



# Operation Manual

PRODUCT NAME

***Programless controller (with stroke study)  
Step motor (servo 24 VDC )***

MODEL/ Series

**LECP2 Series**



**SMC Corporation**

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# LECP2 Series / Controller

## 1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC), Japan Industrial Standards (JIS)\*1) and other safety regulations\*2).

\*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems  
ISO 4413: Hydraulic fluid power -- General rules relating to systems  
IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)  
ISO 10218-1992: Manipulating industrial robots -- Safety  
JIS B 8370: General rules for pneumatic equipment.  
JIS B 8361: General rules for hydraulic equipment.  
JIS B 9960-1: Safety of machinery -- Electrical equipment for machines. (Part 1: General requirements)  
JIS B 8433-1993: Manipulating industrial robots - Safety. etc.

\*2) Labor Safety and Sanitation Law, etc.



### Caution

Operator error could result in injury or equipment damage.



### Warning

Operator error could result in serious injury or loss of life.



### Danger

In extreme conditions, there is a possibility of serious injury or loss of life.

## Warning

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

- 1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
- 2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
- 3) An application which could have negative effects on people, property, or animals requiring special safety analysis.
- 4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# LECP2 Series / Controller

## 1. Safety Instructions

### Caution

**The product is provided for use in manufacturing industries.**

The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.  
If anything is unclear, contact your nearest sales branch.

### **Limited warranty and Disclaimer/Compliance Requirements**

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.  
Read and accept them before using the product.

#### **Limited warranty and Disclaimer**

**The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.\*3)**

**Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.**

**For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.**

**This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.**

**Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.**

**\*3) Vacuum pads are excluded from this 1 year warranty.**

**A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.**

**Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.**

#### **Compliance Requirements**

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

## 2. Outlines of Product

### 2.1 Features

Features of the controller.

- Actuator control

Servo control enables the positioning the actuator.

- Operation and settings are available with the controller.

Settings can be altered and operation can be fun from the controller. Adjustments of the position, speed, acceleration and test runs are available without the teaching box, PC, and PLC.

- Operation with specified thrust

The holding force and pushing force of the actuator can be controlled in three steps.

- Separated power supply input

Power supply input is separated into power supply for the motor and power supply for the control circuit. Even if the power supply for the motor is turned off, the information of the encoder position is not lost while the control power supply is on, and parallel I/O control is available.

- Automatic sequence function of the returning to origin position

After the stroke study has been done, and after the power supply for LEC controller is supplied, the return to origin to the commanded side is possible in the first command of driving to stroke end.

(Wire saving is possible, because the input only for the return to origin command like "SETUP" in LECP6 is unnecessary.)

- Alarm detection

Abnormal conditions are self-detected. Alarms are displayed by LED on the controller and abnormal conditions are output to the outside by the parallel I/O terminal.

- Positioning of 12 intermediate points and both stroke end points are possible.

Through the combination of parallel I/O inputs, the positioning of 12 points (position number 3 to 14(E)) and the positioning of stroke end point are possible. And it is possible to set the speed and the acceleration of the positioning by the switch for each driving direction.

- Stroke study

By the stroke study, LEC\*6 controller recognizes the possible moving area and registers both stroke end points automatically.

Just after the controller is delivered and after adjusting the stopper of the actuator, the stroke study must be performed.

\*When the power supply is supplied to the controller just after it is delivered, ALM LED of the controller flashes in red because Stroke study is not completed. After Stroke study is completed, ALM LED of the controller turns off.

\*Register all of the intermediate positions again after performing Stroke study.

### **Caution**

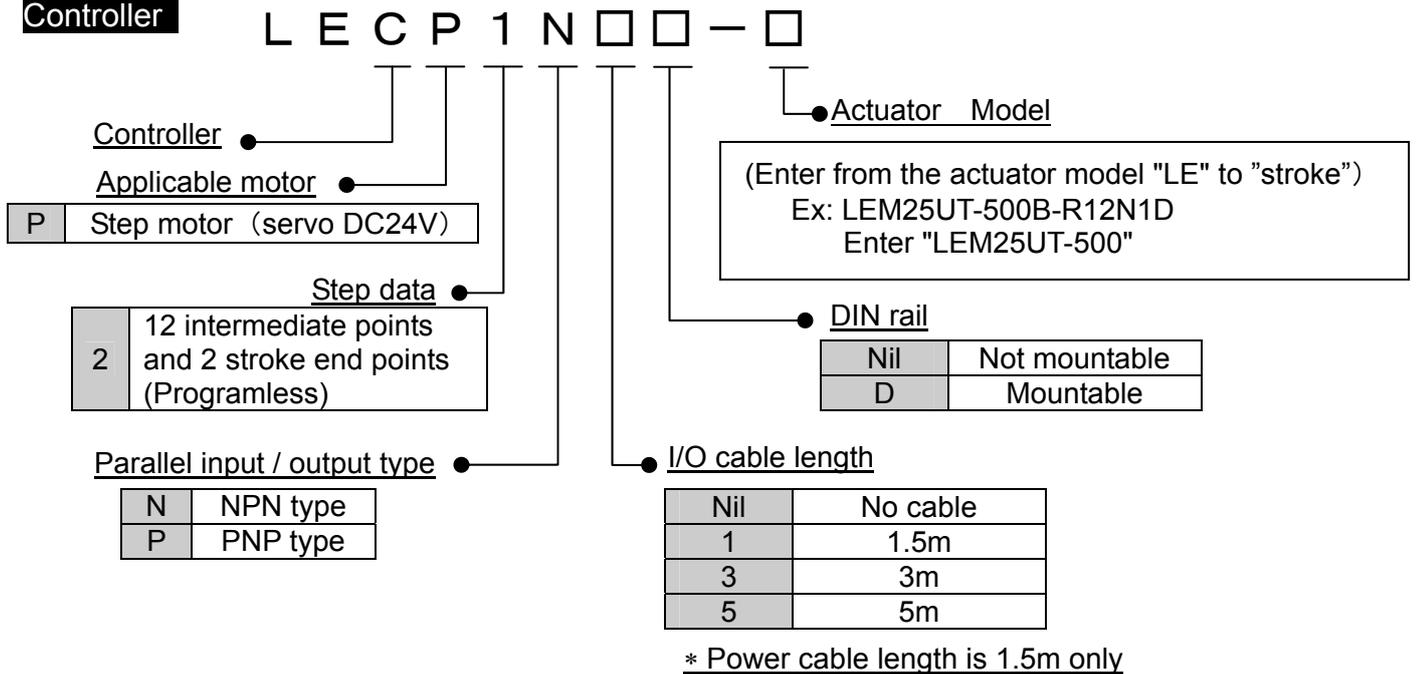
When setting up the actuator or occurring the failure of the actuator, refer to the operation manual of the actuator as well as this operation manual.

\*Keep this operation manual accessible so it can be referred to when necessary.

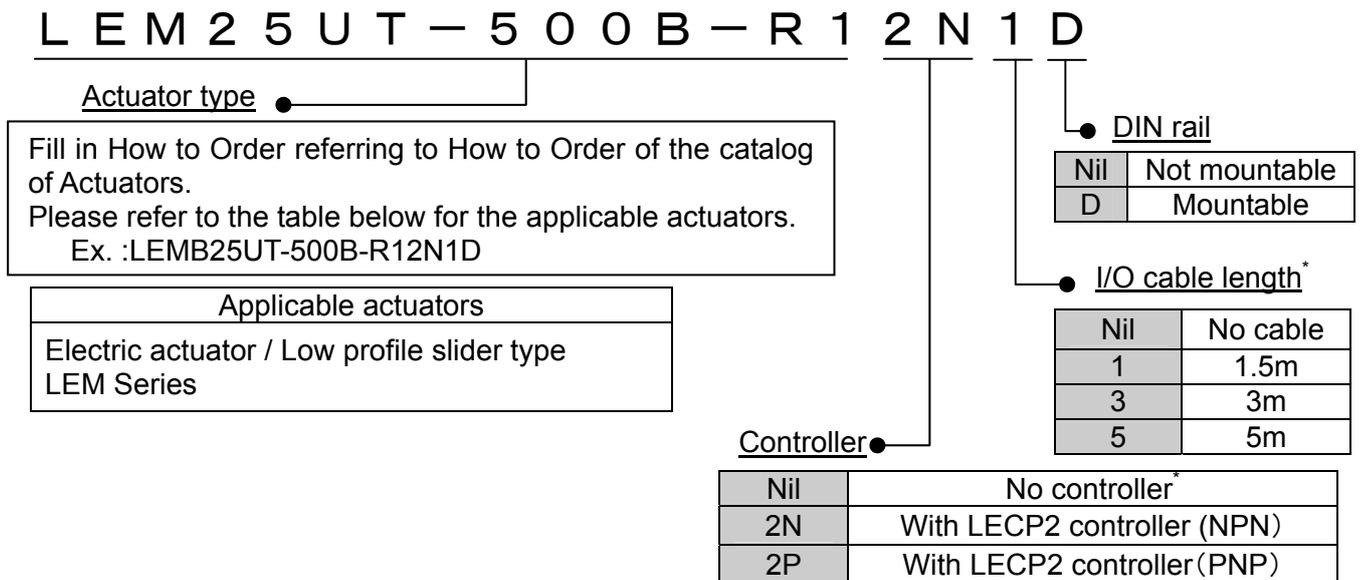
## 2.2 How to Order

How to order is shown below.

### Controller



### Actuator + Controller



\* If the actuator is ordered without the controller, the I/O cable type is not available.

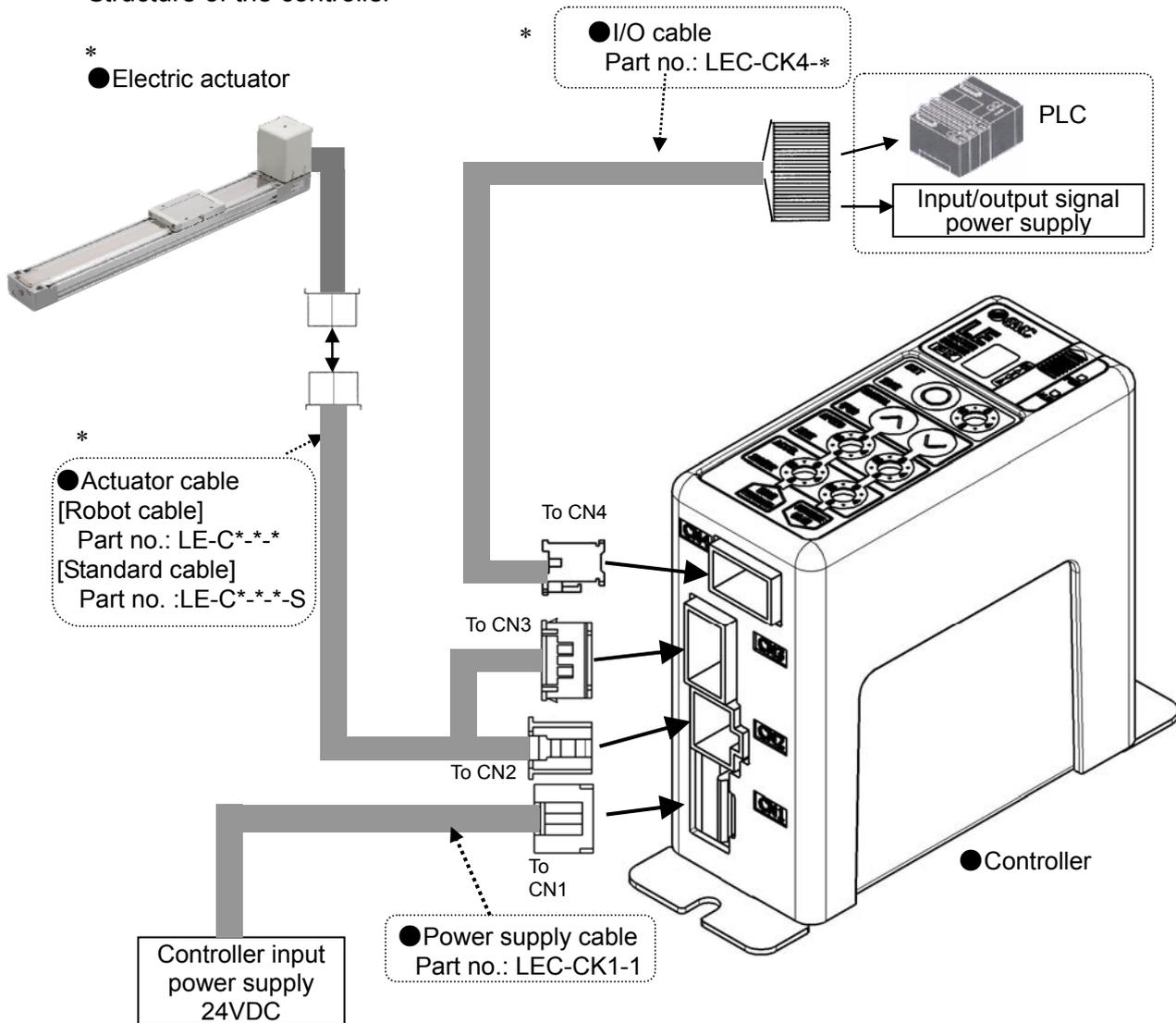
**LECP6 series I/O cables cannot be used due to different specification.**

### Caution

**Single controllers are also shipped after setting the actuator specification parameters.**  
Confirm the combination of the controller and the actuator is correct.

## 2.3 Structure of the product

### Structure of the controller



\*When conformity to UL is required, the electric actuator and controller should be used with a UL1310 Class 2 power supply.

\*These items are included if you ordered using the part number for an actuator set.

### **Warning**

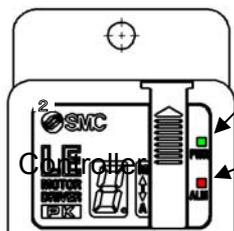
Refer to **4. External connection** for wiring.

Refer to **16. Wiring of cable/Common precautions** when handling the wiring and cables.



#### (4) Power supply ON, and the alarm check

Supply power 24V DC.



Description	LED turns on	Condition
PWR	Green LED turns on	Servo on state
	Green LED flashes	Servo off state
ALARM	Red LED turns on	Alarm state
	Red LED flashes	Stroke study is not completed. [ In the first supplying the power supply to this controller after it is delivered. ]

If the conditions are normal, the LED[PWR] at the front of the controller switches from a flashing to a solid light. The servo is turned on if the conditions are normal. If the LED[ALM] on the front of the controller turns red, the alarm goes off.

Only when the first supplying the power supply to this controller after it is delivered, the LED[ALM] on the front of the controller flashes in red. In this case, please perform Stroke study.

### ! Caution

#### When an alarm is generated

Confirm the content of the alarm with 7-segment LED of the controller or I/O output.

Eliminate the cause referring to **15. Alarm detection.**

#### (5) Stroke study

The stroke study is performed with the buttons and the switches on the controller.

Just after the controller is delivered and after adjusting the stopper of the actuator, the stroke study must be performed.

Refer to **7. 2 Stroke study** for details.

\*After performing Stroke study, register all of the intermediate positions again.

#### (6) Registering of the stopping position

The stopping position, speed and acceleration(and deceleration) are registered with the buttons and switches on the controller. Refer to **8. Registering of the intermediate position** for details.

#### (7) Trial run

The operation of the actuator is tested by the trial run.

The test run is performed with the buttons and the switches on the controller.

Refer to **7.3 Trial run** for details.

#### (8) The operation of the actuator

The operation of the actuator

The controller is changed to the auto mode by the switches on the controller.

The actuator is operated with the external unit of the PLC etc.

Refer to **12. How to command to drive** for details.

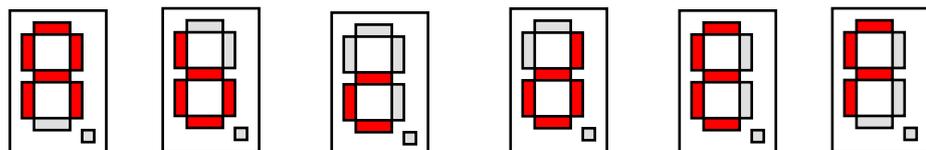
### 3. Specifications

#### 3.1 Basic specifications

Basic specifications of the product.

Item	Specifications
Controlled motor	Step motor(servo 24VDC)
Power supply specification (*1)	Power supply voltage: 24VDC±10% Max. current consumption: Rated 3A (Peak 5A)(*2) [Includes the motor power supply, control power supply, stop, unlocking] *When conformity to UL is required, the electric actuator and controller should be used with a UL1310 Class 2 power supply.
Parallel input	Input 6 points (Photo coupler insulation)
Parallel output	Output 6 points (Photo coupler insulation)
Stop points	Both ends: 2 points, Intermediate position: 12 points (position number 1 to 14(E)) *The stop position of the position number 1,2 (Both ends) cannot be changed.
Controlled encoder	Incremental A/B phase 800 pulse/rev
Memory	EEPROM
LED display	LED(Green/Red) 1 for each
7-segment LED display (*3)	1 digit, 7-segment display (red) Figures are expressed in hexadecimal (10 to 15 in decimal number are expressed as A to F)
Lock control	Forced lock-release terminal
Cable length	I/O cable: 5m or less Actuator cable: 20m or less
Cooling method	Air-cooling type
Operating temperature range	0 to 40°C(No condensation, no freezing)
Operating humidity range	90%RH or less (No condensation)
Storage temperature range	-10 to 60°C(No condensation, no freezing)
Storage humidity range	90%RH or less (No condensation)
Insulation resistance	Between the case (Heat Sink) and SG terminal: 50MΩ(500VDC)
Weight	130g(Mounting screw type), 150g(DIN rail mounting type)

- \*1) Do not use inrush current suppressor types as the power supply for the controller input.
- \*2) Power consumption depends on actuator. Please refer to the operation manual of actuators for details.
- \*3) "10" to "15" in decimal number are displayed as follows in the 7-segment LED



Decimal display

10

11

12

13

14

15

Hexadecimal display

A

b

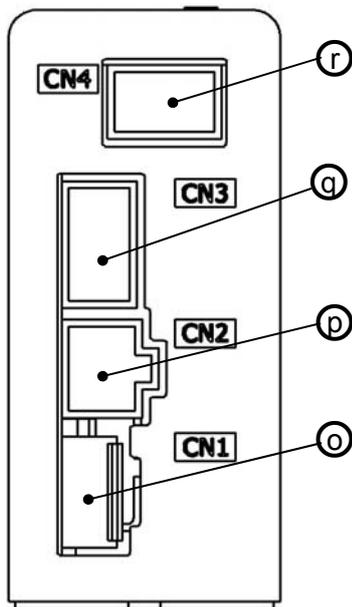
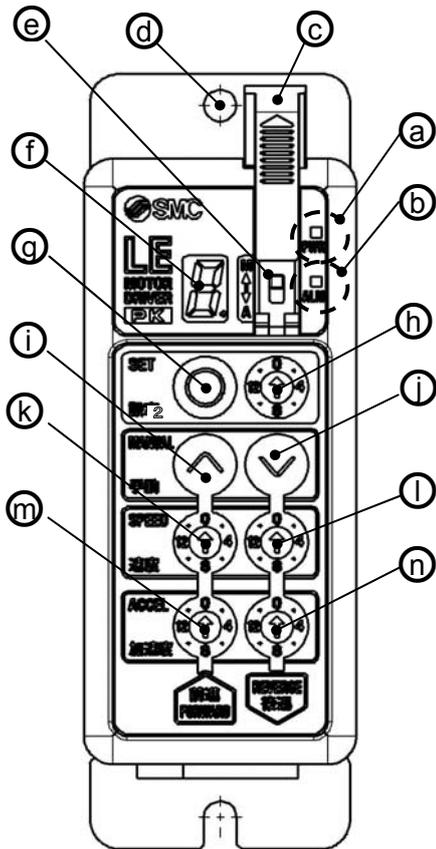
c

d

E

F

### 3.2 Details of the controller



No.	Display	Description	Details
(a)	PWR	Power LED	Power supply ON/No alarm : Turns on in green Power supply ON/servo OFF :Flashes in green
(b)	ALM	Alarm LED	Power supply ON/With alarm : Turns on in red Power supply ON/Parameter setting :Flashes in red Power supply ON/Un-performing of Stroke study : Flashes in red
(c)	—	Cover	Change and protection of the mode SW (Close the cover after changing SW)
(d)	—	FG	Frame ground (Tighten the bolt with the nut when mounting the controller. Connect the grounding cable.)
(e)	—	Mode switch	Switches the mode(Manual mode <-> Auto mode)
(f)	—	7-segment LED	Auto mode/No alarm : Displays the position number that is commanded through IN0-IN3 of CN4 parallel I/O. (In driving:Brinks   In completed: No brinks) Auto mode/With alarm : Displays the alarm group. Manual mode : The display differs depending on the function used.
(g)	SET	Set button	Decide the settings or drive operation in Manual mode.
(h)	—	Position switch	Assign the position to drive(3 to 14), and the origin position.
(i)	MANUAL	Forward button	Perform forward jog and inching.
(j)		Reverse button	Perform reverse jog and inching.
(k)	SPEED	Forward speed switch	16 forward speeds are available.
(l)		Reverse speed switch	16 reverse speeds are available
(m)	ACCEL	Forward acceleration switch	16 forward acceleration steps are available.
(n)		Reverse acceleration switch	16 reverse acceleration steps are available.
(o)	CN1	Power supply connector	Connect the power supply cable
(p)	CN2	Motor driving connector	Connect the motor connector.
(q)	CN3	Encoder connector	Connect the encoder connector
(r)	CN4	I/O connector	Connect I/O cable

