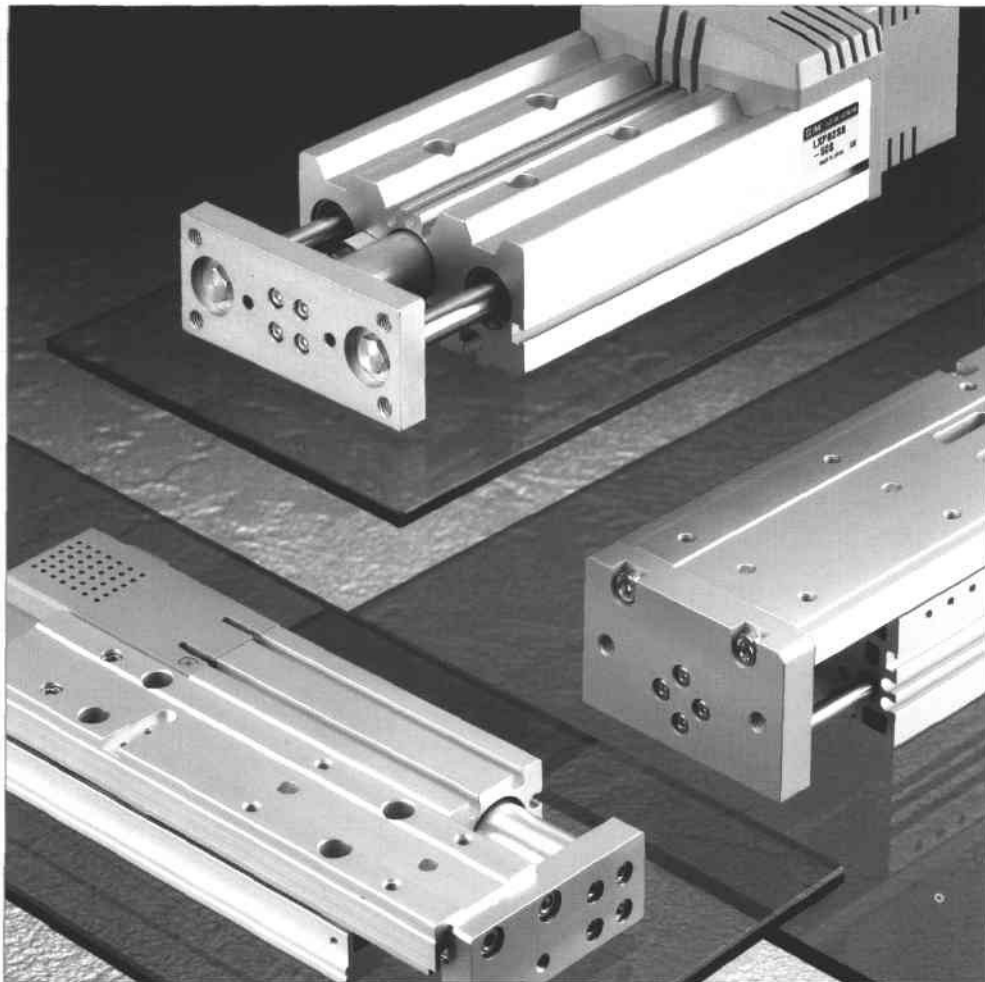


# *LX Series*

Compact Electric Actuators



- Compact, Low Profile
- Rigid Linear Guides
- DC Stepper Motor  
(Optional AC Servo Motor)

# Table of Contents

## **Series LX - Compact Electric Actuators**

Features and Benefits .....	page 4 & 5
Product Variations .....	page 6 & 7

## **Series LXF - Low Profile Slide Table**

Specifications/Construction/Parts List .....	page 8
Selection Chart & Duty Ratio .....	page 9
Kinetic Moment Allowance & Table Deflection .....	page 10
Criteria of Accelerating Speed .....	page 11
How To Order .....	pages 12 & 13
How to Mount .....	page 14
Dimensions.....	pages 15 & 16

## **Series LXP - Low Profile with Guides**

Specifications/Construction/Parts List .....	page 17
Selection Chart & Duty Ratio .....	page 18
Criteria of Accelerating Speed .....	page 19
Table Deflection .....	page 20
Working Range & Operating Conditions .....	page 21
How To Order .....	pages 22 & 23
How to Mount .....	page 24
Dimensions.....	pages 25 & 26

## **Series LXS - Slide Table w/ High Rigidity Guides**

Specifications/Construction/Parts List .....	page 27
Selection Chart & Duty Ratio .....	page 28
Kinetic Moment Allowance/Table Deflection.....	page 29
Criteria of Accelerating Speed .....	page 30
How To Order .....	pages 31 & 32
How to Mount .....	page 33
Dimensions.....	pages 34 & 35

## **Made to Order Options .....**

## **Stepper Motor Control Overview .....**

## **LX Control Methods .....**

## **LC6C & LC6D Positioning Driver .....**

## **Auto Switch Specifications .....**

## **Safety Instructions .....**

## **Glossary of Related Terms .....**

# Stepping Motor and Slide Screw Provide

Multi-point positioning possible: Accuracy to  $\pm 0.03\text{mm}$

Ball/Slide screw mechanism is enclosed

Choice of motor types

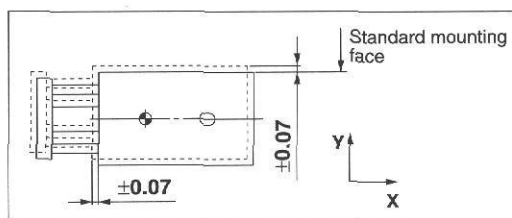
2-phase/5-phase stepping motor is standard with optional AC servo motor.

