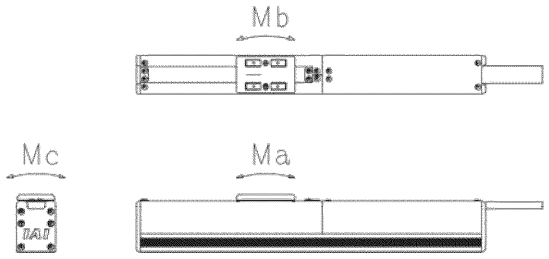
11.2 Loads Received by the Actuator

- Use the actuator by making sure it will not receive moment loads exceeding the specified values.

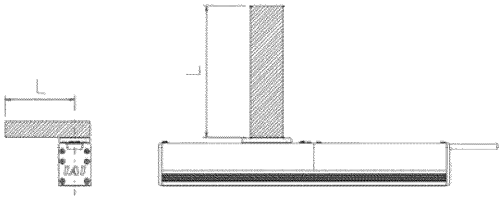
11.2.1 Slim Types

Allowable load moment Unit: N-m (kgf/m)

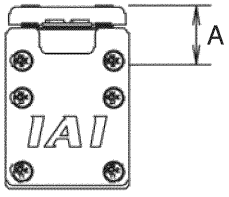
Type	Ma	Mb	Mc	A Ma/Mc moment offset reference position	Overhung load length L	
					Ma direction	Mb/Mc direction
SA1L	0.13 (0.013)	0.12 (0.012)	0.21 (0.021)	9.6 mm	50 mm or less	50 mm or less
SA2L	0.2 (0.02)	0.17 (0.017)	0.25 (0.026)	11.3 mm	60 mm or less	60 mm or less
SA3L	1.22 (0.124)	1.08 (0.110)	0.34 (0.035)	12.3 mm	120 mm or less	80 mm or less



Moment direction



Overhung load length

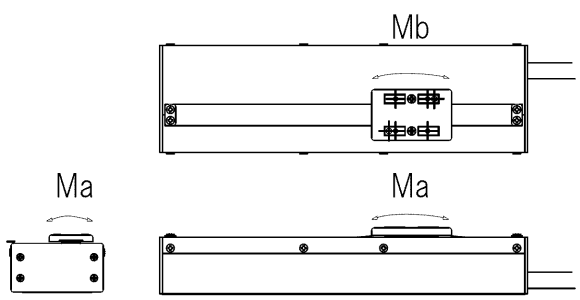


Ma/Mc moment offset reference position

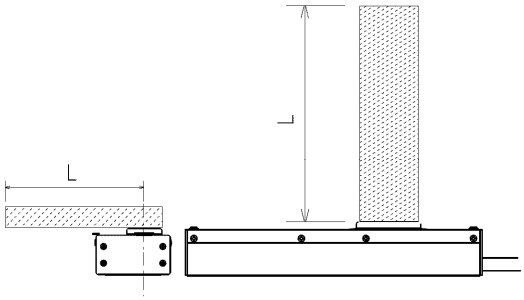
11.2.2 Long Stroke Types SA4L, SA5L, SA6L, SM4L, SM5L, SM6L

Allowable load moment

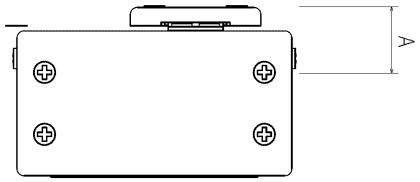
Type	Ma [N-m]	Mb [N-m]	Mc [N-m]	Overhung load length L		A
				Ma direction	Mb/Mc direction	
SA4L SM4L	0.2	0.17	0.25	60 mm or less	80 mm or less	13 mm
SA5L SM5L	0.49	0.41	0.72	80 mm or less	100 mm or less	16 mm
SA6L SM6L	0.87	0.75	1.22	80 mm or less	120 mm or less	20.7 mm



Moment direction



Overhung load length



Ma/Mc moment offset reference position

11.3 Temperature Rise

If the actuator is operated continuously for a long period under high load, the temperature will rise (to 80°C or above) in some parts of the actuator. Accordingly, do not touch the actuator to avoid danger. Also, do not bring flammable objects or items vulnerable to high temperature closer to the actuator. Use metal or other material offering good heat conductivity for the installation section to ensure sufficient heat radiation from the base.