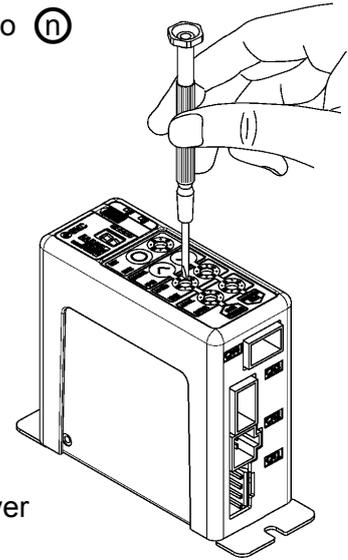
## ! Caution

Use a flat blade watchmaker's screwdriver of the size shown below when changing Position switch (h) and the set value of the speed/acceleration switch (k) to (n)

<Size>

End width L : 2.0 to 2.4 [mm]

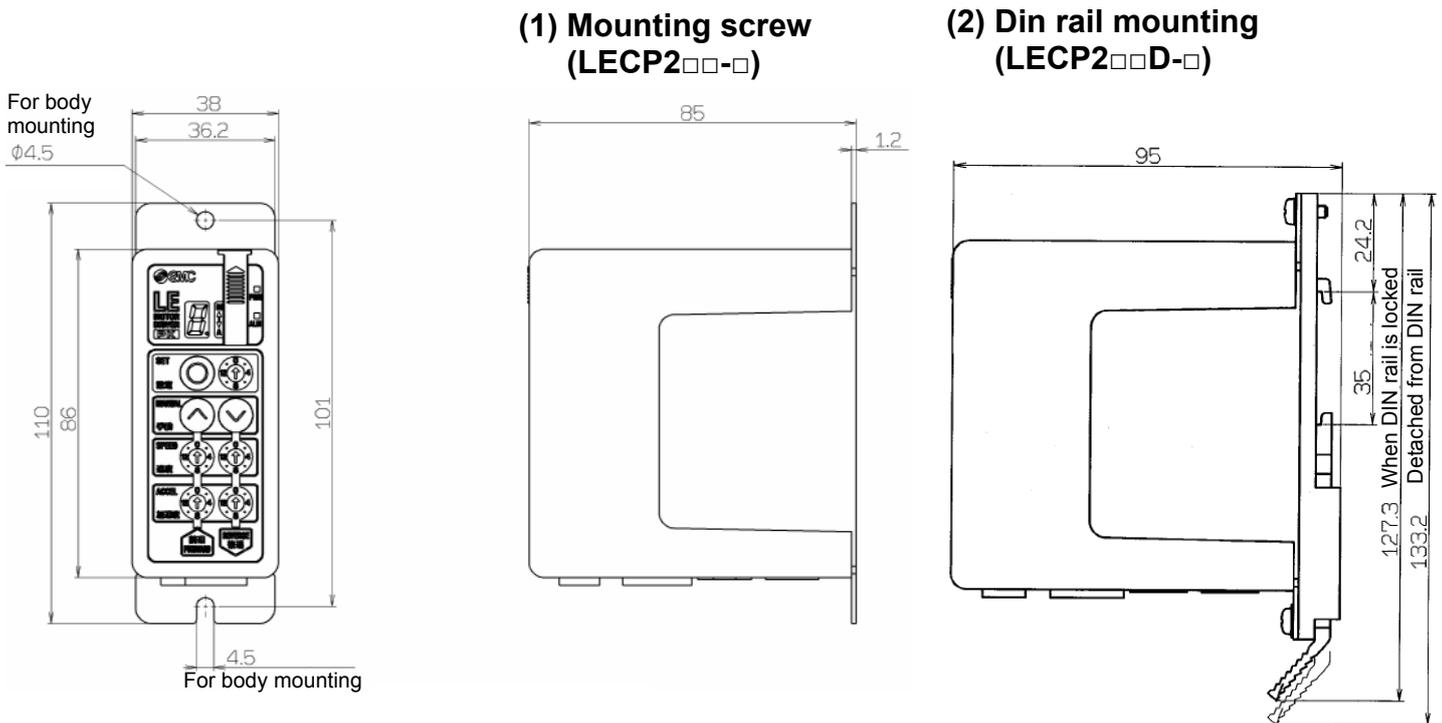
End thickness W : 0.5 to 0.6 [mm]



Magnified view of the end of the flat blade screwdriver

### 3.3 Outer dimensions

The appearance of the product is shown below.



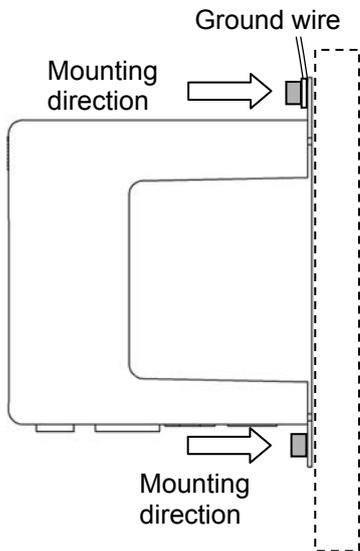
## 3.4 Mounting

### (1) Mounting

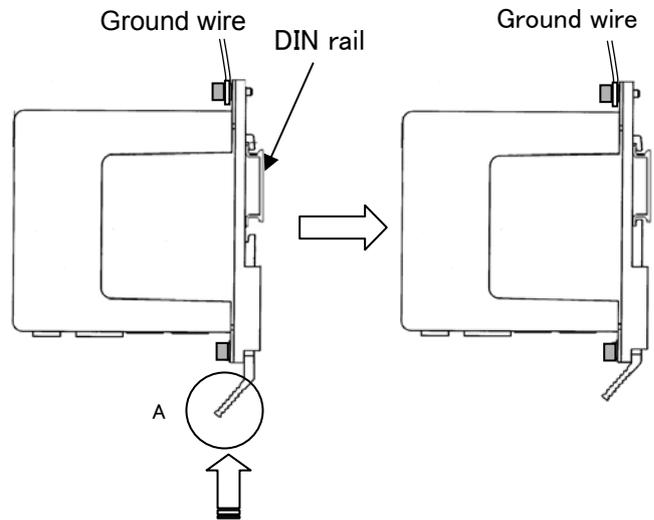
Details of the controller

#### Mounting screw (LECP2□□-□)

(Mounting with two M4 screws)



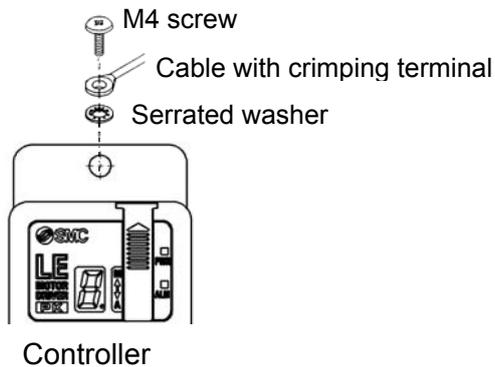
#### DIN rail mounting (LECP2□□D-□)



Hook the controller on the DIN rail and press the lever of section A in the arrow direction to lockit

### (2) Grounding

Tighten the bolt with the nut when mounting the ground cable as shown below.



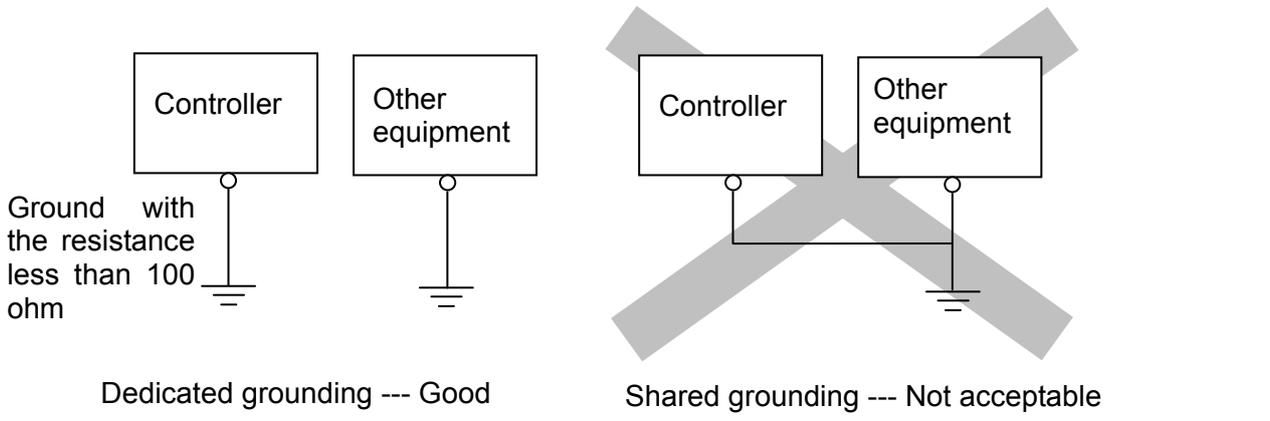
### ! Caution

M4 screws, cable with crimping terminal and serrated washer are prepared by customer.

Ground the controller to reduce noise.

## ⚠ Caution

- (1) Grounding shall be done by dedicated cable. Grounding with the ground resistance of 100Ω or less.
- (2) The cross sectional area of the grounding cable shall be 2mm<sup>2</sup> or more. Grounding location shall be in the vicinity of the controller. Keep the grounding cable short.



### (3) Location for mounting

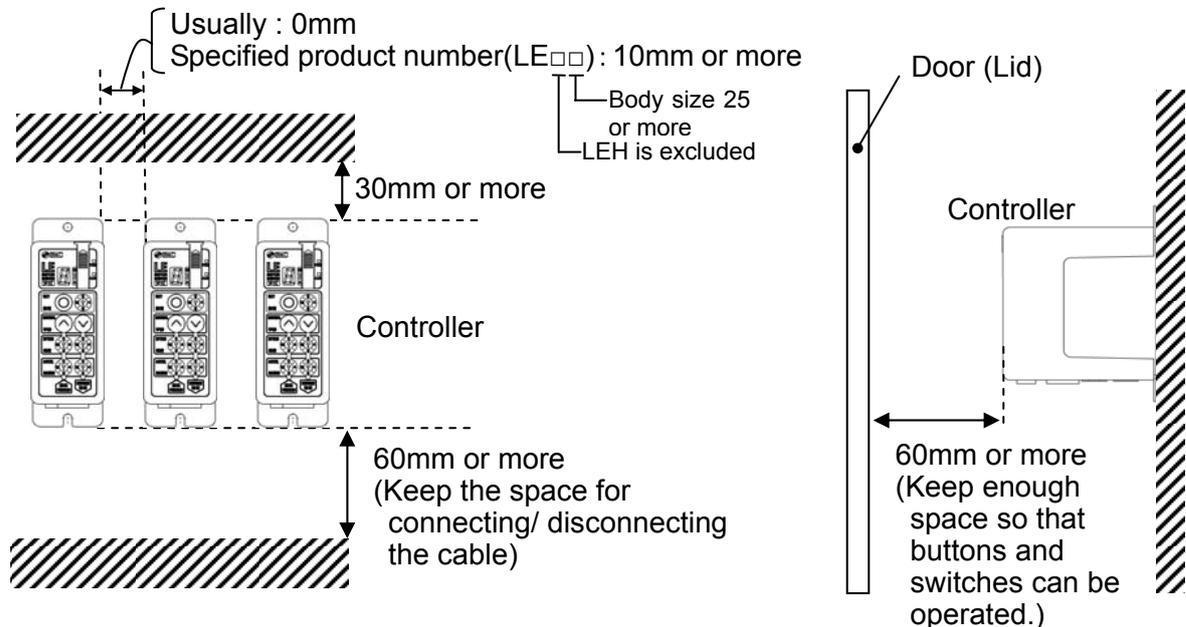
Select the size and the installation style so that the surrounding temperature of the controller is 40°C or less.

Mount the controller vertically on the wall with 60mm or more of space on top and bottom of the controller for connecting and disconnecting of the cable.

Keep 60mm or more between the front of the controller and the cover (lid) so that buttons and switches can be operated.

Keep enough space around the controller so that the operating temperature of the controller stays within the specification range.

Avoid mounting on a panel where a vibration source such as large size electromagnetic contactor or circuit fuse breaker is also mounted.



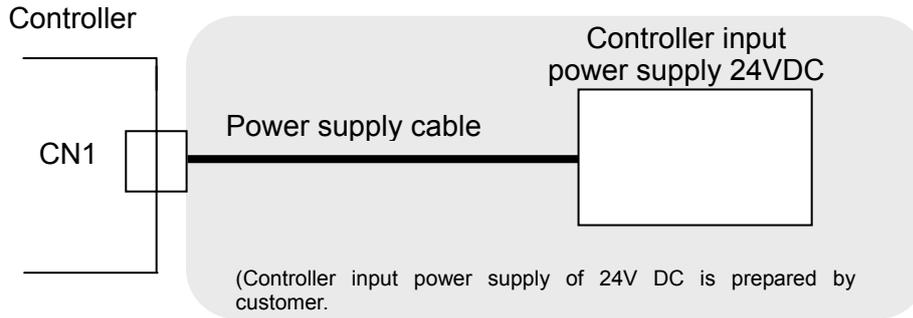
## ⚠ Caution

When there are dents, bumps or warping on the mounting surface of the controller, excessive force can be applied to the case, which can cause failure. Mount on a flat surface.

## 4. External connection

### 4. 1 CN1: Power supply connector

The example of standard wiring of the controller is shown per connector (CN1 to 4).



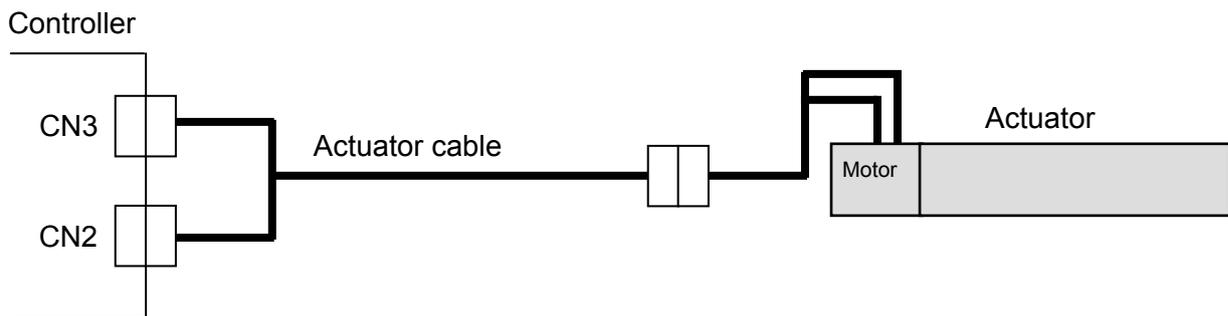
Refer to **5. CN1 Power supply cable** for wiring.

### ! Caution

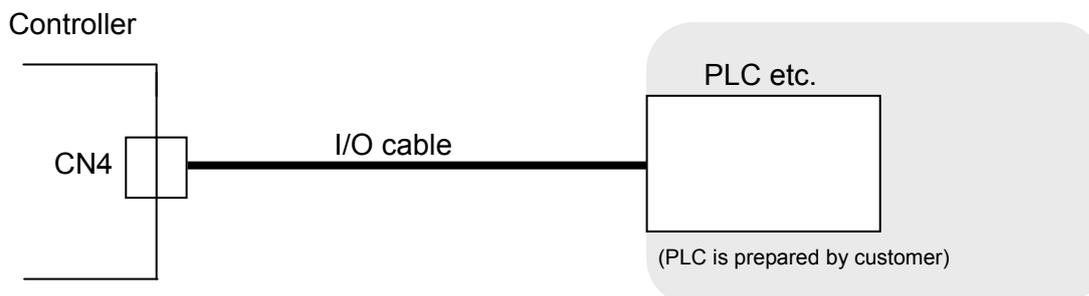
Do not use inrush current suppressor type as the power supply for the controller input.

### 4. 2 CN2: Motor connector, CN3: Encoder connector

Connect the controller and the actuator with the actuator cable (LE-CP-□ or LE-CP-□-S).



### 4. 3 CN4: Parallel I/O connector



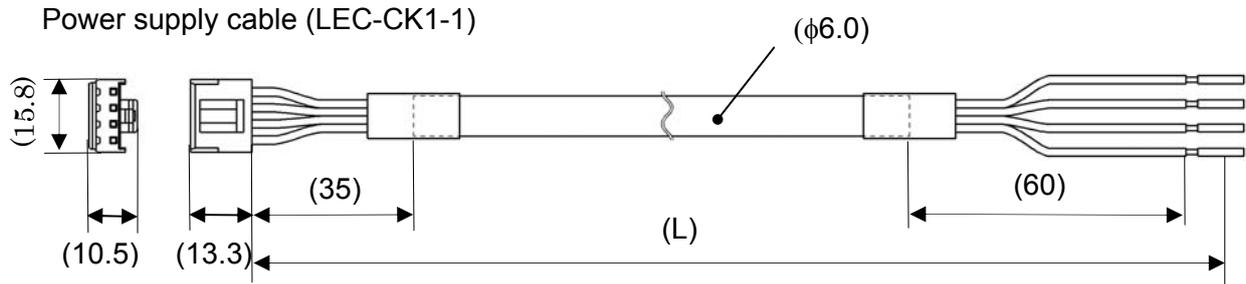
\*Refer to **6.4 Parallel I/O connector CN4 wiring(Example)** for wiring.

\*Refer to **6.3 Details of parallel input/output signal and cable** for details of the parallel input and output signal.

## 5. CN1: Power supply cable

### 5. 1 Power supply cable specification

Included power supply cable specification is shown below.



Item	Specifications
Connector	Manufacturer: J.S.T. Mfg. Co.,Ltd. Product number : VHR-4N
Cross sectional area of the cable	AWG20
Length (L)	LEC-CK1-1 : 1.5m only

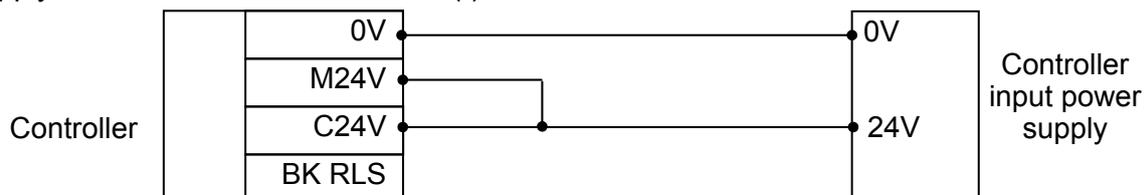
Terminal	Color of covered wire	Function	Functional explanation
0V	Blue	Common power supply (-)	Common for motor supply, controller supply, and brake release.
M24V	White	Power supply of motor (+)	Power for the motor supplied through the controller
C24V	Brown	Power supply (+) for the controller	Power supply for the controller
BK RLS	Black	Unlocking (+)	Unlocks the brake for maintenance

### 5. 2 Power supply cable specification

Referring to (1) to (4), connect the power supply cable included in accessories to the controller input power supply 24VDC and insert it to the controller CN1 power supply connector.

#### (1) Wiring of power supply

Connect the plus (+) of the controller input power supply 24VDC to C24V terminal of the power supply cable, and connect the minus (-) to 0V terminal.



### ⚠ Caution

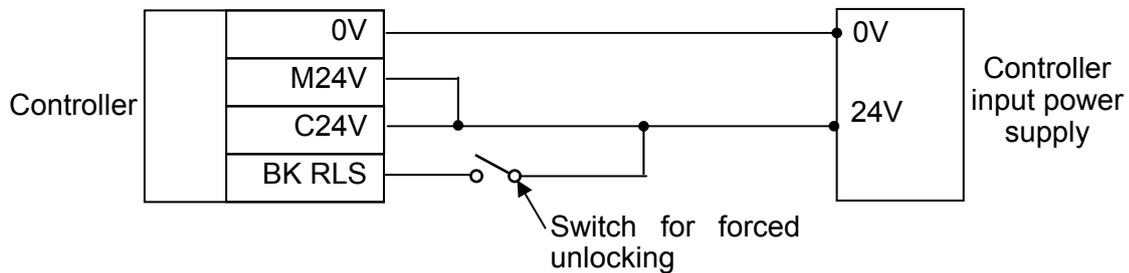
Do not use inrush current suppressor type as the power supply (24VDC) for the controller input.