Proximity Sensor & Auto switch capable

Auto switch grooves provide flush installation.

Precision body installation:  $\pm 0.07\text{mm}$

Can be precisely installed even with repeated removal and reinstallation due to standard mounting face supplied by NC machining process and positioning pin hole.



Horizontal Orientation, Low Profile Space Saving Body, Slide Table With Linear Guide

## Series LXF

Max. pay load: 30N (In horizontal mounting)

Max. thrust: 15N

Max. speed: 200mm/s

Available strokes: 25mm, 50mm, 75mm, 100mm

With Linear Guide

### Noise level comparison

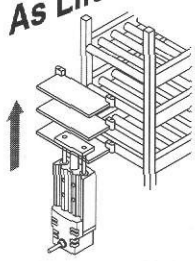
Model	Noise (dB)	Specifications
LXFH5SA-100	58	5-phase stepping motor, screw lead 6
LXFH5SB-100	57	5-phase stepping motor, screw lead 12

### Weight

Model	Standard stroke(mm)				(kg)
	25	50	75	100	
LXF	0.8	1.0	1.1	1.2	

# Positioning Repeatability to $\pm 0.03\text{mm}$

As Lifter



Horizontal/Vertical Orientation,  
Linear Ball Bearing Guide Rods

## Series LXP

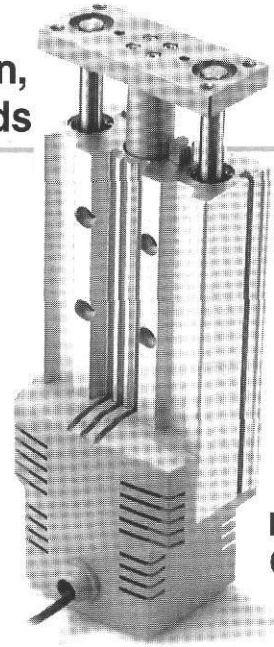
Max. pay load: 60N (In horizontal mounting)

Max. pay load: 50N (In vertical mounting)

Max. thrust: 220N

Max. speed: 200mm/s

Available strokes: 50mm, 75mm, 100mm,  
125mm, 150mm, 175mm, 200mm



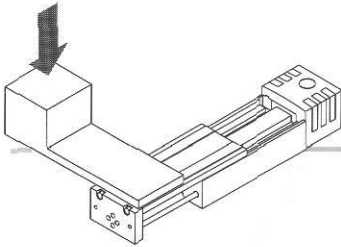
Linear Ball Bearing  
Guide Rods

### Noise level comparison

Model	Noise (dB)	Specifications
LXPB2SB-100	58	2-phase stepping motor, screw lead 12
LXPB5SB-100	57	5-phase stepping motor, screw lead 12

### Weight

Model	Standard stroke (mm)							(kg)
	50	75	100	125	150	175	200	
LXP	2	2.2	2.3	2.6	2.8	2.9	3.1	



Horizontal/Vertical Orientation,  
Slide Table With High Rigidity Guides

## Series LXSH

Max. pay load: 100N (In horizontal mounting)

Max. pay load: 50N (In vertical mounting)

Max. thrust: 220N

Max. speed: 200mm/s

Available strokes: 50mm, 75mm,  
100mm, 125mm, 150mm



With High  
Rigidity Guides

### Noise level comparison

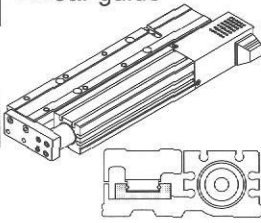
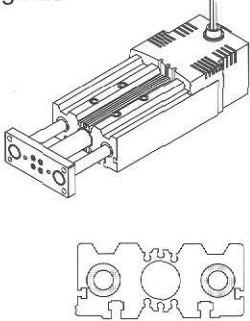
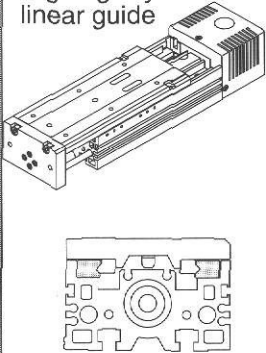
Model	Noise (dB)	Specifications
LXSH2SB-100	60	2-phase stepping motor, screw lead 12
LXSH5SB-100	58	5-phase stepping motor, screw lead 12