11.4 Notes on Power On and Software Reset

After the power has been turned on or a software reset has been performed, the excited pole of the motor is detected. If the slider moves during this excited-pole detection, malfunction may result.
Make sure the slider remains stationary immediately after turning on the power or performing a software reset (approx. 3 seconds).

11.5 Home Position

The RCL actuator must perform home return after starting.
On the slim types (SA1L, SA2L, SA3L), one home is provided at the center of the actuator (the home cannot be changed).
On the long stroke types (SA4L, SA5L, SA6L, SM4L, SM5L, SM6L), the standard home position is on the rear side.
On the long stroke types of single slider specification (SAL4, SA5L, SA6L), the reversed-home specification can be specified.
Configure your system so that no obstructions exit near the home.

11.6 Stainless Sheet

Do not allow adhesive, paint or other viscous material to attach to the stainless sheet, because the slider may malfunction or the sheet may be damaged.
Exercise caution not to apply a local force to the stainless sheet, because it may cause the sheet to deform and present problems. During installation or transportation, do not hold the stainless sheet or press it from above. Doing so may damage the sheet.

11.7 Sound during Operation

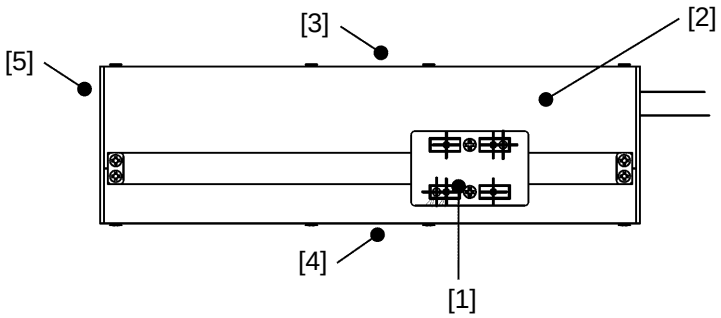
“Clatter” sound may generate from inside the actuator during operation.
This sound is caused by the movement of magnets inside the actuator due to the effect of magnetic attraction force. It does not indicate abnormality.

11.8 Magnetic Attraction Forces of Long Stroke Types

With the long stroke types (SA4L, SA5L, SA6L, SM5L, SM6L, SM7L), the actuator houses high-performance rare permanent magnets (neodymium magnets) having strong magnetic force.
Since large magnetic attraction forces act upon the actuator surface, avoid using these actuators in an environment subject to magnetic powder dust, iron powder, etc. Also, do not use these actuators in applications where magnetism may cause problems.

Leak Magnetic Flux Density at Each Part of Actuator (Reference Values)

Point		Magnetic flux density [mT]
[1]	Slider top face	10
[2]	Slide cover top face	50 to 60
[3]	Actuator side face (top)	50 to 60
[4]	Actuator side face (bottom)	1 to 3
[5]	End cover surface	60 to 100



11.9 Gain Adjustments for Long Stroke Types (Servo Parameters)

The default parameters of the controller are optimized for a small load. With the long stroke types (SA4L, SA5L, SA6L, SM5L, SM6L, SM7L), the gain setting parameters may have to be changed if the load is large. Set the parameters according to the applicable load by referring to the table below.