## (2) Wiring for the switch for forced unlocking

Install unlocking switch for the adjustment or recovery during emergency of the locking actuator.

\*Switch (24V DC, contact capacity 0.5A or more) is provided by customer.

Connect one of unlocking switch terminals to the input power supply for the controller, and the other to BK RLS terminal of the power supply plug. Locking mechanism is released by closing the switch.



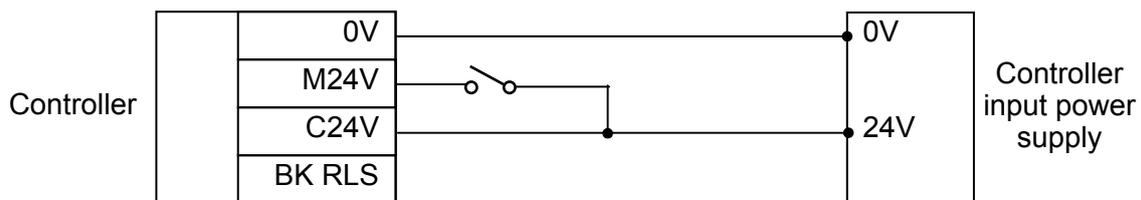
### ! Caution

It is unnecessary to connect BK RLS terminal when the actuator does not have locking mechanism.

Connect BK RLS terminal only when releasing the lock at servo OFF or STOP is ON is needed.

## (3) Wiring for the stop switch

Stop switch is necessary.



### ! Caution

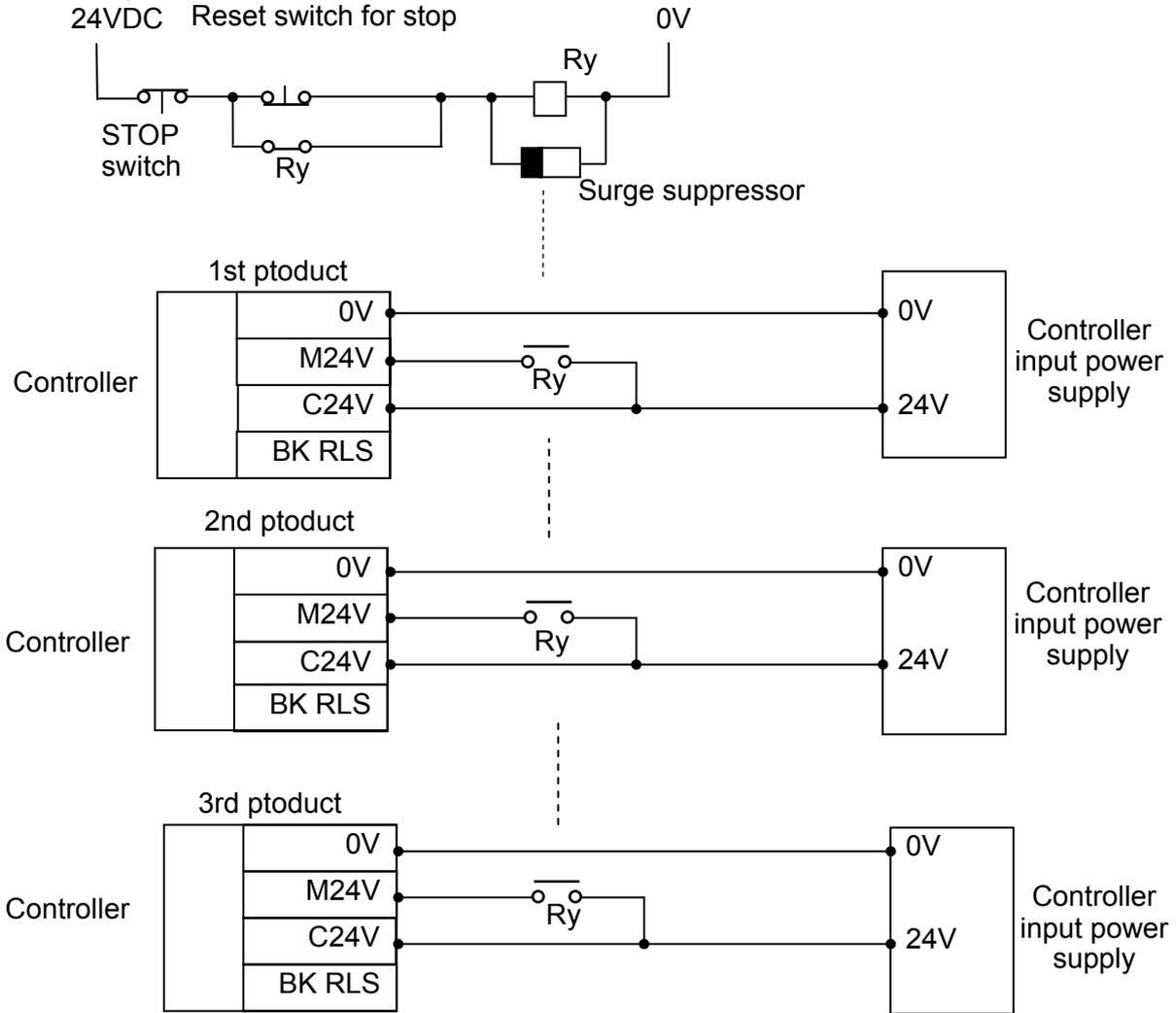
When M24V is cut off during the operation of actuator, the alarm is detected.

When M24V is cut off after turning on the STOP signal (CN4 No.14), the actuator stops without detecting the alarm.

**(4) Stop the power supply for the motor**

If it is necessary to shut off the power supply for the motor from outside, connect the relay between the input power supply for the controller 24VDC and the power supply plug for the controller M24V.

【Example of the circuit】



**⚠ Warning**

- Do not perform returning to origin position neither drive operation when the the power supply for the motor (M24V) is shut off, otherwise alarm will be generated.

## 6. CN4: Parallel I/O cable

### 6.1 Parallels input / output

#### Input specifications

NO.	Item	Specifications
1	Input circuit	Internal circuit and the photo coupler insulation
2	No. of inputs	6 points
3	Voltage	DC24V±10%
4	Input current at ON	3.5mA±20%(at DC24V)
5	Input current / voltage at OFF	1.5mA or less of current 11V or less of voltage

#### Output specifications

NO.	Item	Specifications
1	Output circuit	Internal circuit and the photo coupler insulation
2	No. of output	6 opints
3	Maximum voltage between terminals	DC30V
4	Maximum output current	10mA
5	Saturation voltage between terminals	2.0V (Maximum)

### 6.2 Parallel input / output circuit (NPN, PNP)

There are two types of parallel input / output types for this controller.

NPN type (LECP2N□□-□)

PNP type (LECP2P□□-□)

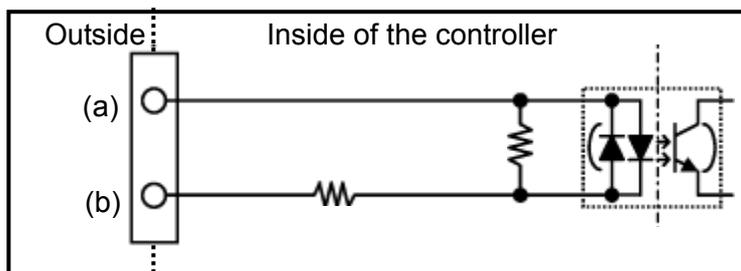
#### (1) Parallel I/O input circuit (NPN, PNP common)

##### ■ NPN TYPE

(a)	「COM+」(1)
(b)	IN0(9)~STOP(14)

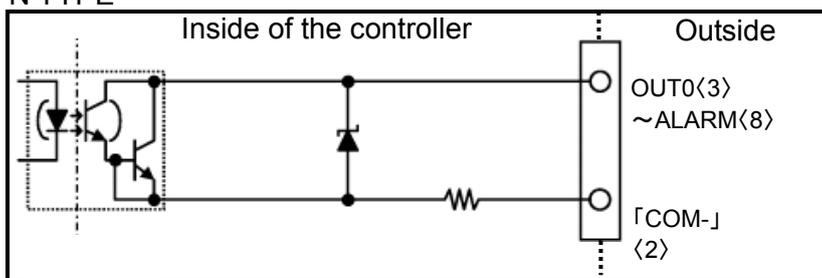
##### ■ PNP TYPE

(a)	「COM-」(2)
(b)	IN0(9)~STOP(14)

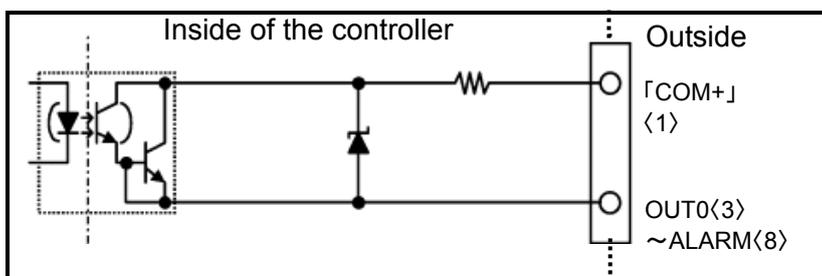


#### (2) Parallel I/O output circuit

##### NPN TYPE

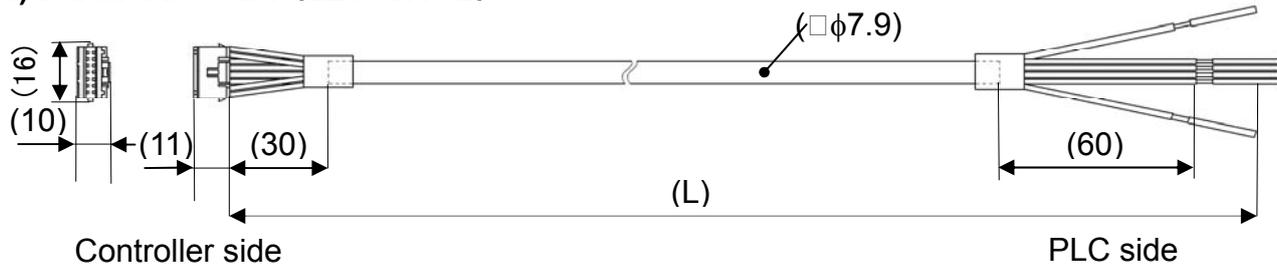


##### PNP TYPE



## 6.3 Details of parallel input / output signal and cable

### (1) Parallel I/O cable(LEC-CK4-□)



Item	Specifications
Connector	Manufacturer: J.S.T. Mfg. Co.,Ltd. Manufacturer: J.S.T. Mfg. Co.,Ltd. Product number : PADP-14V-1-S
Cross sectional area of the cable	AWG26
Length (L)	The suffix of the part number (1,3,5) specifies the length. LEC-CK4-1: 1.5m LEC-CK4-3: 3m LEC-CK4-5: 5m

### (2) Details of Input/Output signal

Terminal No.	Insulation color	Dot Mark	Dot color	Function	Contents								
1	Light brown	■	Black	COM+	Connect the 24V side of the power supply (24VDC) for input / output signal.								
2	Light brown	■	Red	COM-	Connect the 0V side of the power supply (24VDC) for input / output signal.								
3	Yellow	■	Black	OUT0	Completion output of driving (Refer to *1) ●When the return to origin is performed: OUT0 output is turned on only when the return to origin is commanded by IN0. OUT1 output is turned on only when the return to origin is commanded by IN1.								
4	Yellow	■	Red	OUT1	●When motor side or end side is commanded to drive: OUT0 or OUT1 output turns on from a few mm of the stroke end. ●When intermediate position is commanded to drive: OUT output turns on after stopping at the target position. Ex. Output of position number 3 (Output with the combination of OUT0-OUT3)								
5	Light green	■	Black	OUT2	<table border="1"> <tr> <td>OUT3</td> <td>OUT2</td> <td>OUT1</td> <td>OUT0</td> </tr> <tr> <td>OFF</td> <td>OFF</td> <td>ON</td> <td>ON</td> </tr> </table>	OUT3	OUT2	OUT1	OUT0	OFF	OFF	ON	ON
OUT3	OUT2	OUT1	OUT0										
OFF	OFF	ON	ON										
6	Light green	■	Red	OUT3	*After the external stopper of the actuator is adjusted, when the operation to motor side or end side is commanded without the stroke study, the actuator might not be reached to the stroke ends. In that case, the OUT* output state is kept, and the alarm is not generated. <b><u>Perform the stroke study and register all of the intermediate positions after adjusting the external stopper.</u></b>								
7	Gray	■	Black	BUSY	BUSY signal (Turning on during operating)								

8	Gray	■	Red	ALARM	ALARM signal (N.C.) ALARM output signal turns off during alarm or when the actuator is servo off state. *When stopping by STOP input signal, ALARM output signal turns off								
9	White	■	Black	IN0	<ul style="list-style-type: none"> <li>● The command to drive to intermediate position (Input the position number with the binary by the combination of IN0-IN3) Refer to *1 Ex. Input of position number 5 (Input with the combination of IN0-IN3)</li> </ul> <table border="1" style="margin-left: 40px;"> <tr> <td>IN3</td> <td>IN2</td> <td>IN1</td> <td>IN0</td> </tr> <tr> <td>OFF</td> <td>ON</td> <td>OFF</td> <td>ON</td> </tr> </table> <ul style="list-style-type: none"> <li>● The command to the stroke end of end side (Turn on IN0 only)</li> <li>● The command to the stroke end of motor side (Turn on IN1 only)</li> </ul> <p>*The return to origin: When the power supply is supplied to controller in the state that Stroke study has completed, the return to origin starts in the first turning on of IN0 or IN1. When the power supply is supplied to controller in the state that Stroke study has completed, the first turning on IN□ is canceled (Only IN0 and IN1 are valid).</p>	IN3	IN2	IN1	IN0	OFF	ON	OFF	ON
IN3	IN2	IN1	IN0										
OFF	ON	OFF	ON										
10	White	■	Red	IN1									
11	Light brown	■ ■	Black	IN2									
12	Light brown	■ ■	Red	IN3									
13	Yellow	■ ■	Black	RESET	Reset of driving or alarm reset <u>During driving:</u> The speed is reduced from the point where signal is input until the actuator stops. After stops, the state of motor is kept servo ON. <u>Alarm is generated:</u> Alarm reset								
14	Yellow	■ ■	Red	STOP	STOP command (Stops at rapidly deceleration. After stops, the state of motor changes to servo off.)								

\*Parallel I/O signal is valid in auto mode. STOP signal is valid in auto mode and manual mode.

\*During the Trial run of manual mode, the output signal state is kept when changing to manual mode.

Note1) The following table shows the relation of the position number and the combination of IN0-IN3 or OUT0-OUT3.

○ : OFF   ● : ON

Position number	IN3	IN2	IN1	IN0
1 (End side)	○	○	○	●
2 (Motor side)	○	○	●	○
3	○	○	●	●
4	○	●	○	○
5	○	●	○	●
6	○	●	●	○
7	○	●	●	●
8	●	○	○	○
9	●	○	○	●
10 (A)	●	○	●	○
11 (B)	●	○	●	●
12 (C)	●	●	○	○
13 (D)	●	●	○	●
14 (E)	●	●	●	○

○ : OFF   ● : ON

Position number	OUT3	OUT2	OUT1	OUT0
1 (End side)	○	○	○	●
2 (Motor side)	○	○	●	○
3	○	○	●	●
4	○	●	○	○
5	○	●	○	●
6	○	●	●	○
7	○	●	●	●
8	●	○	○	○
9	●	○	○	●
10 (A)	●	○	●	○
11 (B)	●	○	●	●
12 (C)	●	●	○	○
13 (D)	●	●	○	●
14 (E)	●	●	●	○

**(3)The change of I/O output signal under the condition of controller at auto mode.**

Condition of the controller	Output signal					
	OUT0	OUT1	OUT2	OUT3	BUSY	ALARM
Supply of power	OFF	OFF	OFF	OFF	OFF	OFF
After supplying power and at the stop before returning to origin	OFF	OFF	OFF	OFF	OFF	ON
During the returning to origin and positioning operation.	OFF	OFF	OFF	OFF	ON	ON
When return to origin position is completed.	*1	*1	OFF	OFF	OFF	ON
During the return to origin and positioning operation.	*2	*2	*2	*2	OFF	ON
Stopped by RESET command	OFF	OFF	OFF	OFF	OFF	ON
Stopped by STOP command	*3	*3	*3	*3	OFF	OFF
When alarm is generated	OFF	*4	*4	*4	OFF	OFF

\*1 When the return to origin is commanded by turning on IN0 : OUT0 turns on, OUT1-3 turn off.  
 When the return to origin is commanded by turning on IN1 : OUT1 turns on,  
 OUT0 OUT2 and OUT3 turn off.

\*2 ON/OFF of OUT0 to 3 depends on the target position

\*3 The value is not constant. (This value depends on the state of controller.)

\*4 ON/OFF of OUT0 to 3 depends on the alarm group.

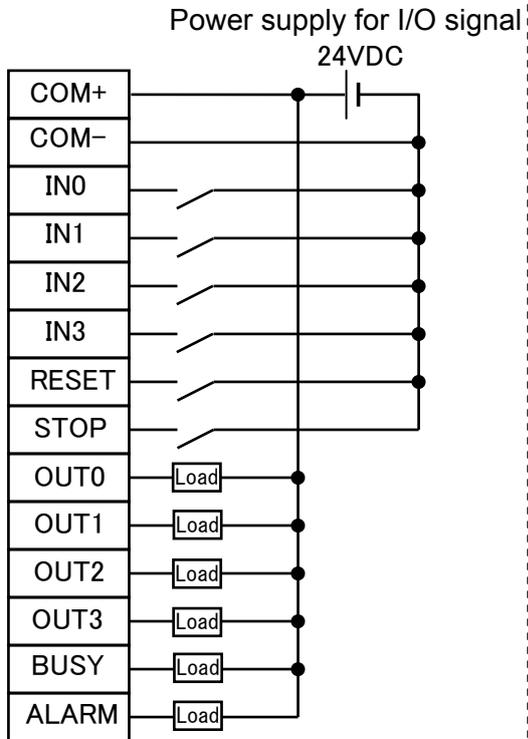
There is no servo ON signal with this controller. The servo turns off when conditions to turn off the servo are satisfied. Refer to **11.3 Servo ON** for details.

 <b>Caution</b>
<ul style="list-style-type: none"> <li>● Signal is not output from I/O right after switching from manual mode to auto mode. Output from I/O is made after the next input of operation command.</li> <li>● Output from I/O is not made if switching from auto mode to manual mode.</li> <li>● When changing from manual mode to auto mode, the output signal in parallel I/O is not output. After inputting the driving command (IN0-IN3), the output signal in parallel I/O is output.</li> <li>● When changing from auto mode to manual mode, the output signal state is kept.</li> </ul>

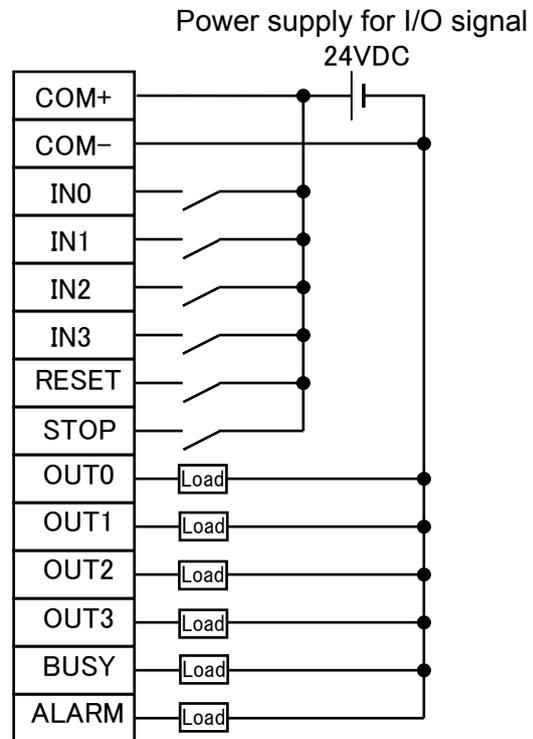
## 6.4 Parallel I/O connector CN4 wiring (Example)

Use an I/O cable (LEC-CK4-□) when connecting to PLC and CN4 parallel I/O connectors. Wiring depends on the parallel input/output of the controller (NPN, PNP type). Please wire the product referring to the wiring diagram,

### ■ NPN TYPE



### ■ PNP TYPE



### ⚠ Caution

Prepare separate 24VDC power supplies for the CN1 controller input power supply and CN4 input / output signal power supply.