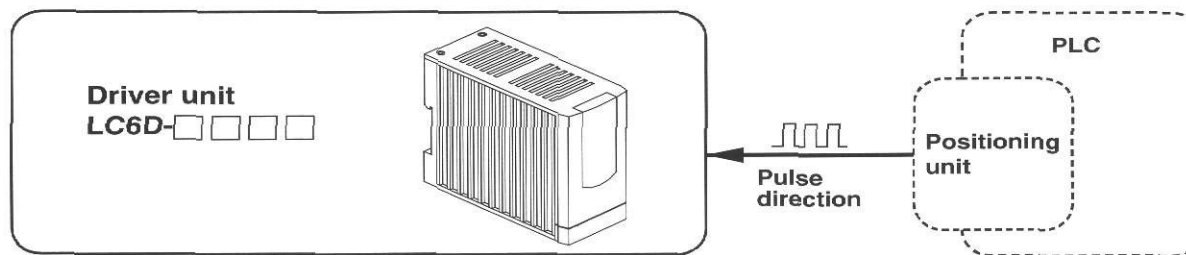
### Weight

Model	Standard stroke (mm)					(kg)
	50	75	100	125	150	
LXSH	1.9	2.1	2.3	2.5	2.7	

Specifications introduced in this page are measured with SMC LC6 Series driver. (See page 40 and 45)

## Series LX Product Variations

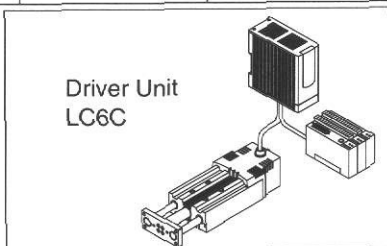
Series	Type of Guide	Drive Screw Type	Model	Max. Horizontal Payload (N)	Max. Vertical Payload (kg)	Max. thrust (N)
<b>Series LXF</b>	Linear guide 	Ball Screw	<b>LXFH5BC</b>	30	—	—
			<b>LXFH5BD</b>	30	—	—
		Slide Screw	<b>LXFH5SA</b>	30	—	15
			<b>LXFH5SB</b>	20	—	9
<b>Series LXP</b>	Linear ball bearing guide 	Ball Screw	<b>LXPB2BC</b>	60	50	220
			<b>LXPB2BD</b>	60	50	90
			<b>LXPB5BC</b>	60	50	160
			<b>LXPB5BD</b>	60	50	70
		Slide Screw	<b>LXPB2SA</b>	60	50	60
			<b>LXPB2SB</b>	30	30	30
			<b>LXPB5SA</b>	40	40	40
			<b>LXPB5SB</b>	20	20	20
<b>Series LXS</b>	High rigidity linear guide 	Ball Screw	<b>LXSH2BC</b>	100	50	220
			<b>LXSH2BD</b>	100	50	90
			<b>LXSH5BC</b>	100	50	160
			<b>LXSH5BD</b>	100	50	70
		Slide Screw	<b>LXSH2SA</b>	90	40	60
			<b>LXSH2SB</b>	45	20	30
			<b>LXSH5SA</b>	60	20	40
			<b>LXSH5SB</b>	30	10	20



System diagram

Supply by user

Max. speed (mm/s)	Positioning repeatability (mm)	Slide screw specifications	Motor specifications	Stroke (mm)								
				25	50	75	100	125	150	175	200	
30	±0.03	Ø8; 2mm lead	ø5 stepping									
80		Ø8; 5mm lead		•	•	•	•					
100	±0.05	Ø8; 6mm lead										
200		Ø8; 12mm lead										
30	±0.03	Ø8; 2mm lead	ø2 stepping									
80		Ø8; 5mm lead										
30		Ø8; 2mm lead	ø5 stepping									
80		Ø8; 5mm lead										
100	±0.05	Ø8; 6mm lead	ø2 stepping		•	•	•	•	•	•	•	•
200		Ø8; 12mm lead										
100		Ø8; 6mm lead	ø5 stepping									
200		Ø8; 12mm lead										
30	±0.03	Ø8; 2mm lead	ø2 stepping									
80		Ø8; 5mm lead										
30		Ø8; 2mm lead	ø5 stepping									
80		Ø8; 5mm lead										
100	±0.05	Ø8; 6mm lead	ø2 stepping		•	•	•	•	•			
200		Ø8; 12mm lead										
100		Ø8; 6mm lead	ø5 stepping									
200		Ø8; 12mm lead										