Load Levels (Loads) and Corresponding Servo Parameters (Recommended Values)

Type	Load		Parameters	
	Level	kg	Speed loop proportional gain	Speed loop integral gain
SA4L SM4L	Low	0 to 0.25	453	2516
	High	0.26 to 0.8	824	4578
SA5L SM5L	Low	0 to 0.5	860	4779
	High	0.6 to 1.6	1571	8728
SA6L SM6L	Low	0 to 1.0	1511	8397
	High	1.1 to 3.2	2761	15337

For information on how to set/change parameters, refer to the operation manual for your controller.

12. Maintenance and Inspection

12.1 Inspection Items and Timings

Perform maintenance and inspection at the timings specified below.
This schedule assumes 8 hours of operation a day.
If the actuator is operated continuously day and night or at a higher utilization rate, shorten the inspection intervals according to the situation.

	Visual inspection of exterior	Inspection of interior
Startup inspection	○	
1 month after startup	○	○
6 months after startup	○	○
Every year thereafter	○	○

12.2 Visual Inspection of Exterior

In the visual inspection of exterior, check the following items.

Actuator	Loose actuator mounting bolts, etc.
Cables	Scratches, connection at connectors
Stainless sheet	Scratches, attachment of foreign matter
Overall	Abnormal noise, vibration

12.3 Inspection of Interior

Turn up the stainless sheet and visually inspect the interior. Do not remove the side covers, encoder cover and other parts. The actuator houses precision electronics components, strong magnets, etc., so an attempt to remove other parts may cause foreign matter to enter, resulting in actuator failure. If any abnormality is found, return the actuator to IAI for maintenance/inspection and repair.

Turn up the stainless sheet and visually inspect the interior.

- Turn off the power, and then remove the setscrews on one side of the stainless sheet.
- Turn up the sheet and check the interior.
- When all checks are completed, tighten the setscrews and return the sheet to its original position.

Inspection location	Description of inspection
Actuator	Loose actuator mounting bolts, etc.
Guide	Lubrication condition, soiling

12.4 Greasing the Guide

The drive guide is designed maintenance-free for a long period (lubricant is automatically released over a long period of time). However, the life and degree of deterioration vary depending on the specific conditions of use. If necessary, grease the guide during the inspection of interior.

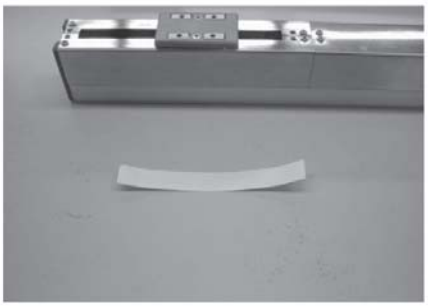
Initial grease to be injected to the guide

Kyodo Yushi Co., Ltd.	Lithium soap grease Multemp PS No. 2

⚠ Caution: Do not use fluorine grease. If fluorine grease is mixed with lithium grease, not only the performance of grease will be lost, but the actuator may also be damaged depending on the situation.

12.5 Replacing the Stainless Sheet

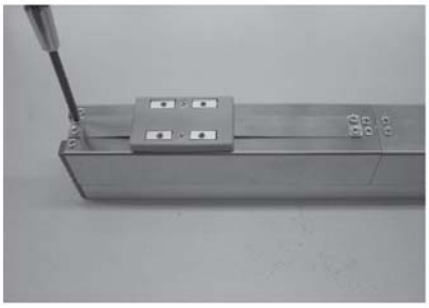
12.5.1 Slim Types



[1] Use a precision Phillips screwdriver of No. 0 to remove the Phillips head screws and take out the old stainless sheet.
Prepare a sheet of normal paper (thickness of approx. 0.1 mm) and cut the paper to the same width as the stainless sheet (SA1L: 8 mm, SA2L/3L: 11 mm) and a length longer than the slider cover.
(See the photograph.)

[2] Guide the cut paper prepared in [1] below the slider cover, as shown in the photograph.