## 7. Function

### 7.1 Mode

This controller has 2 modes (Manual mode and Auto mode).  
In each mode, basically available operations are shown in the following.

**Manual mode:** Registering the stop position, setting parameter.

**Auto mode:** Operating by PLC etc. through CN4 parallel I/O.

#### (1) Switching the mode

The mode is switched by moving Mode switch (e).

Manual mode: Moves to upper side (M) in the figure.

Auto mode : Moves to lower side (A) in the figure.

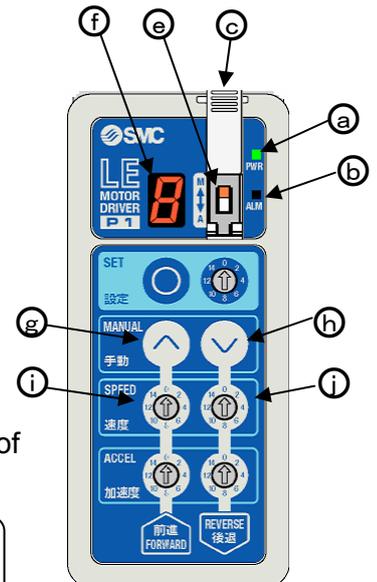
The display at auto mode:

"-" or the position number that is commanded through IN0-IN3 of CN4 parallel I/O is displayed in 7 segments LED (f).

When driving : Displayed in flashing state.  
When driving is completed: Displayed in no-flashing state.

\* When the button or switch on the controller is operated in auto mode,,

**"L" is displayed with flashing** in 7 segments LED (f).



### ⚠ Caution

Close the cover (c) after the switching the mode to avoid unexpected mode changes.

#### (2) Difference according to mode

	Manual mode(M)	Auto mode(A)
Setting of stop position (step data)	O	X
Stroke study	O	X
Setting of Speed and Acceleration	O	Δ (Only in speed adjustment)*1
Setting of operation method	O	X
Setting parameters	O	X
Driving the actuator with using the button on the controller	O	X
<u>Driving the actuator through parallel I/O</u>	<u>X</u>	<u>O</u>
Positioning driving (In LECP2, pushing is not available )	O	O
Trial run	O	X
Check of the alarm by ALM LED	O	O
Check of the alarm group by 7 segments LEDs	O	O
How to reset the alarm	Push set button (g)	Turn on RESET or push Set button (g)
How to change to servo off state	Push Forward button (i) and Reverse button (j) simultaneously for 3 sec.	Turn on STOP

\*1 Refer to **9. Setting of the speed and the acceleration** for details of the adjustment of the speed in the auto mode.

## 7.2 Stroke study

This controller can learn the stroke ends by “Stroke study” automatically.

In the following cases, please perform “Stroke study”.

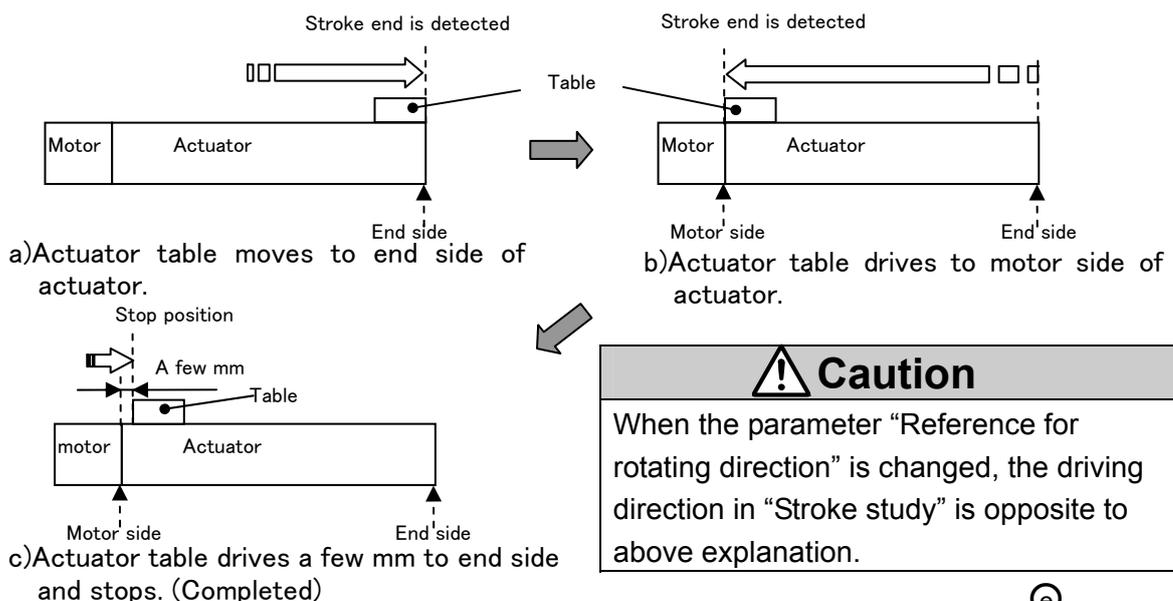
- When using the controller for the first time after it is delivered.
- When changing the connecting actuator.
- When changing the movable range by adjusting the external stopper.

- \*When the power supply is supplied to the controller just after it is delivered, ALM LED of the controller flashes in red because Stroke study is not completed. The stroke study must be performed.
- \*After the external stopper of the actuator is adjusted, when operation to motor side or end side is commanded without the stroke study, the actuator might not be reached to the stroke ends.
- \*After the external stopper of the actuator is adjusted, when the driving to motor side or end side is commanded without the stroke study, the actuator might hit the stroke ends or external stopper, and the actuator might be broken.

### (1) Movement of Stroke study

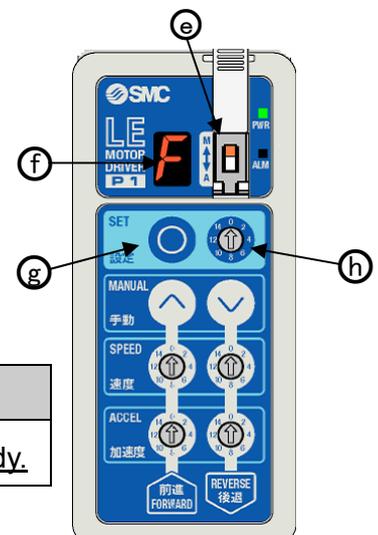
When “Stroke study” is performed, the actuator drives to the end side and the motor side, and detects the stroke ends of actuator.

The positions of stroke ends are registered in the controller by this process.



### (2) Procedure of Stroke study

- Switch to manual mode ("M" side) by Mode switch (e)
- Rotate Position switch (h) to "15". LED (f) displays "F" with flashing.
- Push Set button (g) and keeps pushing 3 seconds or more.  
Stroke study is started.
- When the display "F" in LED (f) is changed from flashing state to no-flashing state, Stroke study is completed.



### Caution

Register all of the intermediate positions again after performing Stroke study.

## 7.3 Trial run

The registered position in each position number can be tested by Trial run.

### (1) Movement at Trial run

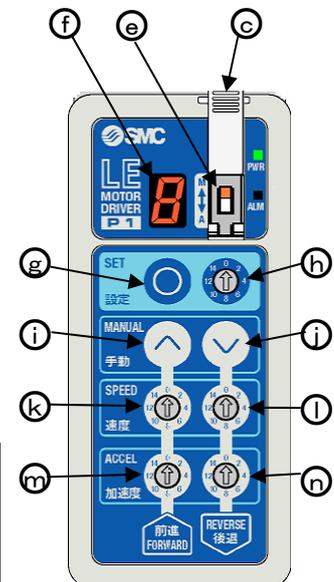
In manual mode, the actuator table moves to the registered position in commanded position number with using button and switch on the controller.

### (2) Procedure of Trial run

- Switch to manual mode ("M" side) by Mode switch **(e)**
- Change Position switch **(h)** to the position number which want to confirm the registration position.  
The set positional number displays in LED **(f)** by flashing.
- Push Set button and the actuator moves to the registered position.
- When the display in LED **(f)** is changed from flashing state to no-flashing state, Trial run is completed.

The state of each item during Trial run is shown in the following.

Item	The state in Trial run
Input of CN4 parallel I/O	Disable
Output of CN4 parallel I/O	The output state when switching to manual mode is kept
The display of LED <b>(f)</b>	<p><u>Before Trial run:</u> The position number flashes.</p> <p><u>During Trial run:</u> “-” flashes.</p> <p><u>After completion of Trial run:</u> The position number displays in no-flashing.</p>
Adjusting speed and acceleration	Possible by using <b>(k)</b> - <b>(n)</b>



## 7.4 Jog and Inching

Jog and Inching can be operated in manual mode.

### (1) Jog and Inching operation

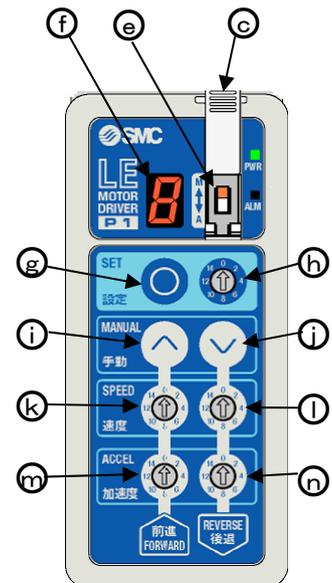
**Inching:** The driving that moves to set distance in commanded direction and stops, when pushing the button once.

**Jog**: The driving that moves to commanded direction during pushing the button and stops when releasing the button.

### (2) Procedure of Jog and Inching

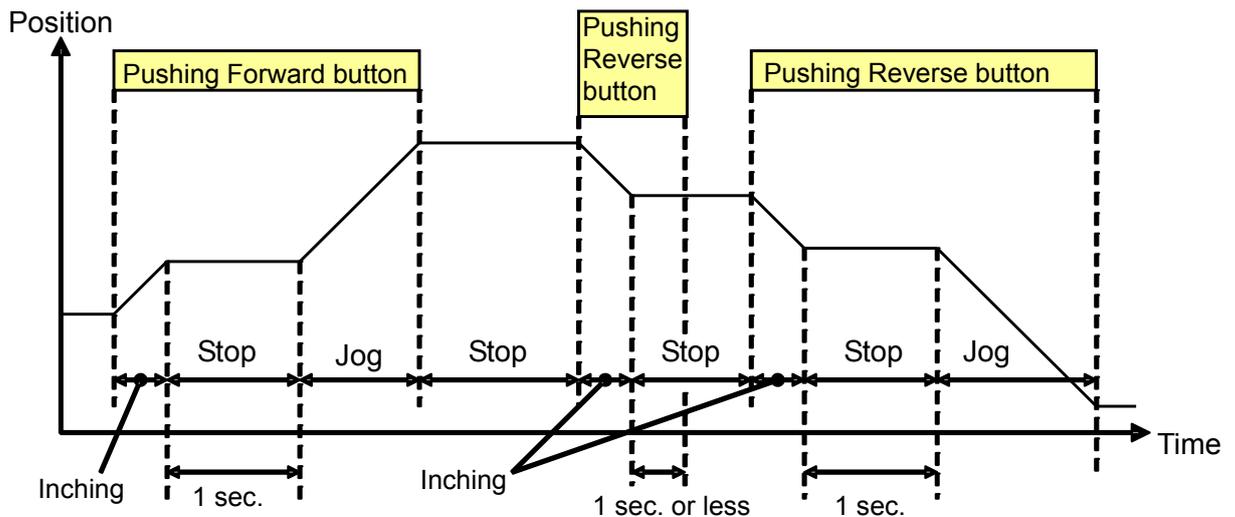
#### Inching

- Switch to manual mode ("M" side) by Mode switch (e).
- Push Forward button (i) or Reverse button (j) for a second or less.  
The actuator drives the set distance in commanded direction and stops.



#### Jog

- Switch to manual mode ("M" side) by Mode switch (e).
- Keep pushing Forward button (i) or Reverse button (j) for a second or more after completion of Inching. After that Jog starts. When release the button, it stops.



### ! Caution

- The driven distance and the speed when Inching, and the speed when Jog are different in each actuator. Refer to **13. Initial setting value for each actuator** for details.
- The driven distance and the speed when Inching, and the speed when Jog can be change by the parameter. Refer to **10. How to set the parameter** for details.

## 8. Registering of the intermediate position

For driving the actuator to commanded position, it is necessary to register the stop position to the specified position number with the button and the switch on the controller. The registered position is saved in the memory of the controller.

### 8.1 How to register the intermediate position

This controller can register intermediate position in 12 points.

The position number is switched to 3-14 with Position switch, and it is displayed to 3-9 and A-E by the hexadecimal number in LED.

\*The stop position cannot be registered into the position number "1" and "2".

### 8.2 Procedure of registering the intermediate position

Procedure of registering the intermediate position is shown in the following

(1) Supply of the power supply

(2) Switching to Manual mode

(3) Return to origin

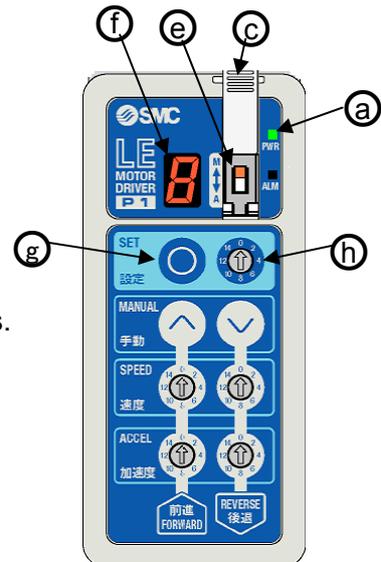
(4) Registering the position

(6) Trial run

(7) Setting the speed/acceleration

(8) Completed

Repeat the same procedure for all intermediate positions.



#### (1) Supplying the power supply

Supplies the 24VDC power supply to the controller for the power line and the signal line. After supplying the power supply, confirm that the power supply LED (a) lights in green (=Servo ON). Refer to **11.3 Servo ON**, if the power supply LED (a) flashes in green.

#### (2) Switching to Manual mode

Switches to manual mode (M) by Mode switch (e).

In manual mode, LED (f) displays the position number of Position switch (h) with flashing.

#### (3) Return to origin

Change Position switch (h) to "1" or "2". Confirms that LED (f) display "1" or "2" and push the set button to start the return to origin (When Position switch (h) is "1": Returns to end side, When Position switch (h) is "2": Returns to motor side).

During returning to origin, LED (f) display "F" with flashing.

When the return to origin is completed, the display of LED (f) changes from flashing state to no-flashing state.

### ⚠ Caution

- When you perform return to origin before the servo on state(PWR LED (a) lights in green), an alarm is generated. Perform the return to origin after confirming the servo on state.
- Refer to **11.1 Return to origin** for details of the return to origin.

#### (4) Registering the position

In the manual mode after returning to origin, the position can be registered by the following 2 methods.

##### (A) Registering by Jog / inching

This is the method to register the intermediate position by moving the actuator with Jog/inching.

##### (B) Registering by Direct teaching

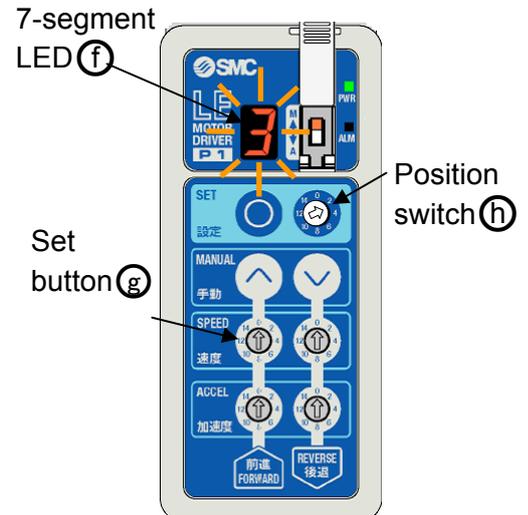
This is the method to register the intermediate position by moving the actuator with the hand.

##### (A) Registering by Jog / inching

\*The following figures are example for registering the position into the position number 3.

[1] Switch Position switch (h) to the position number to register ("3" is in this example). LED (f) displays the position number.

\*The position can not be registered into the position number "0", "1", "2" and "F(15)".



[2] When LED[PWR] (a) is ON, push Set button (g).

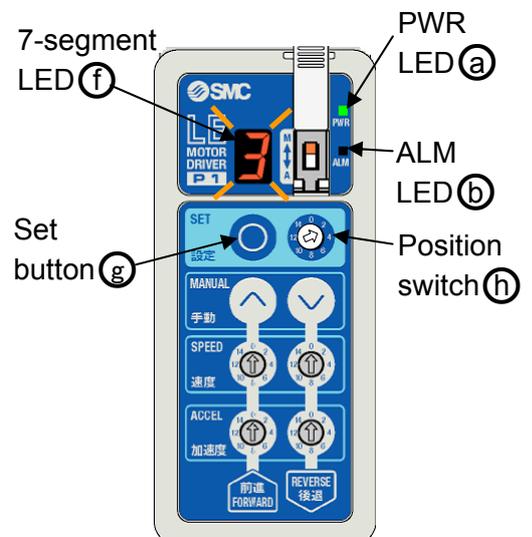
The actuator drives to the originally registered position in the commanded position number.

When completing, the display of LED (f) change from flashing state to no-flashing state.

Then, keep pushing Set button (g) until LED (f) displays with flashing.

\*The actuator stops on the way when Set button (g) is pushed during driving the actuator.

Then, when Set button (g) is pushed again, the actuator drives to the originally registered position.



### ⚠ Caution

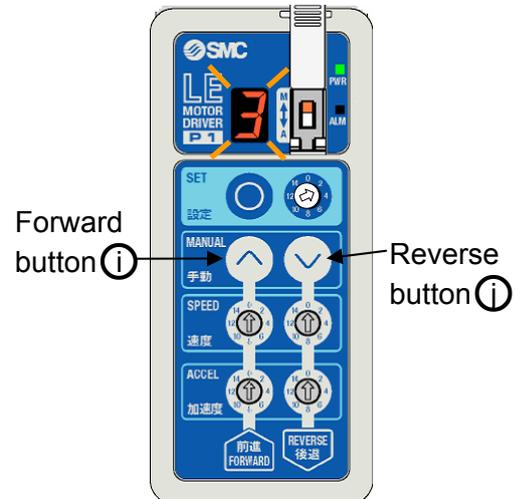
- When procedure [2] is performed before the return to origin is not completed, the driving command is canceled and the actuator does not drive. In this case, perform the return to origin according to above (3).
- When the actuator cannot drive to the originally registered position due to the mechanical interference, registers the position by (B)Direct teaching.

[3] Drives to the position to register by using Forward button (i) or Reverse button (i).

\*Inching starts by pushing Forward button (i) or Reverse button (i) for 1 second or less.

\*Jog starts by keeping pushing Forward button (i) or Reverse button (i) for 1 second or more.

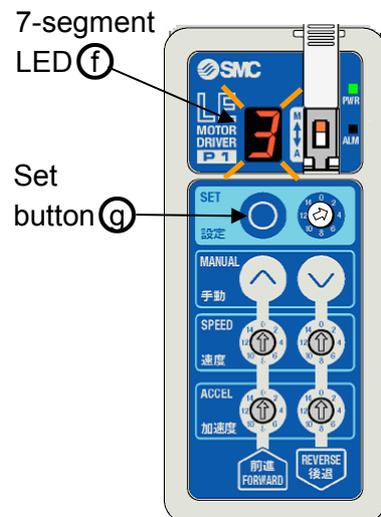
\*Refer to **7.4 Jog and Inching** for details of Jog and Inching.



[4] Keep pushing Set button (g) until the display of LED (f) changes from flashing state to no-flashing state.

When LED (f) is in no-flashing state, the position is registered.

Then, when releasing the Set button, LED (f) flashes again.



Registering the position by jog / inching is completed.  
Do the same procedure for other position numbers.

### **Caution**

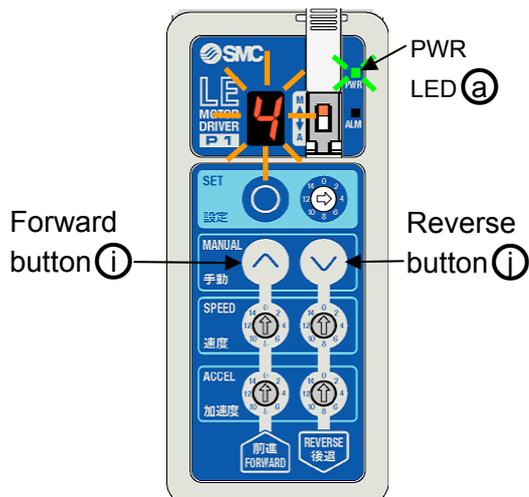
- When performing Jog / Inching in the servo off state (Power supply LED (a) flashes), alarm "C" is generated. Perform Jog / Inching after the servo on state (Power supply LED (a) lights in green).

**(B) Registering by Direct teaching**

\*The following figures are example for registering the position into the position number 4.