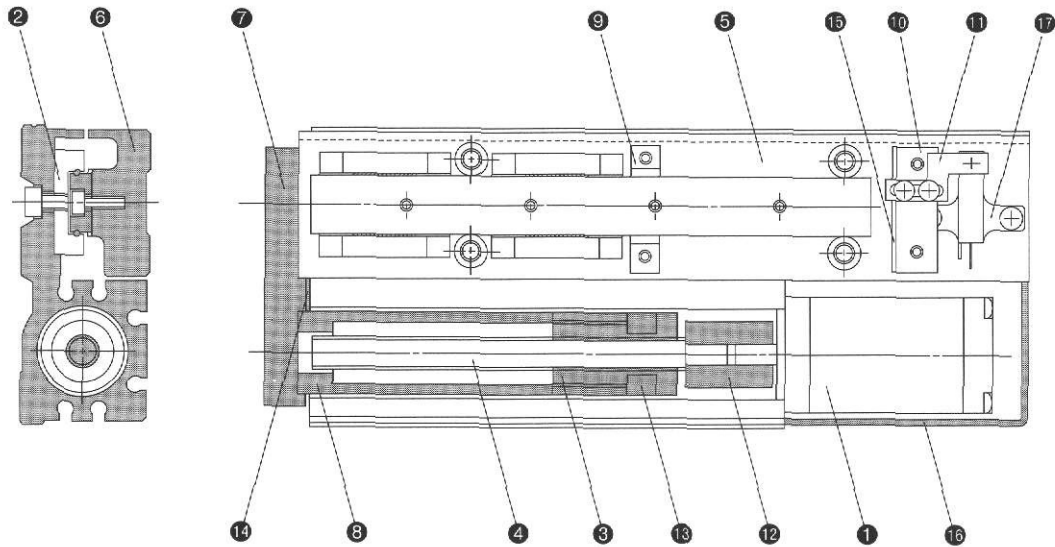


See Page 40

### Specifications

Model	LXFH5SA	LXFH5SB	LXFHBC	LXFHBD
Stroke(mm)	25, 50, 75, 100			
Motor	5-phase stepping motor			
Screw(mm)	ø8, Lead 6	ø8, Lead 12	ø8, Lead 2	ø8, Lead 5
Max. pay load (horizontal orientation)	30N (6.6 lb)	20N (4.4 lb)	30N (6.6 lb)	30N (6.6 lb)
Max. speed	100mm/s	200mm/s	30mm/s	80mm/s
Positioning repeatability	±0.05mm		±0.03mm	
Type of guide	Linear guide			
Operating temperature range	5 to 40°C (40~105°F)			
Static moment allowance	Pitch (Nm)	4		
	Roll (Nm)	3		
	Yaw (Nm)	4		

### Construction

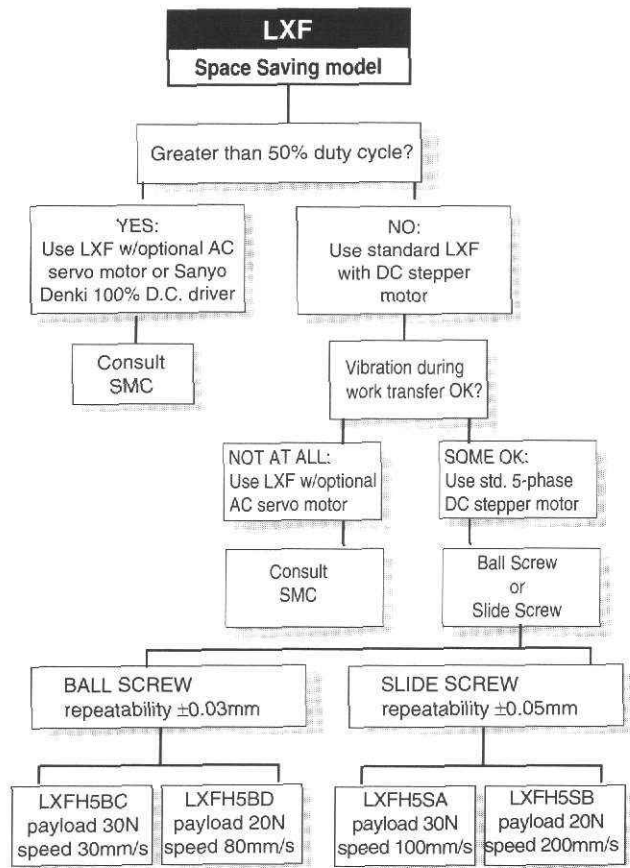


#### Component parts

No.	Description	Material	Note
1	Motor	—	
2	Linear guide	—	
3	Nut	Resin	
4	Forged screw	Alloy steel	
5	Body	Aluminum alloy	Anodized
6	Table	Aluminum alloy	Anodized
7	End plate	Aluminum alloy	Anodized
8	Tube	Aluminum alloy	Anodized
9	Stopper A	Aluminum alloy	

#### Component parts

No.	Description	Material	Note
10	Stopper B	Aluminum alloy	
11	Sensor plate	Soft steel	Chromated
12	Coupling	Aluminum alloy	
13	Magnet	—	
14	Damper	Rubber	
15	Cushion damper	Rubber	
16	Motor cover	Resin	
17	Photo micro sensor	—	



## Duty ratio

When using a stepping motor actuator must be operated at less than 50% of duty ratio\* independent of payload value. Continuous operation time\*\* should be less than 30 seconds.