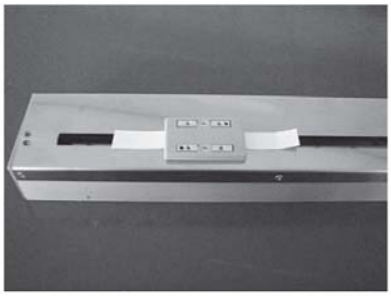
[3] Slide in the new stainless sheet along the paper.



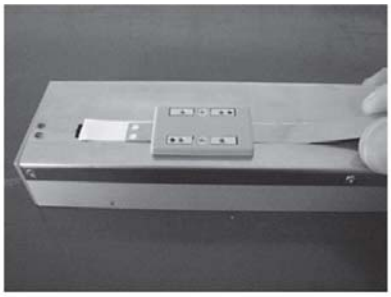
[4] Remove the paper and use the precision Phillips screwdriver of No. 0 to tighten the Phillips head screws and install the stainless sheet.

12.5.2 Long Stroke Types SA4L, SA5L, SA6L, SM4L, SM5L, SM6L

[1] Take out the old stainless sheet.
Prepare a sheet of normal paper (thickness of approx. 0.1 mm) and cut the paper to the same width as the stainless sheet (SA1L: 8 mm, SA2L/3L: 11 mm) and a length longer than the slider cover.
(See the photograph.)



[2] Guide the cut paper prepared in [1] below the slider cover, as shown in the photograph.



[3] Slide in the new stainless sheet along the paper.

[4] Remove the paper and secure the stainless sheet.

13. Warranty

The ZR-series robot you have purchased passed IAI's strict shipping inspection.
The warranty information is provided below.

(1) Warranty period
One of the following periods, whichever expires first:

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

(2) Scope of warranty
The warranty covers only the purchased and delivered IAI product.
If any failure is found during the warranty period despite use in appropriate conditions and such failure is clearly attributable to IAI, IAI will provide a replacement or repair the defective product free of charge.
However, failures due to the following causes are excluded from the scope of warranty:

[1] Handling or use in any condition or environment not specified in the catalog, operation manual, etc.
[2] Anything other than IAI's product
[3] Modification or repair not performed by IAI or its agent
[4] Not foreseeable at the science and technology standards available at the time of shipment from IAI
[5] Act of God, natural disaster, accident or any other cause beyond IAI's control
[6] Natural discoloration of paint or other aging
[7] Wear of consumable parts (stainless sheet, etc.)
[8] Sound or other subjective feeling not affecting the facility

Take note that the warranty specified herein covers only the delivered product. Any losses arising from a failure of the delivered product are excluded from the scope of warranty.
The defective product is delivered to IAI for repair service.

(3) Limited liability
IAI shall under no circumstance be held liable for any special, indirect or passive losses arising from its product.

(4) Scope of service
The price of the delivered product does not include the costs of programming, dispatching engineers, etc.
Accordingly, separate fees are charged for the following services even during the warranty period:

- Guidance of installation and adjustment, and witnessing of test operation
- Maintenance and inspection
- Technical guidance and training relating to operating methods, wiring methods, etc.
- Technical guidance and training relating to programming and other matters relating to programs
- Other services and tasks that are deemed subject to fees by IAI

14. Change History

Revision Date	Description of Revision
April 2009	Second Edition. Added the long stroke types RCL-SA4L, SA5L, SA6L, SM4L, SM5L, SM6L.

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IAI
Quality and Innovation

IAI America, Inc.

Head Office: 2690 W. 237th Street, Torrance, CA 90505
TEL (310) 891-6015 FAX (310) 891-0815
Chicago Office: 1261 Hamilton Parkway, Itasca, IL 60143
TEL (630) 467-9900 FAX (630) 467-9912
Atlanta Office: 1220-E Kenneston Circle, Marrietta, GA 30066
TEL (678) 354-9470 FAX (678) 354-9471

website: www.intelligentactuator.com

IAI Industrieroboter GmbH

Ober der Röth 4, D-65824 Schwalbach am Taunus, Germany
TEL 06196-88950 FAX 06196-889524