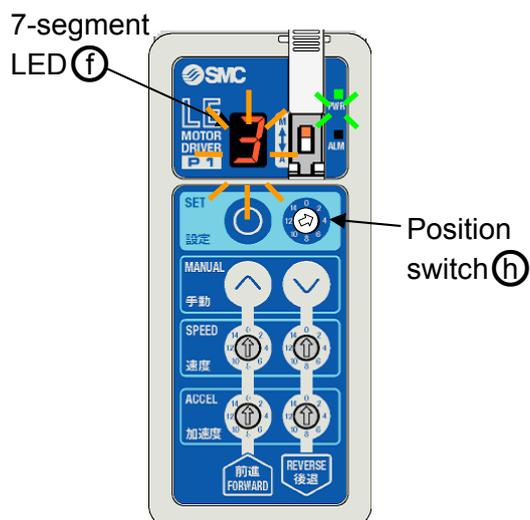
[1] Push the Forward button (i) and Reverse button (i) simultaneously for 3 sec or more until the power supply LED flashes.

\*When the power supply LED (a) flashes, actuator is in the servo off state.

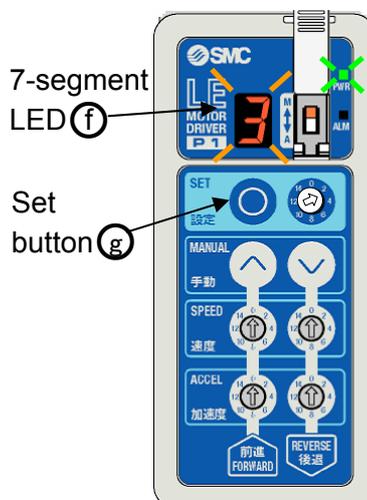


[2] Switch Position switch (h) to the position number to register ("3" is in this case). LED (f) displays the position number in no-flashing state.

\* The position can not be registered into the position number "0", "1", "2" or "F(15)".



[3] Keep pushing Set button (g) until the display of LED (f) flashes.



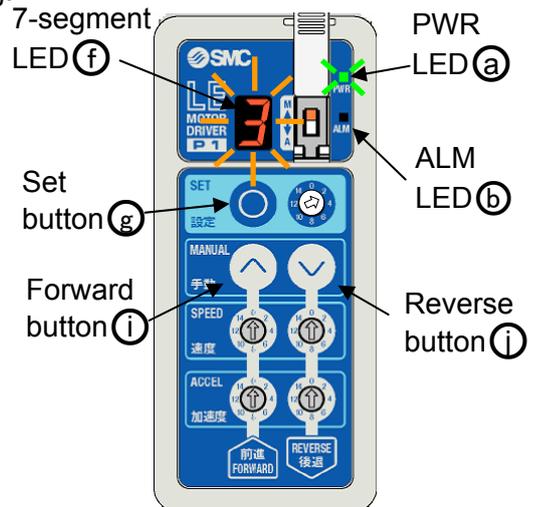
[4] Move the actuator to the position to register with external force.

\*In the case of low lead screws, the actuator may not be moved by external force although in the servo off state. Register the position by (A) jog / inching.

[5] Keep pushing Set button (g) until the display of LED (f) changes from flashing state to no-flashing state.

Then, when releasing the Set button (g), LED (f) flashes again.

\*When procedure [5] is performed before the return to origin is not completed, the alarm "A" is generated and ALM LED (b) lights in red. In this case, reset the alarm by pushing Set button (g) and perform the return to origin.



[6] Keep pushing Forward button (i) and Reverse button (i) simultaneously until the display of LED (f) changes from flashing state to no-flashing state.

Registering the position by Direct teaching is completed.

Do the same procedure for other position numbers.

### Caution

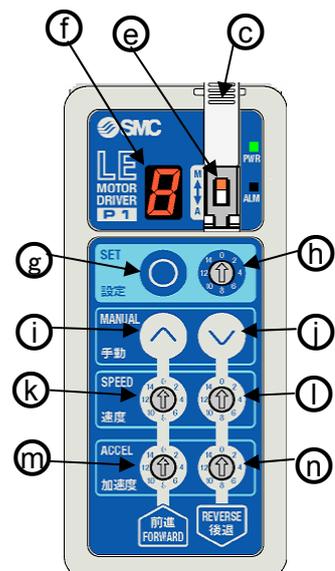
● In the case of low lead screw, the actuator may not be moved by external force although in the servo off state. Register the position by (A) jog / inching.

### (5) Trial run

Confirm the registered position by using the controller buttons and the switches.

Procedure of Trial run is shown in the following.

- Change Position switch (h) to the position number to check. LED (f) displays the position number with flashing.
- Pushes Set button (g). When the display of LED (f) changes from flashing state to no-flashing state, the driving to the registered position is completed.



### (6) Setting of the Speed and the Acceleration

Set the speed and the acceleration by using switch (k)-(n) in each driving direction. The switch can be set in 16 steps. Actual value depends on the actuator. Refer to **13. Initial setting value for each actuator** for details of setting the speed and the acceleration. The set speed and acceleration can be checked by Trial run.

### (7) The setting is completed

After the setting is completed, the actuator is operated with PLC etc. **in auto mode**.

Refer to **12. How to command to drive** for operation by PLC etc.

### Caution

Close the cover (c) to avoid unexpected mode changing after changing the mode.

## 9. Setting of the speed and the acceleration

The speed and the acceleration can be set by using switch (k)-(n) in each driving direction.

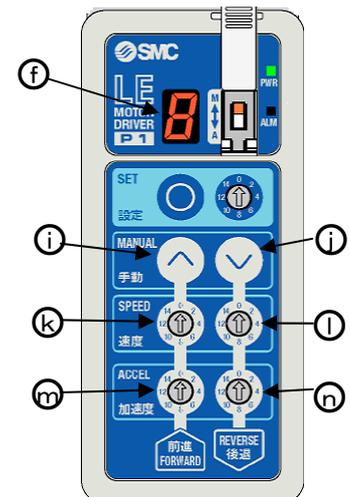
This setting of speed and acceleration applies to the driving of all position number.

\*The speed and acceleration cannot be set in each position number respectively.

### 9.1 How to set the speed and the acceleration

According to the mode, the setting procedure of the speed and the acceleration is different. And the application of the function of changed setting is different.

The difference in the setting of the speed and the acceleration according to the mode is shown in the table below.



<u>The setting of the speed and the acceleration.</u>	Manual mode(M)	Auto mode(A)
<b>Setting procedure</b>	Change the switch (k)-(n)	a) Keep pushing Forward button (j) and Reverse button (l) for 3 seconds or more. b) Changing the switch (k)-(n) when LED (f) displays “.”(Dot).
<b>Controller state of when it is possible to set</b>	Always (It is required that the stroke study has been completed.)	When LED (f) displays “.”(Dot).
<b>Set value</b>	<u>16 phases of speed and acceleration can be set</u> The set value of the speed and the acceleration are different according to the actuator. Refer to <b>13. Initial setting value for each actuator</b> for details.	
<b>The timing that the set speed and acceleration are applied</b>	<u>Applied when actuator is stopping</u> * Not applied when actuator is driving. Applied after actuator stops.	
<b>Function that the set speed and the acceleration are applied</b>	Trial run	Driving through CN4 parallel I/O

## 10. How to set the parameter

In the manual mode, the parameter can be set.

The parameters that can be set are shown in the table below.

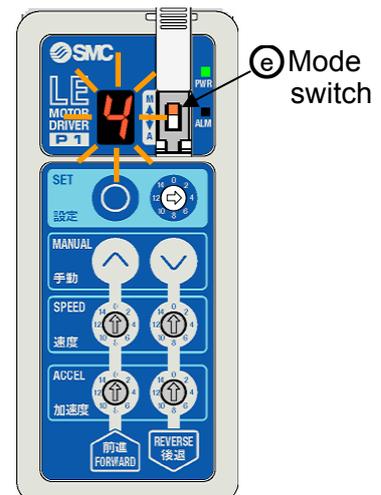
Description of parameters	Number of parameters	Value and the content of parameters
Reference for rotating direction	1	Change the direction of Forward and Reverse. 1: CW+ (Default value of LEM series at the time of shipment) 2: CCW+
Jog speed level	2	Adjust the jog speed 1: Multiplier=1 (Default value at the time of shipment) 2: Multiplier=2 3: Multiplier=3      Jog speed 4: Multiplier=4      =(Reference value per actuator)×(Multiplier)
Inching level	3	Adjust the inching distance 1: Multiplier=1 (Default value at the time of shipment) 2: Multiplier=2 3: Multiplier=3      Inching distance 4: Multiplier=4      =(Reference value per actuator)×(Multiplier)

### 10.1 Procedure to set the parameters

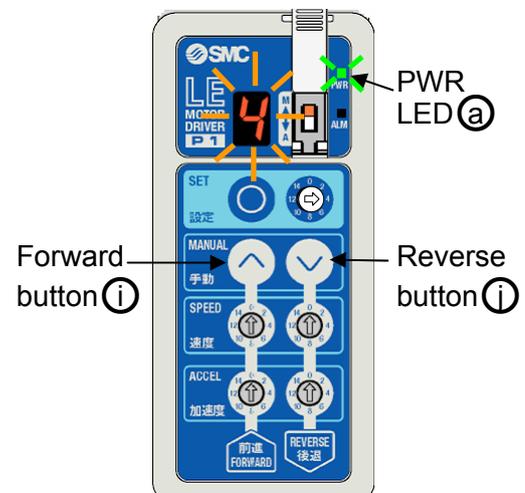
The procedure to set the parameters is shown below.

\*The following figures are example for setting the set value of the parameter "Jog speed level" to "3".

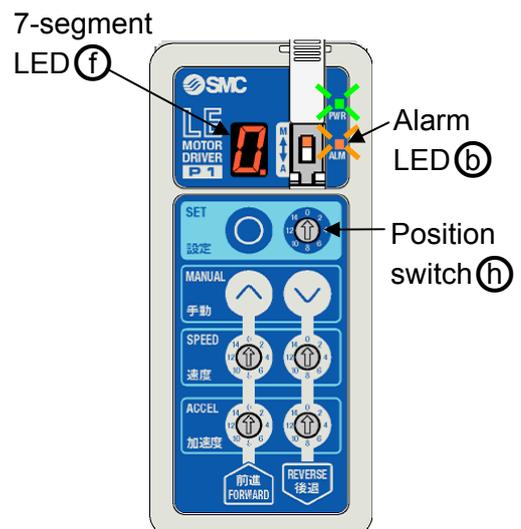
(1) Switch to manual mode (M) by Mode switch **e**.



(2) Keep pushing Forward button **i** and Reverse button **j** simultaneously until PWR LED **a** flashes (for 3 seconds or more).



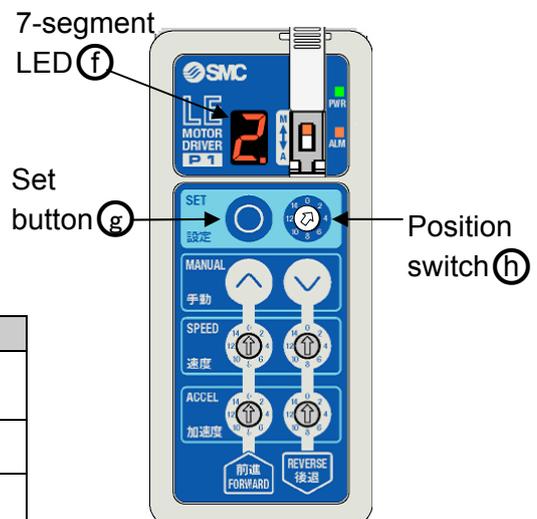
- (3) Switch Position switch (h) to "0" and keep pushing Set button (g) until Alarm LED (b) flashes (for 3 seconds or more).  
LED (f) displays "0."(Zero with a dot).



- (4) Switch Position switch (h) to the parameter number ("2" is in this example); LED (f) displays the parameter number with a dot.

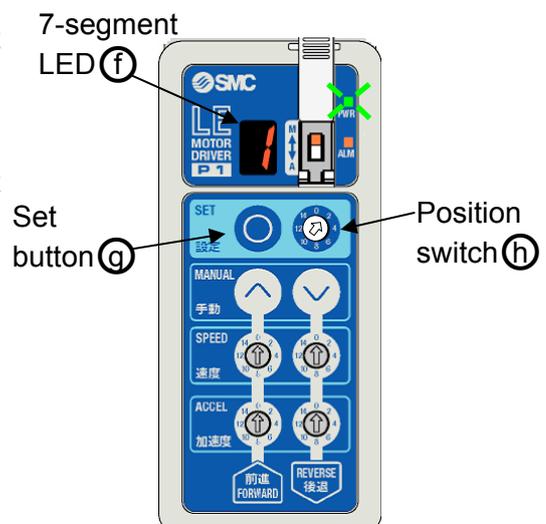
\*Refer to the previous page for the details of the parameters.

No.	Description	Function
1	Reference for rotating direction	Changing the direction of Forward / Reverse.
2	Jog speed level	Adjust the jog speed
3	Inching level	Adjustment of inching



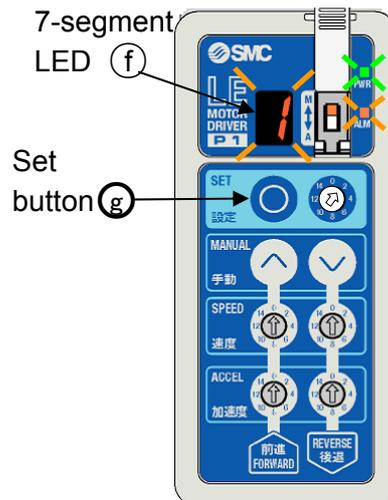
- (5) Push Set button (g). The LED (f) displays the set value of the parameter without a dot.

\*When Position switch (h) is changed at this time, it returns to procedure (4).



(6) Push Set button **(g)** until LED **(f)** flashes (for 2 seconds or more).

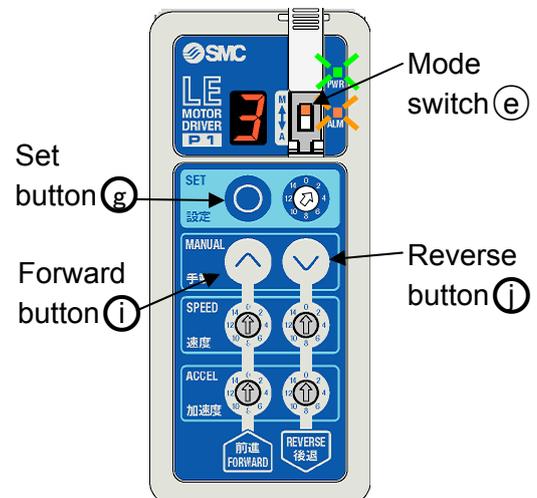
When LED **(f)** flashes, the set value of the parameter can be changed.



(7) Push Forward button **(i)** or Reverse button **(j)** to change the set value of the parameter ("3" is in this example).

Keep pushing Set button **(g)** until the display of LED **(f)** changes from flashing state to no-flashing state (for 2 seconds or more).

When the display of LED **(f)** is no-flashing state, the set value is registered into the controller.



\*The changed parameter is applied after the power supply for the controller is re-supplied.

The parameter setting is completed.

When set the other parameter, repeat the procedure of (4) to (7).

### ⚠ Caution

- The changed parameter is applied after the power supply for the controller is re-supplied.
- Refer to **13. Initial setting value for each actuator** for the default value of the direction Forward / Reverse and the reference value of jog speed and the inching distance.
- When "Reference for rotating direction" is changed, the direction of the setting of the speed and the acceleration is changed. Change the setting of the speed and the acceleration also.

# 11. Operations

## 11.1 Return to origin

It is necessary for this controller to perform the return to origin after the power supply to the controller. The stroke end is recognized by the return to origin, and then the actuator can be driven.

### (1) Movement of the return to origin.

When the power supply is supplied to controller in the state that Stroke study has completed, the return to origin starts in the first turning on of IN0 or IN1.

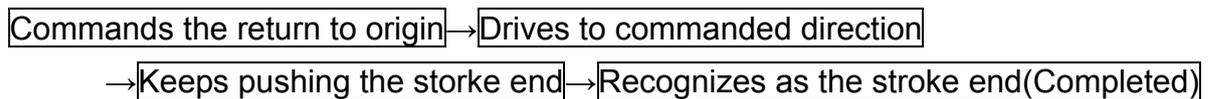
The actuator drives to commanded direction.

After that, the actuator keeps pushing the stroke end.

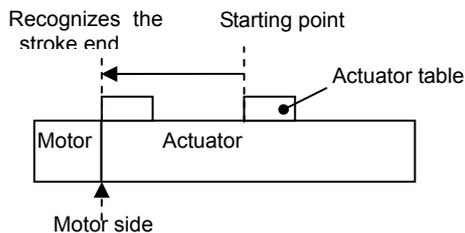
When the actuator keeps pushing the stroke end for several seconds, the controller recognizes the current position as the stroke end and the return to origin is completed.

\*The stop position in all position numbers doesn't change regardless of the direction of the return to origin.

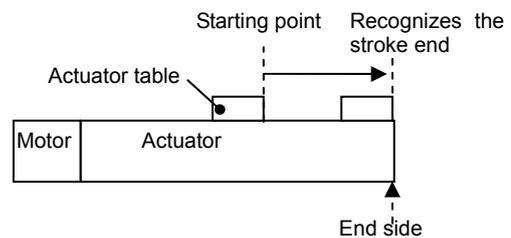
\*The speed of the return to origin depends on the actuator. Refer to **13. Initial setting value for each actuator** for the default setting of the return to origin.



The return to origin commanded to motor side



The return to origin commanded to end side



### (2) How to command the return to origin

Only when the following conditions are met, the return to origin can be commanded.

- The stroke study has been completed.
- After the power supply is supplied to controller, the first command is to drive to the stroke end.

#### In the manual mode:

- Supply the power supply to the controller.
- Switch the position switch (h) to "1" or "2", and push Set button (g).

During returning to origin, LED (f) displays "F" with flashing.

- When the return to origin is commanded by position number "1":  
Actuator drives to end side for the return to origin.
- When the return to origin is commanded by position number "2":  
Actuator drives to motor side for the return to origin.

- When the return to origin is completed, the display of LED (f) changes from flashing state to no-flashing state.

### In the auto mode:

- a) Supply the power supply to the controller.
- b) Turn on IN0 or IN1 input in CN4 parallel I/O.

During returning to origin, LED (f) displays "F" with flashing.

- |   |   |
|---|---|
| { | When the return to origin is commanded by turning on IN0: |
|   | Actuator drives to end side for the return to origin.     |
|   | When the return to origin is commanded by turning on IN1: |
|   | Actuator drives to motor side for the return to origin.   |

- c) When the return to origin is completed, OUT0 or OUT1 output turns on.

- |   |   |
|---|---|
| { | When the return to origin is commanded by turning on IN0: |
|   | OUT0 output turns on. OUT1-3 output turns off.            |
|   | When the return to origin is commanded by turning on IN1: |
|   | OUT1 output turns on. OUT0, OUT2-3 output turns off.      |

- \* When the power supply is supplied to controller, only "Stroke study" and "The command to stroke end(The return to origin)" is valid in the first command to drive.
- \*When the power supply is supplied to controller in the state that Stroke study has completed, the first turning on IN□ is canceled (Only IN0 and IN1 are valid).
- \*After performing Stroke study, the positioning operation can be commanded.
- By performing Stroke study, the return to origin is completed simultaneously.

## 11.2 Positioning

### (1) Movement of the positioning drive

The actuator accelerates up to the set speed by set acceleration in each driving direction.

It drives in the constant velocity when becoming the set speed.

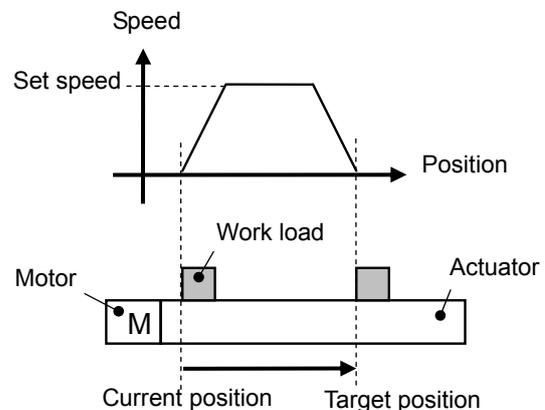
After that, it decelerates by set acceleration in each driving direction, and stops in the target position.

### (2) How to command the positioning drive

When the return to origin is completed, the positioning drive can be commanded.

How to command the positioning drive is shown in the following in each mode

### Ex. Positioning



\*The speed wave in the chart above is simplified.

### In the manual mode:

The positioning drive can be commanded in Trial run function

Refer to **7.3 Trial mode** for details of how to command the positioning drive in Trial run function.