\*Duty ratio: ratio of actuator operating time and suspended time in a cycle. It is calculated by the formula below.

$$\text{Duty ratio} = \{ \text{Operating time} / (\text{Operating time} + \text{Suspended time}) \} \times 100$$

\* Refer to the examples.

\*\*Continuous operation time: time between the initiation and the end of slider movement

Remark) The operation provisionally ends when slider turns at the stroke end; the operation is no longer "continuous".

Examples below show how to acquire duty ratio and possibility of use.

### Example 1

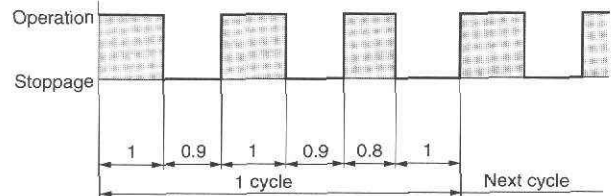


Figure 1

$$\text{Duty ratio} = \{ (1 + 1 + 0.8) / (1 + 0.9 + 1 + 0.8 + 1) \} \times 100 = 50\%$$

∴ Possible to use.

### Example 2

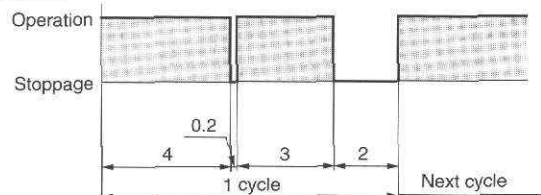


Figure 2

$$\text{Duty ratio} = \{ (4 + 3) / (4 + 0.2 + 3 + 2) \} \times 100 = 76\%$$

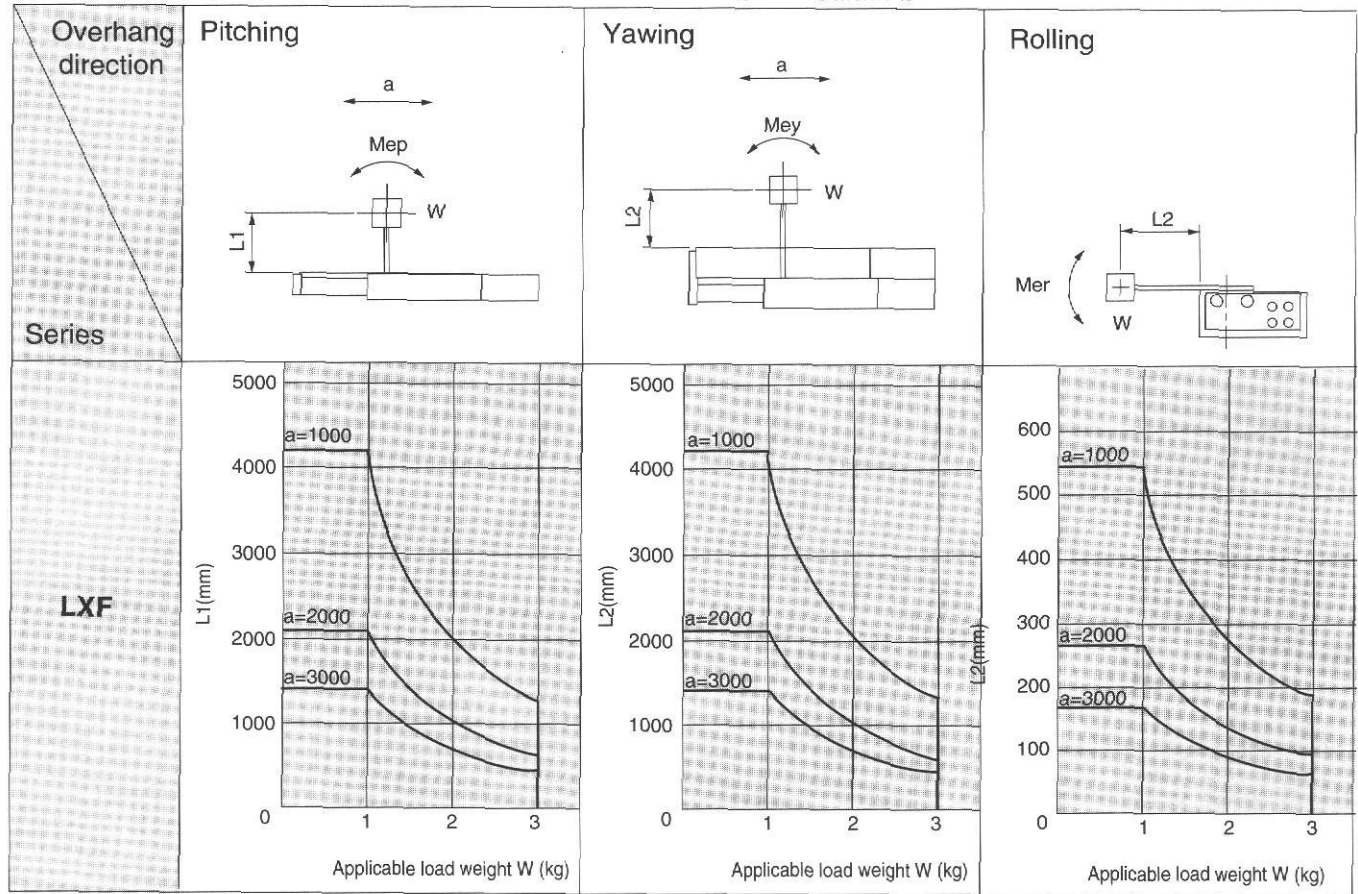
∴ Not possible to use.



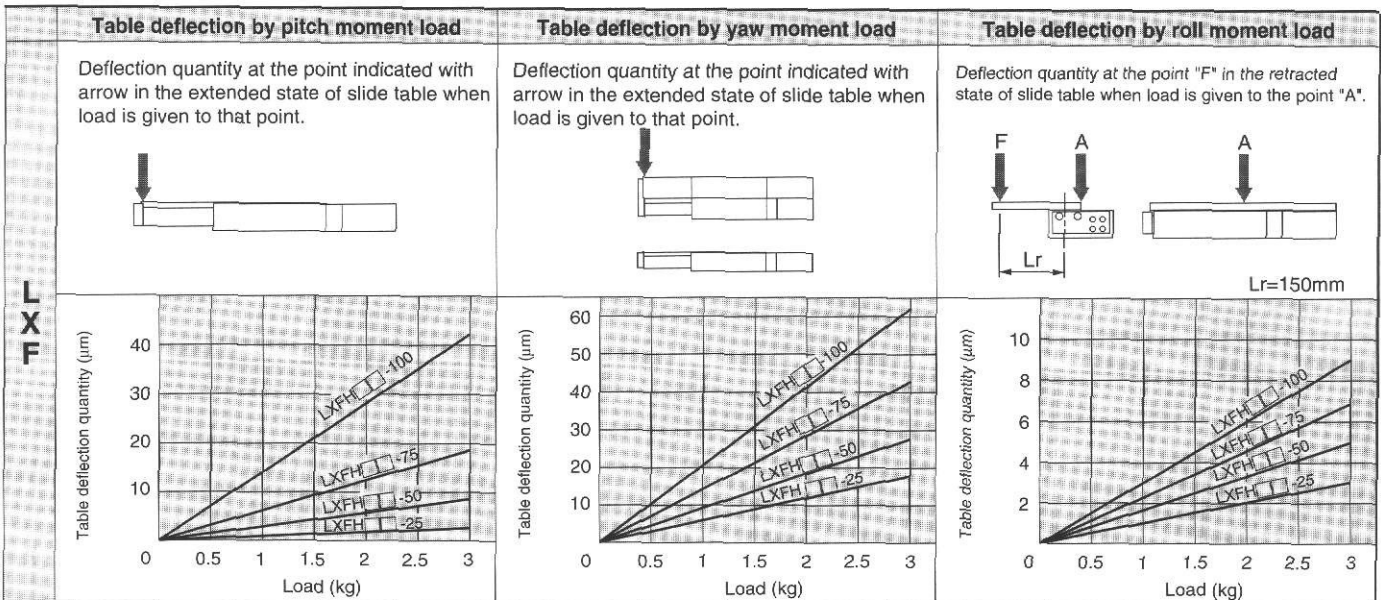
## Kinetic Moment Allowance

Table receives moment from each direction according to center of gravity of work. Overhang of work should be within the range shown in the figures below.

W: Applicable load weight (kg)  
 L1, L2: Overhang distance to the center of gravity of work (mm)  
 a: Acceleration of work (mm/sec<sup>2</sup>)  
 Me: Kinetic moment



## Table Deflection

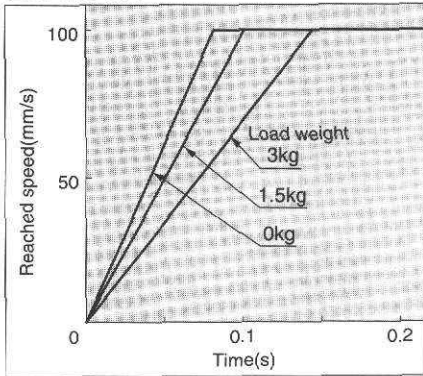


### How to use the graph

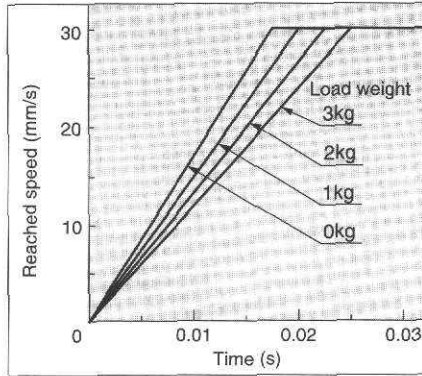
1. If work overhangs to the direction of "L1" or "L2", 70% of applicable load weight shown in the graph is the upper limit.
2. The graph above shows the case of horizontal orientation of actuator. If using in vertical, static moment should NOT exceed static moment allowance. Above graph is based on calculation; therefore, there may be differences from values of actual usage. Safe margin must be taken into consideration when designing. See the specifications of each model for static moment allowance.