### In the auto mode:

The positioning drive can be commanded through CN4 parallel I/O.

Refer to **12.2 (2) Positioning [Driving to the stroke end] and [Driving to the intermediate position]** for detail of how to command the positioning drive through CN4 parallel I/O.

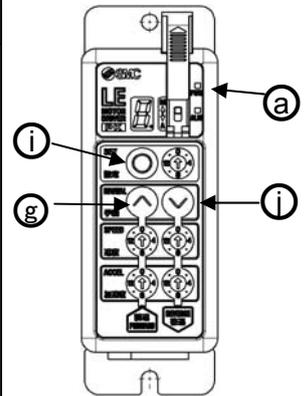
### 11.3 Servo ON

Servo ON signal is not assigned to the parallel I/O of this controller. When the power supply is supplied to controller, “Servo on” is automatically commanded in the controller. At this time, when the alarm is not generated, the actuator becomes the servo on state after a few seconds.

When the actuator becomes the servo on state normally, LED[PWR] (a) changes from flashing state to no-flashing state.

The table below shows conditions for becoming servo off state.

	Conditions for becoming servo off state.	Indication when servo OFF
Manual mode	<p><b>a) In the alarm state.</b>            It returns to servo on state when the alarm is reset by pushing Set button (g).</p> <p><b>b) In the switch operation.</b>            When pushing Forward button (i) and Reverse button (i) simultaneously for 3sec or more, the actuator becomes servo off state.            It returns to servo on state when pushing again Forward button and Reverse button simultaneously for 3sec or more.</p>	LED [PWR] (a): flashing ALARM output signal: OFF
Auto mode	<p><b>a) In the alarm state.</b>            It returns to servo on state when RESET input signal turns on.</p> <p><b>b) In turning on STOP input signal.</b>            It returns to servo on state when STOP input signal turns off.</p>	LED [PWR] (a): flashing

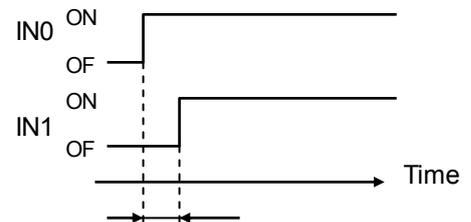


### 11.4 Response time for the controller input signal

Response delay due to the controller input signal contains following factors.

- (1) Controller input signal scan delay
- (2) Delay due to input signal analysis
- (3) Delay of command analysis

Process delay of PLC or scanning delay of the controller may occur. Keep the input signal combination for 15ms or longer (the recommendation is 30ms). Initialize the input signal conditioning the response signal to the input signal.



If the time difference is large, only IN0 input is recognized.

When one command is made by inputting several input signal simultaneously, time difference between signals has to be 3ms or less. If the time difference is longer than 3ms, it is recognized as another signal and starts the operation. For example, when IN0 and IN1 are commanded to drive to ON(position number 3) simultaneously and the time difference between them is large, only the first command is recognized (Only IN0 input is recognized).

## 12. How to command to drive

### 12.1 Outline

#### (1) The return to origin

When the power supply is supplied to controller in the state that Stroke study has completed, the return to origin starts in the first turning on of IN0 or IN1.

The actuator performs the return to origin to commanded direction with proper speed and proper acceleration for each actuator.

#### (2) The command to drive to the stroke end and the intermediate position.

##### a) The command to drive to the stroke end:

After registering the stroke end into the position number 1 and 2 in this controller by Stroke study, the actuator drives to the registered position in the position number by the set speed and set acceleration when commanding the position number(1 or 2) through CN4 parallel I/O.

##### b) The command to drive to the intermediate position:

After registering the stop position into the position number(3-14) in this controller, the actuator drives to the registered position in the position number by the set speed and set acceleration when commanding the position number(3-14) through CN4 parallel I/O.

#### (3) The command to stop

##### a) Reset of driving

During driving, when turning on the RESET input signal, the actuator decelerates on the way of driving and keeps stopping at the servo on state.

##### b) Stopping with STOP input signal

During driving, when turning on the STOP input signal, the actuator decelerates rapidly on the way of driving and stops. Then the actuator change to the servo off state.

## 12.2 Procedure of commanding to drive through CN4 parallel I/O

Refer to the following "Procedure" and "Timing chart" for procedure of commanding to drive.

#### (1) "Supplies the power supply" – "The return to origin"

##### -Procedure-

a) Supplies the power supply to the controller.

↓  
b) "Servo on" is automatically commanded in the controller.

When the actuator becomes servo-on state normally, ALARM output signal turns on.

\*The time that the actuator becomes servo-on state is different by the actuator kind and by the condition used.

\*In the case of the actuator with the lock, the lock is released.

↓  
c) Turn on IN0 or IN1 input signal.

↓  
d) BUSY output signal turns on.(The actuator starts to drive.)

\*The actuator performs the return to origin to commanded direction with proper speed and proper acceleration for each actuator.

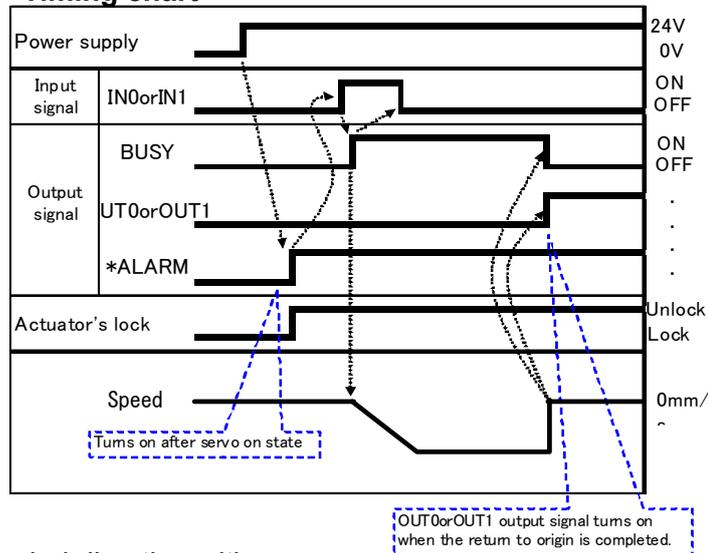
↓  
e) BUSY output signal turns off.(The actuator stops.)

OUT0 output signal turns on when turning on IN0 input signal.

OUT1 output signal turns on when turning on IN1 input signal.

↓  
f) The return to origin is completed.

##### -Timing chart-



**(2) Positioning [Driving to the stroke end] and [Driving to the intermediate position]**

**-Procedure- [Driving to the stroke end]**

a) Turn on IN0(To end side) or IN1(To motor side) input signal.

↓

b) BUSY output signal turns on.(Starts to drive to stroke end)

↓

c) From a few mm of stroke end,  
 OUT0 output signal turns on when turning on IN0 input signal.  
 OUT1 output signal turns on when turning on IN1 input signal.

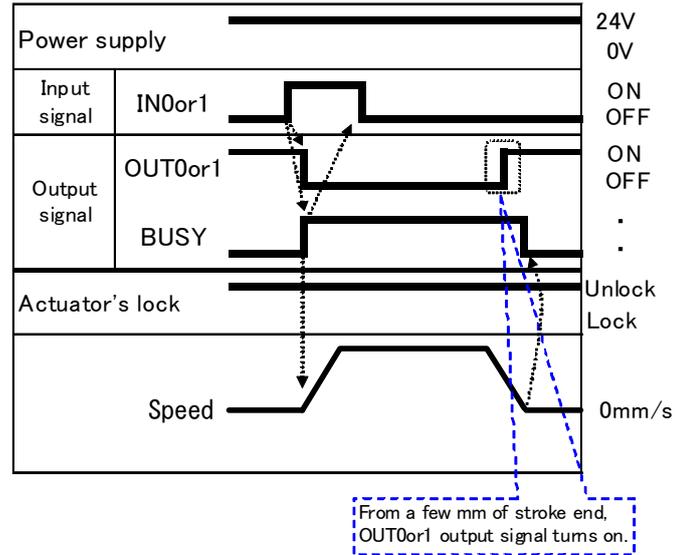
↓

d) BUSY output turns off. (The actuator stops.)  
 \*After OUT0 or OUT1 output turns on, the actuator drives to the stroke end and stops. Then, BUSY output turns off.

↓

e) Driving to the stroke end is completed

**-Timing chart- [Driving to the stroke end]**



**-Procedure-[Driving to the intermediate position]**

a) Turn on IN0-IN3 input signals.  
 (Inputs the position number with the binary by the combination of IN0-IN3)

↓

b) BUSY output turns on.(The actuator starts to drive)

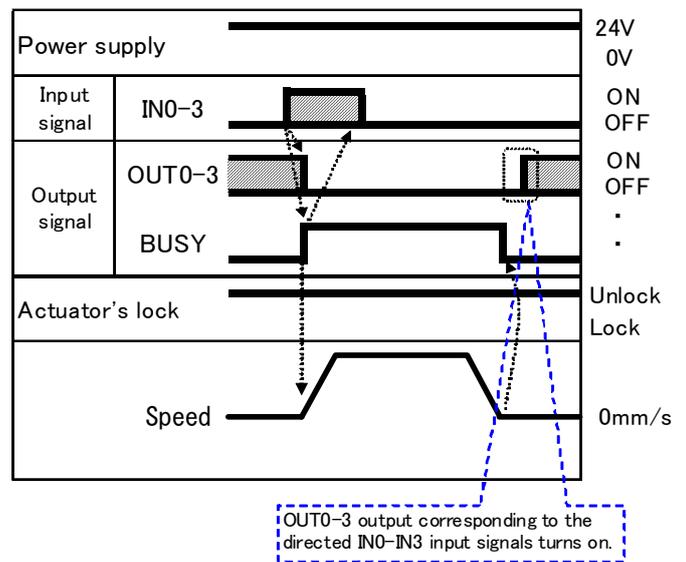
↓

c) BUSY output turns off. (The actuator stops)  
 \*OUT0-3 outputs corresponding to the commanded IN0-IN3 input signals turns on.

↓

d) Driving to the intermediate position is completed.

**-Timing chart-[Driving to the intermediate position]**



### (3) Reset [Reset of the driving] and [Reset of the alarm]

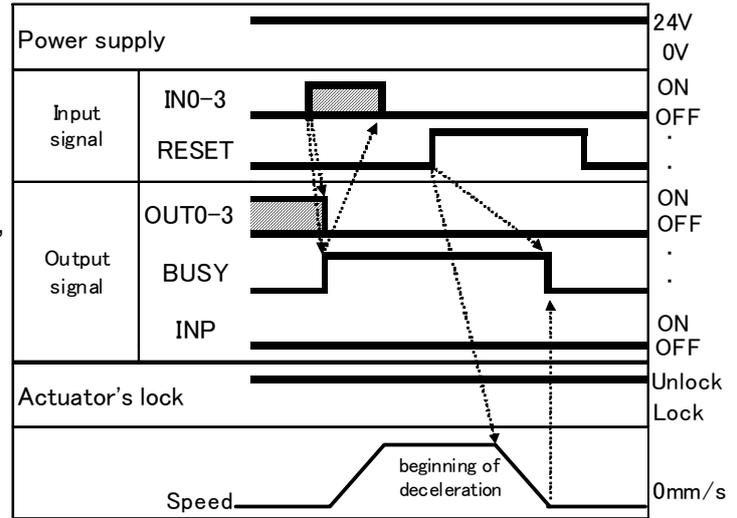
#### -Procedure- [Reset of the driving]

##### “Reset of driving”:

The stop that cancels the command to drive and stops after decelerating when driving through IN0-IN3 input signal.

- a) During driving(While BUSY output is turning on), turn on RESET input
- ↓
- b) BUSY output turns off.  
(The actuator stops)  
All of OUT0-OUT3 outputs turn off.

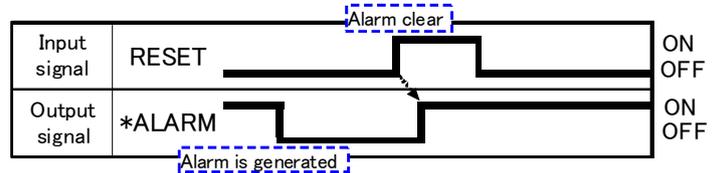
#### -Timing chart- [Reset of the driving]



#### -Procedure-[Reset of the alarm]

- a) The alarm is generated.  
ALARM output turns off.  
OUT-OUT3 output turns off.  
(Outputs the alarm group)
- ↓
- b) Turns on RESET input.
- ↓
- c) When the alarm is reset, ALARM output turns on.  
Moreover all of OUT0-OUT3 turns off.

#### -Timing chart- Reset of the alarm(Alarm clear)

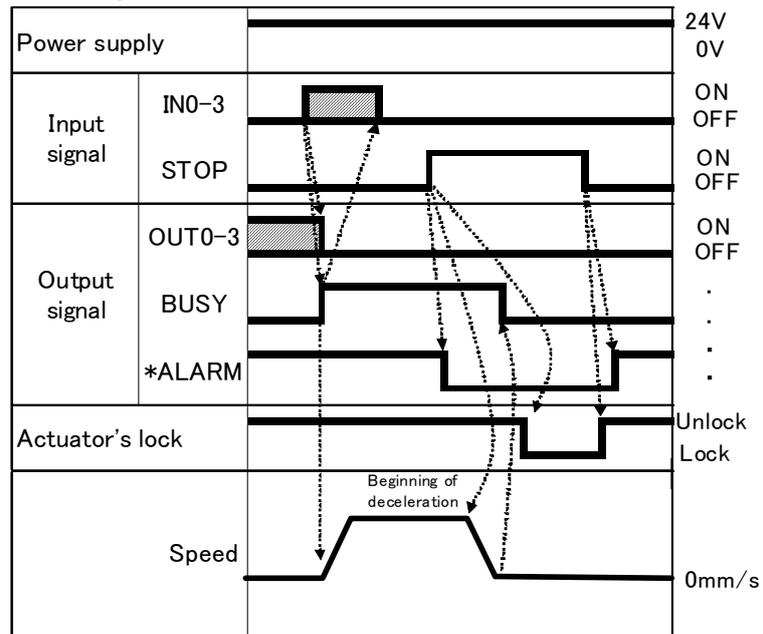


### (4) The stop by STOP input (The stop that becomes servo off state after stopping)

#### -Procedure-

- a) During driving (While BUSY output is turning on), turn on STOP input
- ↓
- b) ALARM output turns off.
- ↓
- c) BUSY output turns off. (The actuator stops)
- ↓
- d) The actuator becomes servo off state.  
(The shaft of the motor becomes a free state.)  
\*When the actuator with the lock is used, the actuator is locked
- ↓
- e) Turn off STOP input.  
(Clear of the stop command)
- ↓
- f) ALARM output turns on.  
The actuator becomes servo on state. (The motor becomes rotatable.)  
\*When the actuator with the lock is used, the lock is released.

#### -Timing chart-



## 13. Initial setting value for each actuator

### 13.1 Initial setting value of LEM series

Initial setting value of LEM series

Refer to the table below for the initial setting of the Reference for rotating direction, the Return to origin, Jog and Inching.

		All of LEM Series
Reference for rotating direction	Direction	2 (Direction of End side: +)
Return to origin	Speed [mm/s]	60
	Acceleration [mm/s <sup>2</sup> ]	500
Jog	Speed [mm/s]	48
	Acceleration [mm/s <sup>2</sup> ]	1000
Inching	Distance [mm]	0.12

Refer to the table below for the speed and the acceleration table of the LEM series.

	LEMB, LEMC		LEMH, LEMHT	
	Speed [mm/s]	Acceleration [mm/s <sup>2</sup> ]	Speed [mm/s]	Acceleration [mm/s <sup>2</sup> ]
0	48	250	48	250
1	75	500	75	500
2	100	1000	100	1000
3	150	1500	150	1500
4	200	2000	200	2000
5	250	2500	300	2500
6	300	3000	400	3000
7	350	4000	500	4000
8	400	5000	600	5000
9	450	6000	800	6000
10	500	7500	1000	7500
11	600	10000	1200	10000
12	700	12500	1400	12500
13	800	15000	1600	15000
14	900	17500	1800	17500
15	1000	20000	2000	20000

# 14. Options

## 14.1 Actuator cable [5m or less]

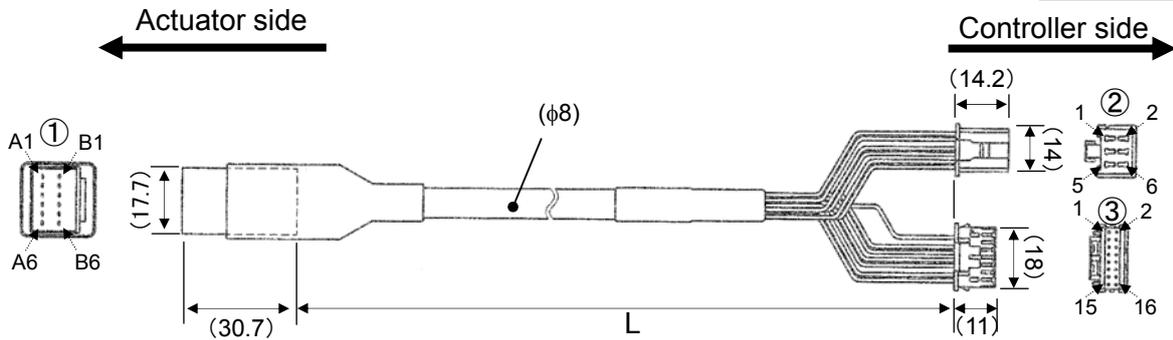
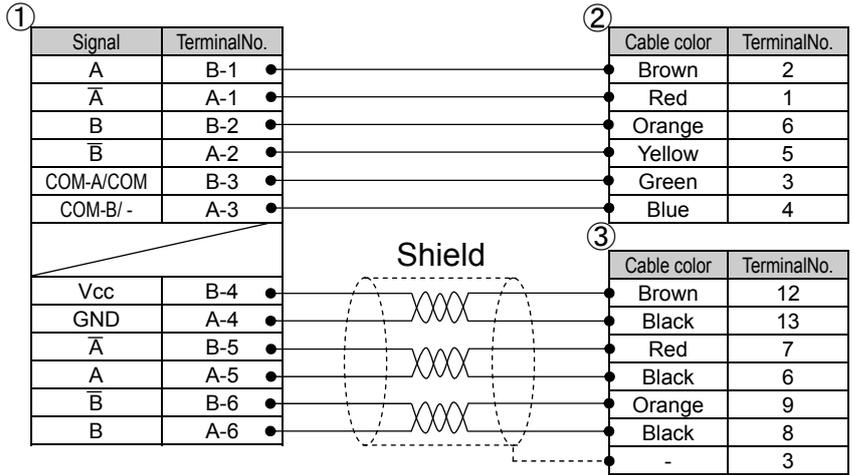
LE - CP - □ - □

Cable length (L)

1	1.5m
3	3m
5	5m

Actuator cable type

Nil	Robot cable
S	Standard cable



## 14.2 Actuator cable [8 to 20m]

LE - CP - □

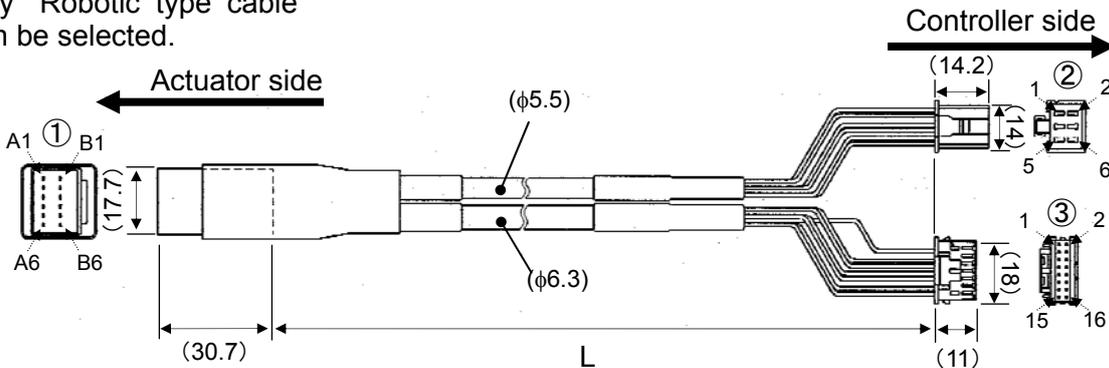
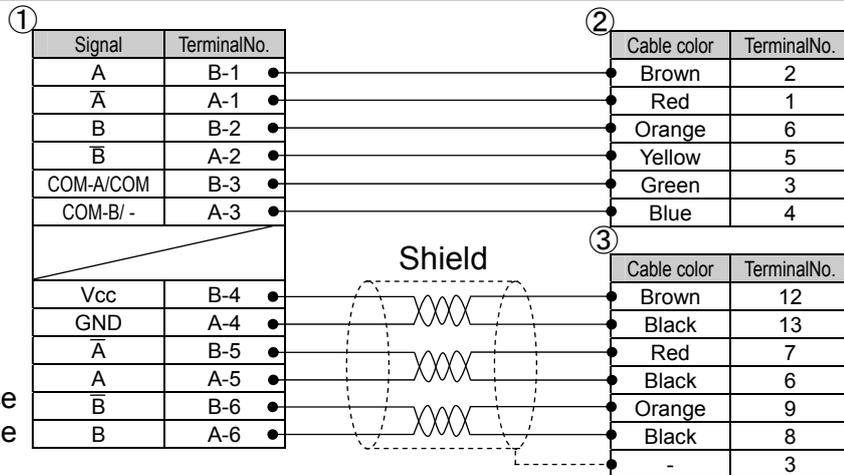
Cable length (L)

8	8m*
A	10m*
B	15m*
C	20m*

\*Made to order

\*Transporting performance is reduced by the voltage drop of the cable.

\*Only "Robotic type cable" can be selected.



### 14.3 Actuator cable (for sensor / lock) [5m or less]

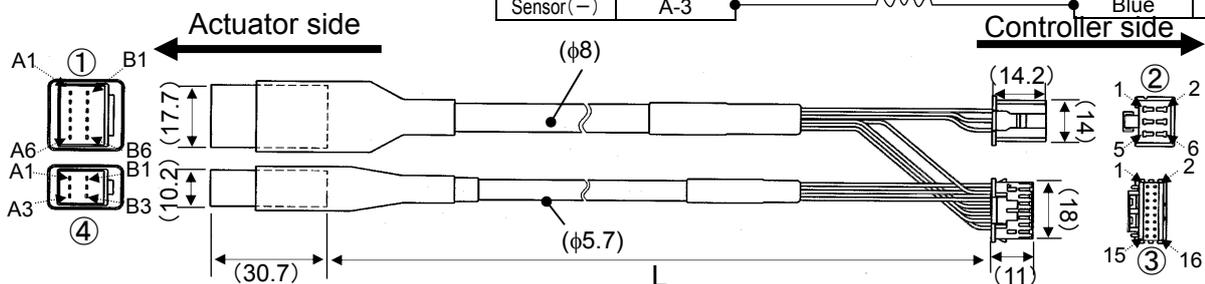
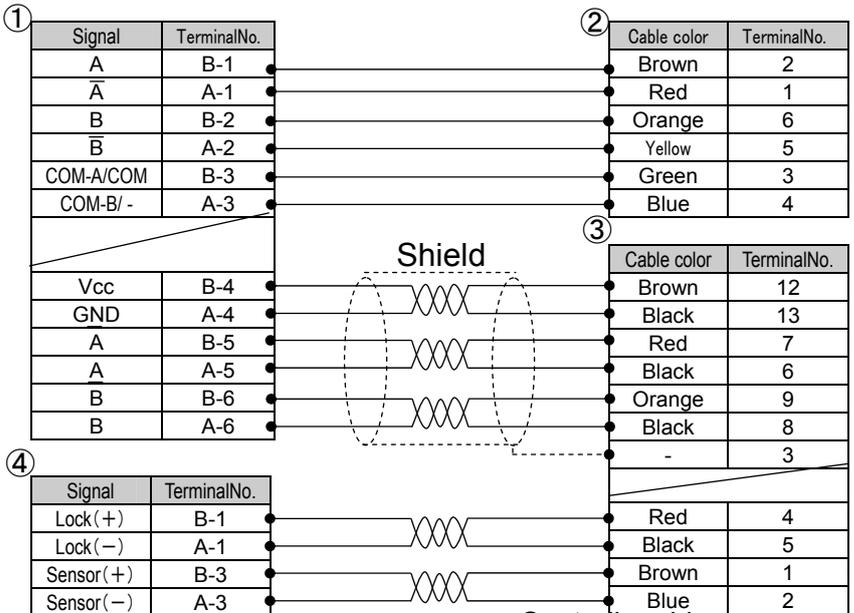
L E - C P - □ - □ - B

Cable length (L)

1	1.5m
3	3m
5	5m

Actuator cable type

Nil	Robot cable
S	Standard cable



### 14.4 Actuator cable (for sensor / lock) [8 to 20m]

L E - C P - □ - □ - B

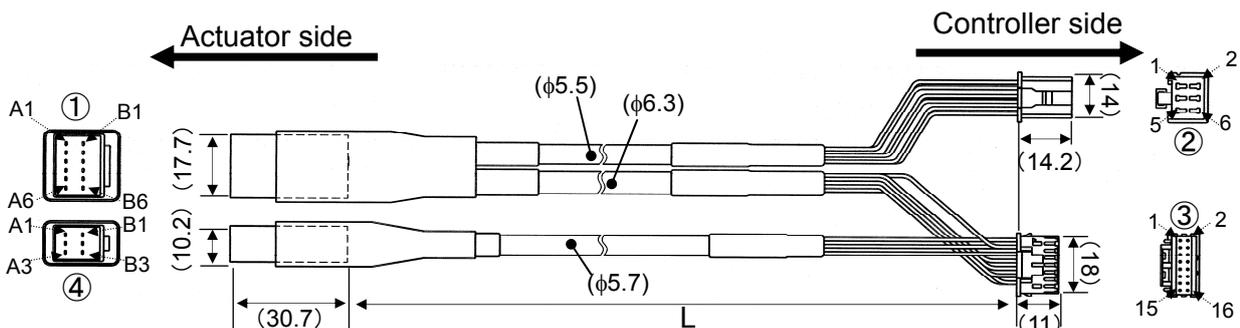
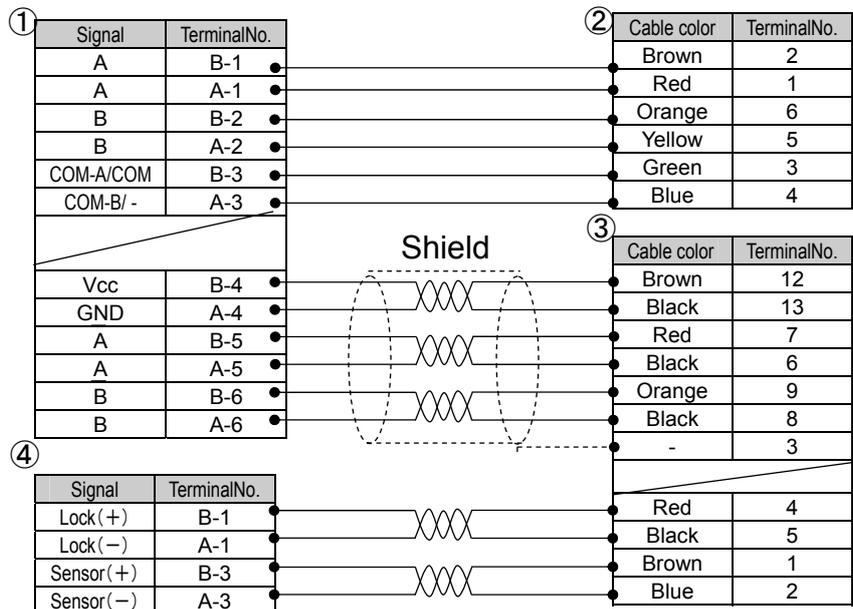
Cable length (L)

8	8m*
A	10m*
B	15m*
C	20m*

\*Made to order

\*Transporting performance is reduced by the voltage drop of the cable.

\*Only "Robotic type cable" can be selected.



## 15. Alarm detection

Details of the alarm can be checked by the controller LED indication and parallel I/O terminal.

When an alarm is generated, deactivate the alarm by troubleshooting, referring to

### 9. Troubleshooting.

Alarms are divided into two types. One type can be cleared by pressing the set button (g) or turning on RESET input signal. The other type cannot be cleared unless the power supply (C24V) is supplied after cutting off it.

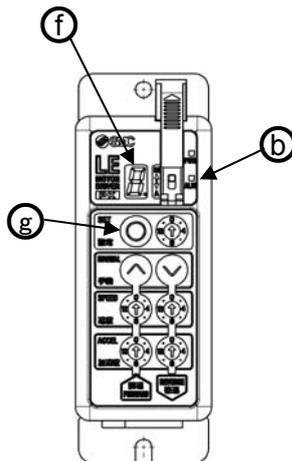
### 15.1 Alarm group output

In this controller, When the alarm is generated, LED (b) lights in red and the alarm group is displayed in LED (f) and is turned on from OUT0-3 output signal in CN4 parallel I/O.

Alarm group	LED (f) Display	Parallel I/O output signal state					How to restart
		ALARM *1, *2	OUT0	OUT1	OUT2	OUT3	
A	A	OFF	ON	OFF	OFF	OFF	Turns on RESET input signal or pushes the button (g)
B	b	OFF	OFF	ON	OFF	OFF	
C	c	OFF	OFF	OFF	ON	OFF	
D	d	OFF	OFF	OFF	OFF	ON	
E	E	OFF	OFF	OFF	OFF	OFF	The power supply (C24V) is supplied after cutting off it

\*1 ALARM output signal turns off when an alarm is generated because it is a normal closed type output signal.

\*2 When the actuator is the servo off state, ALARM turns off, too. The alarm state cannot be identified only by ALARM output signal.



## 15.2 Alarm Content • Countermeasure

Group	The condition of the controller when an alarm is generated	How to clear the alarm	Condition / Countermeasure
A	Servo off state	Input RESET	<p><b>&lt;Condition&gt;</b> In registering the intermediate position by Direct teaching, the alarm occurs when the position is registered before the return to origin is completed.</p>
			<p><b>&lt;Countermeasure&gt;</b> Perform the return to origin.</p>
B	Any condition	Input RESET	<p><b>&lt;Condition&gt;</b> The alarm occurs when the controller's internal data or parameters are abnormal.</p>
			<p><b>&lt;Countermeasure&gt;</b> If the problem is not solved by supplying power again, contact SMC.</p>
C	Stopped	Input RESET	<p><b>&lt;Condition&gt;</b> The alarm occurs when the return to origin, positioning or a jog operation is commanded when the actuator is servo off state.</p>
			<p><b>&lt;Countermeasure&gt;</b> Check if I/O signal STOP is input. Also, check if the servo is OFF in manual mode. Refer to <b>11.3 Servo ON</b> for turning off the servo.</p>
C	Stopped	Input RESET	<p><b>&lt;Condition&gt;</b> The alarm occurs when positioning is commanded before the return to origin is completed.</p>
			<p><b>&lt;Countermeasure&gt;</b> Perform the return to origin.</p>

Group	The condition of the controller when an alarm is generated	How to clear the alarm	Condition / Countermeasure
D	During operation	Input RESET	<p><b>&lt;Condition&gt;</b> Motor rotation exceeds specified value.</p> <p><b>&lt;Countermeasure&gt;</b> If an external force is being applied, remove it. If there is no external force being applied, and the problem is not solved by supplying power again, please contact SMC.</p>
D	During operation	Input RESET	<p><b>&lt;Condition&gt;</b> The power supply voltage for motor which is detected in the controller is out of the specified range. The regenerative electricity of the motor is large while using the brake.</p> <p><b>&lt;Countermeasure&gt;</b> Check the voltage supplied to the power supply for the controller motor (M24V). Check if the operating condition of the actuator is within the specification range.</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p style="text-align: center;"><b>⚠ Caution</b></p> <p>If the power supply is an inrush current suppressor type, a voltage drop may occur during acceleration/deceleration, generating an alarm.</p> </div>
D	Any condition	Input RESET	<p><b>&lt;Condition&gt;</b> Ambient temperature of the power element in the controller is high.</p> <p><b>&lt;Countermeasure&gt;</b> Improve the peripheral environment of the controller after checking the installation of the controller. Refer to <b>3.4 Mounting</b> for the mounting conditions of the controller.</p>
D	Any condition	Input RESET	<p><b>&lt;Condition&gt;</b> The power supply voltage control which is detected in the controller is out of the specified range.</p> <p><b>&lt;Countermeasure&gt;</b> Check the voltage supplied to the power supply for the controller motor (24VC).</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p style="text-align: center;"><b>⚠ Caution</b></p> <p>When the power supply for the motor and control is shared and the power supply is an inrush current suppressor type, a voltage drop may occur during acceleration/deceleration, generating an alarm.</p> </div>
D	During or after suspension of operation	Input RESET	<p><b>&lt;Condition&gt;</b> When there is a delay to reach the target position longer than the specific value for delay.</p> <p><b>&lt;Countermeasure&gt;</b> Check if the travel of the actuator was interrupted.</p>

Group	The condition of the controller when an alarm is generated	How to clear the alarm	Condition / Countermeasure
E	When the power is supplied	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> Positioning of the polarity is not finished properly. When the power is supplied, the actuator slightly moves to detect the polarity of the motor. This alarm is generated when the actuator cannot be moved.</p> <p><b>&lt;Countermeasure&gt;</b> Supply power in conditions in which the actuator is operable.</p>
E	When the power is supplied	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> An abnormality is confirmed with the current sensors which are recognized when the controller is initialized.</p> <p><b>&lt;Countermeasure&gt;</b> Confirm the combination of the controller and the actuator is correct. If the problem is not solved by supplying power again, please contact SMC.</p>
E	During operation	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> Position deviation counter in the controller has overflowed.</p> <p><b>&lt;Countermeasure&gt;</b> Check if the travel of the actuator is interrupted. Check if the load of the actuator is within the specification range.</p>
E	During operation	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> During positioning, the power supply of M24V-0V has been cut off.</p> <p><b>&lt;Countermeasure&gt;</b> Check if the power supply of M24V-0V has been cut off.</p>
E	Any condition	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> Output current at the power supply circuit is abnormally high.</p> <p><b>&lt;Countermeasure&gt;</b> Check if the actuator cable or connector is short-circuited. Confirm the combination of the controller and the actuator is correct.</p>
E	Any condition	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> Abnormality concerning EEPROM is confirmed.</p> <p><b>&lt;Countermeasure&gt;</b> If the problem is not solved by supplying power again, please contact us. (The write limit of the EEPROM is roughly 100,000 times)</p>
E	Any condition	Power supply for control is turned off	<p><b>&lt;Condition&gt;</b> CPU is not operating properly. (Failure of CPU and peripheral circuits, or malfunction due to noise)</p> <p><b>&lt;Countermeasure&gt;</b> If the problem is not solved by supplying power again, please contact SMC.</p>

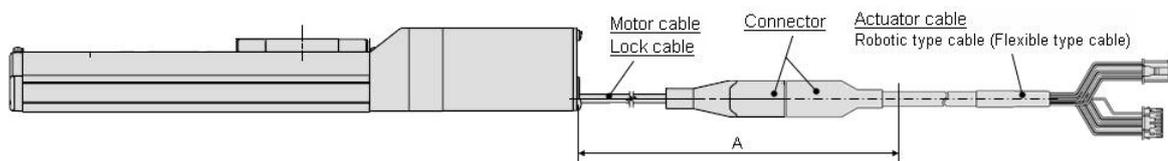
## 16. Wiring of cables/Common precautions

### ⚠Warning

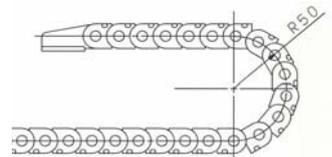
1. **Adjusting, mounting or wiring change should never be done before shutting off the power supply to the product.**  
Electrical shock, malfunction and damaged can result.
2. **Never disassemble the cable. Use only specified cables.**
3. **Never connect or disconnect the cable or connector with power on.**

### ⚠Caution

1. **Wire the connector securely. Do not apply any voltage to the terminals other than those specified in the product Manual.**
2. **Wire the connector securely.**  
Check for correct connector wiring and polarity.
3. **Take appropriate measures against noise.**  
Noise in a signal line may cause malfunction. As a countermeasure, separate high voltage and low voltage cables, and shorten wiring lengths, etc.
4. **Do not route wires and cables together with power or high voltage cables.**  
The product can malfunction due to interference of noise and surge voltage from power and high voltage cables to the signal line. Route the wires of the product separately from power or high voltage cables.
5. **Take care that actuator movement does not catch cables.**
6. **Operate with cables secured. Avoid bending cables at sharp angles where they enter the product.**
7. **Avoid twisting, folding, rotating or applying an external force to the cable.**  
Risk of electric shock, wire break, contact failure and lost of control for the product can happen.
8. **Fix the cable protruding from the product in place before using.**  
The motor and lock cables are not robotic type cables and can be damaged when moved. Therefore fix the cables and the connectors (part "A" in figure below) when set up.



9. **Select "Robotic type cables" in case of inflecting actuator-cable repeatedly. And do not put cables into a flexible moving tube with a radius smaller than the specified value. (Min. 50mm).**  
Risk of electric shock, wire break, contact failure and loss of control for the product can happen if "Standard cables" are used in case of inflecting the cables repeatedly.
10. **Confirm proper wiring of the product.**  
Poor insulation (interference with other circuits, poor insulation between terminals and etc.) can apply excessive voltage or current to the product causing damage.
11. **The Speed / pushing force may vary, depending on the cable length, load and mounting conditions etc..**  
If the cable length exceeds 5m, the speed / pushing force will be reduced by a maximum of 10% per 5m. (If cable length is 15m: Maximum 20% reduction.)



### [Transportation]

#### ⚠Caution

1. **Do not carry or swing the product by the motor or the cablethe cable**

## 17. Electric actuators/Common precautions

### 17.1 Design and selection

#### Warning

- 1. Be sure to read the Operation Manual.**

Handling or usage/operation other than that specified in the Operation Manual may lead to breakage and operation failure of the product.  
Any damage attributed to the use beyond the specifications is not guaranteed.
- 2. There is a possibility of dangerous sudden action by the product if sliding parts of machinery are twisted due to external forces, etc.**

In such cases, human injury may occur, such as by catching hands or feet in the machinery, or damage to the machinery itself may occur. Design the machinery should be designed to avoid such dangers.
- 3. A protective cover is recommended to minimize the risk of personal injury.**

If a driven object and moving parts of the product are in close proximity, personal injury may occur. Design the system to avoid contact with the human body.
- 4. Securely tighten all stationary parts and connected parts so that they will not become loose.**

When the product operates with high frequency or is installed where there is a lot of vibration, ensure that all parts remain secure.
- 5. Consider a possible loss of power source.**

Take measures to prevent injury and equipment damage even in the case of a power source failure.
- 6. Consider behavior of emergency stop of whole system.**

Design the system so that human injury and/or damage to machinery and equipment will not be caused, when it is stopped by a safety device for abnormal conditions such as a power outage or a manual emergency stop of whole system.
- 7. Consider the action when operation is restarted after an emergency stop or abnormal stop of whole system.**

Design the system so that human injury or equipment damage will not occur upon restart of operation of whole system.
- 8. Disassembly and modification prohibited**

Do not modify or reconstruct (including additional machining) the product. An injury or failure can result.
- 9. Do not use parallel input STOP signal as the emergency stop of system.**

The "STOP" signal is for decelerating and stopping the actuator.  
Design the system with an emergency stop circuit which is applied relevant safety standard separately.
- 10. When using it for vertical application, it is necessary to build in a safety device.**

The rod may fall due to the weight of work. The safety device should not interfere with normal operation of the machine.

#### Caution

- 1. Operate within the limits of the maximum usable stroke.**

The product will be damaged if it is used with the stroke which is over the maximum stroke. Refer to the specifications of the product.
- 2. When the product repeatedly cycles with partial strokes, operate it at a full stroke at least once a day or every 1000 strokes.**

Otherwise, lubrication can run out.
- 3. Do not use the product in applications where excessive external force or impact force is applied to it.**

The product can be damaged. Each component that includes motor is made with accurate tolerance. So even slightly deformed or miss-alignment of component may lead operation failure of the product.
- 4. Refer to a common auto switch /matter (Best Pneumatics No. 2) when an auto switch is built in and used.**

**5. Return to origin cannot return while operating.**

It cannot be done during positioning operation, pushing operation and pushing.

**6. When conformity to UL is required, the electric actuator and controller should be used with a UL1310 Class 2 power supply.**

## 17.2 Mounting

### **Warning**

**1. Install and operate the product only after reading the Operation Manual carefully and understanding its contents. Keep the manual in a safe place for future reference.**

**2. Observe the tightening torque for screws.**

Tighten the screws to the recommended torque for mounting the product.

**3. Do not make any alterations to this product.**

Alterations made to this product may lead to a loss of durability and damage to the product, which can lead to human injury and damage to other equipment and machinery.

**4. When using external guide, the guide axis should be parallel to the actuator axis.**

There will be damage/excessive wear on the lead screw if the external guide is not parallel.

**5. When an external guide is used, connect the moving parts of the product and the load in such a way that there is no interference at any point within the stroke.**

Do not scratch or dent the sliding parts of the product tube or piston rod etc., by striking or grasping them with other objects. Components are manufactured to precise tolerances, so that even a slight deformation may cause faulty operation.