Criteria of Accelerating Speed (Horizontal Orientation)

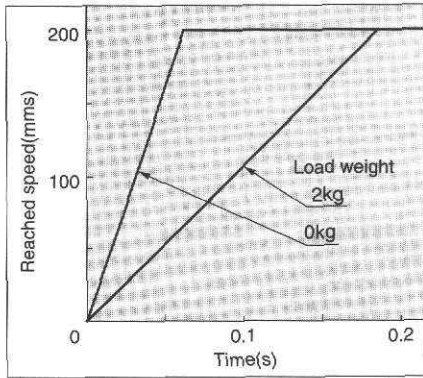
LXFH5SA



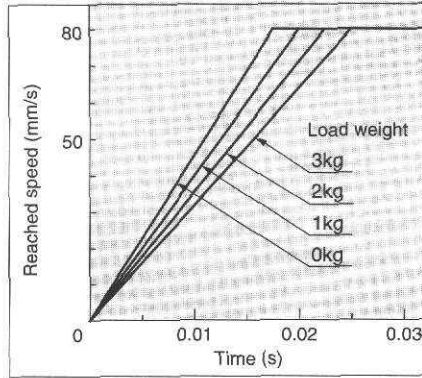
LXFH5BC



LXFH5SB

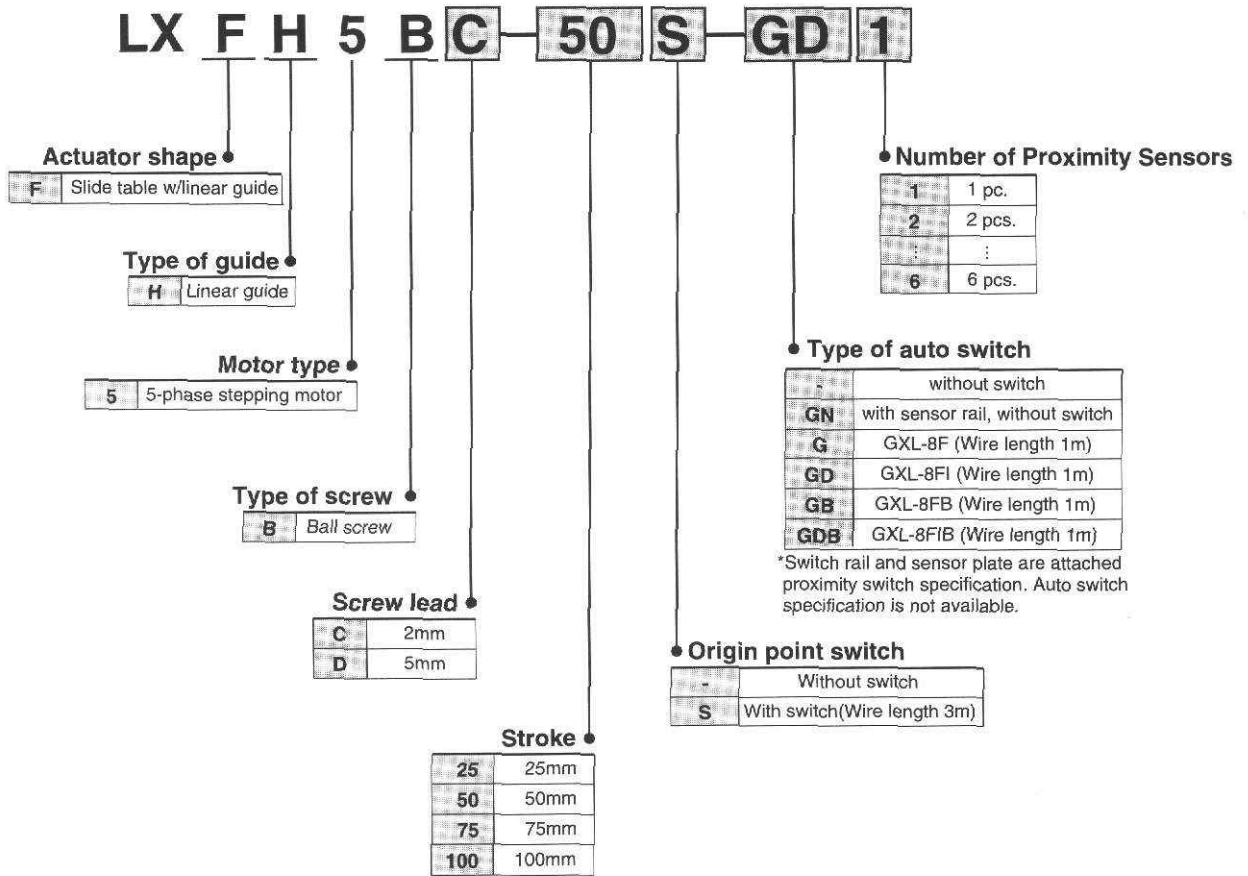


LXFH5BD



**⚠ Caution**

- \*Payload should be under the max. payload.
- \*Accelerating time is decided per pay load and reached speed.
- \*If operating beyond the range shown in those graphs, unit may function improperly.
- \*The data in these graphs represents the LXS used with the LC6D in half-step mode.
- \*Data varies depending upon operating conditions.



### Proximity Sensor Information

The LX series uses SUNX brand GXL-8F series micro proximity sensors. For more information on these sensors, please visit the SUNX website at [www.sunx-ramco.com](http://www.sunx-ramco.com)

Designator	<b>G</b>	<b>GD</b>	<b>GB</b>	<b>GDB</b>
SUNX Part Number	GXL-8F	GXL-8FB	GXL-8FI	GXL-8FIB
Sensing Type	Approach-ON	Depart-ON	Approach-ON	Depart-ON
			Varied Frequency*	Varied Frequency*
Output	NPN Open-Collector (100mA)			
Sensing Direction	Front			
Sensing Range	2.5mm ±20% (rated), 0~1.8mm (normal)			
Indication	Red LED when ON			
Cable Length	1m, extendable up to 100m			

\*Units with the suffix "I" are varied oscillating frequency type. Use this type when installing 12mm or closer to the nearest sensor. Separate by at least 2mm when using three or more sensors.

### Applicable driver unit

	DC power supply type driver
<b>LXFH5S</b>	LC6D-507AD

**LX F H 5 S B 50 S F9N 1**

Actuator shape

F	Guided slide table
---	--------------------

Type of guide

H	Linear guide
---	--------------

Motor type