**6. Prevent the seizure of rotating parts.**

Prevent the seizure of rotating parts (pins, etc.) by applying grease.

**7. Do not use the product until you verify that the equipment can be operated properly.**

After mounting or repair, connect the power supply to the product and perform appropriate functional inspections to check it is mounted properly.

**8. Cantilever**

When the actuator is operated at high speed while it is fixed at one end and free at the other end (flange type, foot type, double clevis type, direct mount type), a bending moment may act on the actuator due to vibration generated at the stroke end, which can damage the actuator. In such a case, install a support bracket to suppress the vibration of the actuator body or reduce the speed so that the actuator does not vibrate. Use a support bracket also when moving the actuator body or when a long stroke actuator is mounted horizontally and fixed at one end.

**9. When mounting the actuator or attaching to the work piece, do not apply strong impact or large moment.**

If an external force over the allowable moment is applied, it may cause looseness in the guide unit, an increase in sliding resistance or other problems.

**10. Maintenance space.**

Allow sufficient space for maintenance and inspection.

## 17.3 Handling

### Warning

- 1. Do not touch the motor while in operation.**  
The surface temperature of the motor can increase to approx. 90°C to 100°C due to operating conditions. Energizing alone may also cause this temperature increase. As it may cause burns, do not touch the motor when in operation.
- 2. If abnormal heating, smoking or fire, etc., occurs in the product, immediately shut off the power supply.**
- 3. Immediately stop operation if abnormal operation noise or vibration occurs.**  
If abnormal operation noise or vibration occurs, the product may have been mounted incorrectly. Unless operation of the product is stopped for inspection, the product can be seriously damaged.
- 4. Never touch the rotating part of the motor or moving part of the actuator while in operation.**
- 5. When installing, adjusting, inspecting or performing maintenance on the product, controller and related equipment, be sure to shut off the power supply to each of them. Then, lock it so that no one other than the person working can turn the power on, or implement measures such as a safety plug.**
- 6. In the case of the actuator that has a servo motor (24VDC), the “motor phase detection step” is done by inputting the servo on signal just after the controller power is turned on. The “motor phase detection step” operates the table/rod to the maximum distance of the lead screw. (The motor rotates in the reverse direction if the table hits an obstacle such as the end stop damper.) Take the “motor phase detection step” into consideration for the installation and operation of this actuator.**

### Caution

- 1. Keep the controller and product combined as delivered for use.**  
The product is set in parameters for shipment. If it is combined with a different parameter, failure can result.
- 2. Check the product for the following points before operation.**
  - a) Damage to electric driving line and signal lines
  - b) Looseness of the connector to each power line and signal line
  - c) Looseness of the actuator/cylinder and controller/driver mounting
  - d) Abnormal operation
  - e) Emergency stop of the total system
- 3. When more than one person is performing work, decide on the procedures, signals, measures and resolution for abnormal conditions before beginning the work. Also, designate a person to supervise work other than those performing work.**
- 4. The product can operate at a different speed from the set speed depending on load and resistance.**  
When selecting a product, check the catalog for the instructions regarding selection and specifications.
- 5. Do not apply a load, impact or resistance in addition to a transferred load during return to origin.**  
The product is made return to origin by pushing force, which causes the displacement of origin.
- 6. Do not remove the name plate.**
- 7. Operation test should be done by low speed. Start operation by predefined speed after confirming there is no trouble.**

### [Ground]

#### Warning

- 1. Please give the ground to the actuator.**
- 2. The ground should be exclusive use. (Less than 100Ω)**
- 3. The ground cable length should be as short as possible.**

## [Unpackaging]

### Caution

**1. Check the received product is as ordered.**

If a different product is installed from the one ordered, injury or damage can result.

## 17.4 Operating environment

### Warning

**1. Avoid use in the following environments.**

- a. Locations where a large amount of dusts and cutting chips are airborne.
- b. Locations where the ambient temperature is outside the range of the temperature specification (refer to specifications).
- c. Locations where the ambient humidity is outside the range of the humidity specification (refer to specifications).
- d. Locations where corrosive gas, flammable gas, sea water, water and steam are present.
- e. Locations where strong magnetic or electric fields are generated.
- f. Locations where direct vibration or impact is applied to the product.
- g. Areas that are dusty, or are exposed to splashes of water and oil drops.
- h. Areas exposed to direct sunlight (ultraviolet ray).

**2. Do not use in an environment where the product is directly exposed to liquid, such as cutting oils.**

If cutting oils, coolant or oil mist contaminates the product, failure or increased sliding resistance can result.

**3. Install a protective cover when the product is used in an environment directly exposed to foreign matters such as dust, cutting chips and spatter.**

Play or increased sliding resistance can result.

**4. Shade the sunlight in the place where the product is applied with direct sunshine.**

**5. Shield the valve from radiated heat generated by nearby heat sources.**

When there is a heat source surrounding the product, the radiated heat from the heat source can increase the temperature of the product beyond the operating temperature range. Protect it with a cover, etc.

**6. Grease oil can be decreased due to external environment and operating conditions, and it deteriorates lubrication performance to shorten the life of the product.**

## [Storage]

### Warning

**1. Do not store the product in a place in direct contact with rain or water drops or is exposed to harmful gas or liquid.**

**2. Store in an area that is shaded from direct sunlight and has a temperature and humidity within the specified range (-10°C to 60°C, 90%RH or less and No condensation or freezing.)**

**3. Do not apply vibration and impact to the product during storage.**

## 17.5 Maintenance

### Warning

- 1. Do not disassemble or repair the product.**  
Fire or electric shock can result.
- 2. Before modifying or checking the wiring, the voltage should be checked with a tester 5 minutes after the power supply is turned off.**  
Electrical shock can result.

### Caution

- 1. Maintenance should be performed according to the procedure indicated in the Operating Manual.**  
Incorrect handling can cause injury, damage or malfunction of equipment and machinery.
- 2. Removal of product.**  
When equipment is serviced, first confirm that measures are in place to prevent dropping of work pieces and run-away of equipment, etc, and then cut the power supply to the system. When machinery is restarted, check that operation is normal with actuators in the proper positions.

## [Lubrication]

### Caution

- 1. The product has been lubricated for life at manufacturer, and does not require lubrication in service.**  
Contact SMC if lubrication will be applied.

## 17.6 Precautions for actuator with lock

### Warning

- 1. Do not use the lock as a safety lock or a control that requires a locking force.**  
The lock used for the product with a lock is designed to prevent dropping of work piece.
- 2. For vertical mounting, use the product with a lock.**  
If the product is not equipped with a lock, the product will move and drop the work piece when the power is removed.
- 3. "Measures against drops" means preventing a work piece from dropping due to its weight when the product operation is stopped and the power supply is turned off.**
- 4. Do not apply an impact load or strong vibration while the lock is activated.**  
If an external impact load or strong vibration is applied to the product, the lock will lose its holding force and damage to the sliding part of the lock or reduced lifetime can result. The same situations will happen when the lock slips due to a force over the thrust of the product, as this accelerates the wear to the lock.
- 5. Do not apply liquid or oil and grease to the lock or its surrounding.**  
When liquid or oil and grease is applied to the sliding part of the lock, its holding force will reduce significantly.
- 6. Take measures against drops and check that safety is assured before mounting, adjustment and inspection of the product.**  
If the lock is released with the product mounted vertically, a work piece can drop due to its weight.
- 7. When the actuator is operated manually (when servo is off), supply 24VDC to the [BK RLS] terminal of the power supply connector.**  
If the product is operated without releasing the lock, wearing of the lock sliding surface will be accelerated, causing reduction in the holding force and the life of the locking mechanism.
- 8. Do not supply 24VDC power supply constantly to the [BK RLS(Lock release)] terminal.**  
Stop supplying 24VDC power supply to the [BK RLS(Lock release) terminal during normal operation. If power is supplied to the [BK RLS] terminal continuously, the lock will be released, and workpieces may be dropped at servo off.

## 18. Controller and its peripheral devices / Specific product precautions

### 18.1 Design and selection

#### Warning

**1. Be sure to apply the specified voltage.**

Otherwise, a malfunction and breakage of the controller may be caused.

If the applied voltage is lower than the specified, it is possible that the load cannot be moved due to an internal voltage drop. Please check the operating voltage before use.

**2. Do not operate beyond the specifications.**

It may cause a fire, malfunction or actuator damage can result. Please check the specifications before use.

**3. Install an emergency stop circuit.**

Please install an emergency stop outside of the enclosure so that it can stop the system operation immediately and intercept the power supply.

**4. In order to prevent danger and damage due to the breakdown and the malfunction of this product, which may occur at a certain probability, a backup system should be established previously by giving a multiple-layered structure or a fail-safe design to the equipment, etc.**

**5. If a fire or danger against the personnel is expected due to an abnormal heat generation, ignition, smoking of the product, etc., cut off the power supply for this product and the system immediately.**

### 18.2 Handling

#### Warning

**1. The inside of the controller and its connector should not be touched.**

It may cause an electric shock or damage to the controller.

**2. Do not perform the operation or setting of this equipment with wet hands.**

It may cause an electric shock.

**3. Product with damage or the one lacking of any components should not be used.**

It may cause an electric shock, fire, or injury.

**4. Use only the specified combination between the controller and electric actuator.**

It may cause damage to the controller or the actuator.

**5. Be careful not to be caught or hit by the workpiece while the actuator is moving.**

It may cause an injury.

**6. Do not connect the power supply or power on the product before confirming the area where the work moves is safe.**

The movement of the work may cause accident.

**7. Do not touch the product when it is energized and for some time after power has been disconnected, as it is very hot.**

It may lead to a burn due to the high temperature.

**8. Check the voltage using a tester for more than 5 minute after power-off in case of installation, wiring and maintenance.**

There is a possibility of getting electric shock, fire and injury.

**9. Do not use in an area where dust, powder dust, water or oil is in the air.**

It will cause failure or malfunction.

**10. Do not use in an area where a magnetic field is generated.**

It will cause failure or malfunction.

**11. Do not install in the environment of flammable gas, corrosive gas and explosive gas.**

It could lead to fire, explosion and corrosion.

**12. Radiant heat from strong heat supplies such as a furnace, direct sunlight, etc. should not be applied to the product.**

It will cause failure of the controller or its peripheral devices.

- 13. Do not use the product in an environment subject to a temperature cycle.**  
It will cause failure of the controller or its peripheral devices.
- 14. Do not use in a place where surges are generated.**  
When there are units that generate a large amount of surge around the product (e.g., solenoid type lifters, high frequency induction furnaces, motors, etc.), this may cause deterioration or damage to the product's internal circuit. Avoid supplies of surge generation and crossed lines.
- 15. Do not install this product in an environment under the effect of vibrations and impacts.**  
It will cause failure or malfunction.
- 16. If this product is used with a relay or solenoid valve, they should be the surge absorbing element built-in type.**

### 18.3 Installation

#### Warning

- 1. The controller and its peripheral devices should be installed on a fire-proof material.**  
A direct installation on or near a flammable material may cause fire.
- 2. Do not install this product in a place subject to vibrations and impacts.**  
It may cause an electric shock, fire, or injury.
- 3. Take measure so that the operating temperature of this controller and its peripheral devices are within the range of the specifications. Also, this controller should be installed with 50mm or larger spaces between each side of it and the other structures or components.**  
It may cause a malfunction of the controller and its peripheral devices and a fire.
- 4. Do not mount this controller and its peripheral devices together with a large-sized electromagnetic contactor or no-fuse breaker, which generates vibration, on the same panel. Mount them on different panels, or keep the controller and its peripheral devices away from such a vibration supply.**
- 5. This controller and its peripheral devices should be installed on a flat surface.**  
If the mounting surface is distorted or not flat, an unacceptable force may be added to the housing, etc. to cause troubles.

### 18.4 Wiring of cables/Common precautions

#### Warning

- 1. Do not apply any excessive force to cables by repeated bending, tensioning or placing a heavy object on the cables.**  
It may cause an electric shock, fire, or breaking of wire.
- 2. Connect wires and cables correctly.**  
Incorrect wiring could break the controller or its peripheral devices depending on the seriousness.
- 3. Do not connect wires while the power is supplied.**  
It can break the controller or its peripheral devices could be damaged to cause a malfunction.
- 4. Do not carry this product by holding its cables.**  
It may cause an injury or damage to the product.
- 5. Do not connect power cable or high-voltage cable in the same wiring route as the unit.**  
The wires to the controller or its peripheral devices can be interrupted with noise or induced surge voltage from power lines or high-voltage lines and malfunction could be caused.  
Separate the wiring of the controller and its peripheral device from that of power line and high voltage line.
- 6. Verify the insulation of wiring.**  
Insulation failure (interference with other circuit, poor insulation between terminals and etc.) could introduce excessive voltage or current to the controller or its peripheral devices and damage them.

## 18.5 Power supply

### Caution

- 1. Use a power supply that has low noise between lines and between power and ground.**  
In cases where noise is high, an isolation transformer should be used.
- 2. The power supplies should be separated between the controller power and the I/O signal power and both of them do not use the power supply of “rush-current restraining type”.**  
If the power supply is “rush-current restraining type”, a voltage drop may be caused during the acceleration of the actuator.
- 3. To prevent surges from lightning, an appropriate measure should be taken. Ground the surge absorber for lightning separately from the grounding of the controller and its peripheral devices.**

## 18.6 Grounding

### Warning

- 1. Be sure to carry out grounding in order to ensure the noise tolerance of the controller.**  
It may cause an electric shock or fire.
- 2. Dedicated grounding should be used.**  
Grounding should be to a D-class ground (Ground resistance of 100 Ω or less.)
- 3. Grounding should be performed near the unit as much as possible to shorten the grounding distance.**
- 4. In the unlikely event that malfunction is caused by the ground, it may be disconnected.**

## 18.7 Maintenance

### Warning

- 1. Perform a maintenance check periodically**  
Confirm wiring and screws are not loose.  
Loose screws or wires may cause unintentional malfunction.
- 2. Conduct an appropriate functional inspection after completing the maintenance.**  
In case of any abnormalities (in the case that the actuator does not move, etc.), stop the operation of the system. Otherwise, an unexpected malfunction may occur and it will become impossible to secure the safety.
- 3. Do not disassemble, modify or repair this controller and the peripheral equipment.**
- 4. Do not put anything conductive or flammable inside of this controller.**  
It may cause a fire and explosion.
- 5. Do not conduct an insulation resistance test and withstand voltage test on this product.**
- 6. Ensure sufficient space for maintenance activities. Provide space required for maintenance.**  
Design the system that allows required space for maintenance.

## 19. Troubleshooting

Refer to the table below for troubleshooting. When none of the causes in the troubleshooting can be confirmed and normal operation is recovered by the replacement of a part, it is presumed that failure is in the product.

Problems with the product may be due to the operating environment (application). Please consult us if troubleshooting is necessary.

### 19.1 Operation troubles

Failure Problem	Possible causes	Investigation method and the location of possible causes	Countermeasure
Does not operate	Stroke study is not completed	Just after the power supply is supplied to the controller, is ALM LED(red) flashing?	Perform Stroke study. → <b><u>7.2 Stroke study</u></b>
	Power supply failure	Controller PWR LED lights in green?	Check the supplied voltage and current for power supply to the controller. → <b><u>4. External connection</u></b> → <b><u>5. CN1:Power supply cable</u></b>
	External equipment failure	PLC connected to the controller operates properly? Check the operation with a test run of the controller alone.	Refer to the operation manual of the controller. → <b><u>6. CN4:Parallel I/O cable</u></b>
	Wiring failure	Check if the wiring is correct. Refer to the operation manual of the controller to check wiring, for broken wires and short-circuits. Correct wiring and check if the input/output of each signal is correct.	Prepare separate power supply for CN1 controller input power supply and CN4 input / output signal power supply. → <b><u>4. External connection</u></b> → <b><u>6.4 Parallel I/O connector CN4 wiring(Example)</u></b>
	Alarm generated	Controller alarm is generated? Refer to the operation manual of the controller. Check the type of alarm.	Refer to the operation manual of the controller. → <b><u>15. Alarm detection</u></b>
	Unlocking error	When the unlock switch is turned ON or OFF there is an unlocking sound made.	If there is no unlocking sound from the actuator, the lock of the actuator may be broken. → If the problem continues to happen, please contact SMC.
	Unsuitable specification	Check if a product with a suitable specification was selected. Reconfirm the combination of the power supply and the controller and the actuator in used is correct.	Confirm if the combination of the actuator part number which is applicable for the controller and used actuator is correct. → <b><u>2.2 How to order</u></b>

Failure Problem	Possible causes	Investigation method and the location of possible causes	Countermeasure
Operation stops intermittently	Alarm generated	Controller alarm is generated? Check the type of the alarm referring to the operation manual of the controller for troubleshooting.	Refer to the operation manual of the controller. → <b><u>15. Alarm detection</u></b>
	Wiring failure	Check if the wiring is correct. Refer to the operation manual of the controller to check wiring, for broken wires and short-circuits.	Correct wiring and check if the input/output of each signal is correct. Prepare a separate power supply for the CN1 controller input power supply and CN4 input / output signal power supply. → <b><u>4. External connection</u></b> → <b><u>6.4 Parallel I/O connector CN4 wiring(Example)</u></b>
	Counter-measures against noise	Ground properly. Avoid bundling the cables.	Refer to the operation manual of the controller. → <b><u>3.4 Mouting</u></b>
	Voltage drop	Temporary voltage drop in the power supply.	Possibility of momentary voltage drop due to an inadequate power supply capacity, or the power supply is inrush current suppressor type. → <b><u>3.1 Basic specifications</u></b>
	Unsuitable specification	Check if a product with a suitable specification was selected. Reconfirm the combination of the power supply and the actuator and controller.	Confirm if the combination of the actuator part number which is applicable for the controller and the actuator in use is correct. → <b><u>2.2 How to order</u></b>

## 19.2 Position / Speed troubles

Failure Problem	Possible causes	Investigation method and the location of possible causes	Countermeasure
Displacement	Displaced from the origin	In the return to origin, does the actuator drive to the stroke end? Perform the return to origin several times to check the origin position.	Check if foreign matter is caught in the product by operating the actuator.
	Change of the possible moving area	Was the stopper of actuator adjusted? Check the set position of the stopper of actuator.	Perform the stroke study and re-register all the intermediate positions when adjusting the stopper of actuator. → <b><u>7.2 Stroke study</u></b> → <b><u>8.2 Procedure of registering the intermediate position</u></b>
		After performing Stroke study, were all the intermediate positions re-registered?	Re-register all the intermediate positions (position number 3 to 14(E)) after stroke study is completed. → <b><u>8.2 Procedure of registering the intermediate position</u></b>
	Unsuitable specification	Check if a product with a suitable specification was selected. Reconfirm the combination of the power supply and the actuator and controller.	Confirm if the combination of the actuator part number which is applicable for the controller and used actuator in use is correct. → <b><u>2.2 How to order</u></b>
Doesn't move to the correct position	Change of the possible moving area	Was the stopper of actuator adjusted? Check the set position of the stopper of actuator.	Perform the stroke study when adjusting the stopper of actuator. → <b><u>7.2 Stroke study</u></b>
		After performing Stroke study, were all the intermediate positions re-registered?	Perform the stroke study and re-register all the intermediate positions when adjusting the stopper of actuator. → <b><u>7.2 Stroke study</u></b> → <b><u>8.2 Procedure of registering the intermediate position</u></b>
	Wiring failure	Check if the wiring is correct. Refer to the operation manual of the controller to check wiring, for broken wires and short-circuits.	Correct wiring and check if the input/output of each signal is correct. Prepare a separate power supply for the CN1 controller input power supply and CN4 input / output signal power supply. → <b><u>4. External connection</u></b> → <b><u>6.4 Parallel I/O connector CN4 wiring(Example)</u></b>
	Unsuitable specification	Check if a product with a suitable specification was selected. Reconfirm the combination of the power supply and the actuator and controller.	Confirm if the combination of the actuator part number which is applicable for the controller and used actuator in use is correct. → <b><u>2.2 How to order</u></b>

Failure Problem	Possible causes	Investigation method and the location of possible causes	Countermeasure
Speed does not reach the desired speed	Operation pattern is not suitable	Operation pattern is triangular? If the operation pattern is triangular, it is possible that the actuator will start to decelerate before reaching the maximum speed.	Set a longer position, or set a larger acceleration. → <b><u>8.2 Procedure of registering the intermediate position</u></b>
	Speed change in auto mode	Change the value of the speed or acceleration switch in auto mode.	Go to speed adjustment in auto mode to change the speed and acceleration. → <b><u>9. Setting of the speed and the acceleration</u></b>
	Unsuitable specification	Check if a product with a suitable specification was selected. Reconfirm the combination of the power supply and the actuator and controller.	Confirm if the combination of the actuator part number which is applicable for the controller and used actuator in use is correct. → <b><u>2.2 How to order</u></b>

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.

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