5	5-phase stepping motor
---	------------------------

Type of screw

S	Acme screw
---	------------

Screw lead

A	6mm
B	12mm

Stroke

25	25mm
50	50mm
75	75mm
100	100mm

Number of auto switch

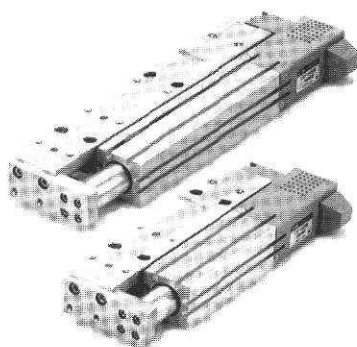
1	1 pc.
2	2 pcs.
⋮	⋮
6	6 pcs.

Type of auto switch

-	Nil
F9N	D-F9N(Lead wire length: 0.5m)
F9P	D-F9P(Lead wire length: 0.5m)
F9B	D-F9B(Lead wire length: 0.5m)
F9NL	D-F9NL(Lead wire length: 3m)
F9PL	D-F9PL(Lead wire length: 3m)
F9BL	D-F9BL(Lead wire length: 3m)

Origin point switch

-	Without switch
S	With switch(Wire length 3m)



Applicable auto switch

Part number	Type	Wiring method/ output type	Indicator light	Electrical entry	Lead wire length(m)	
					0.5(-)	3(L)
D-F9N	Solid-state switch	3-wire/NPN	With	In-line	●	●
D-F9P		3-wire/PNP	With	In-line	●	●
D-F9B		2-wire	With	In-line	●	●

\* Refer to page 47 for further specifications of auto switch.

Applicable driver unit

	DC power supply type driver
LXFH5S	LC6D-507AD

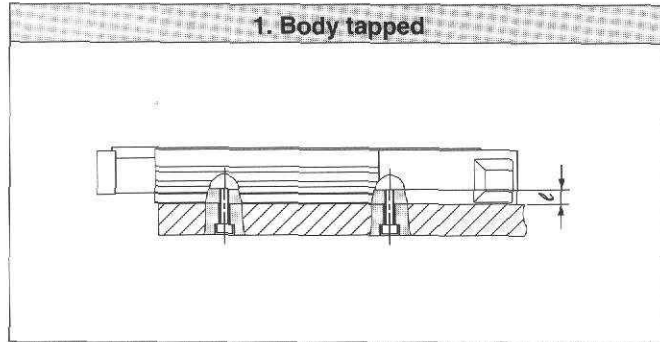
Origin Home Switch Information

K series actuators are available with an optional photo micro sensor as an origin home switch to detect when the actuator is fully retracted. The LC6C series positioning driver requires an input from the origin home switch or some other sensor when homing the actuator. The origin home switch can be used for other purposes as well, and likewise other sensors can be used to trigger the home position. Please refer to pages 42 and 45 of this catalog for more information and precautions regarding the optional origin home switch.

### How to mount LXF

#### How to mount actuator

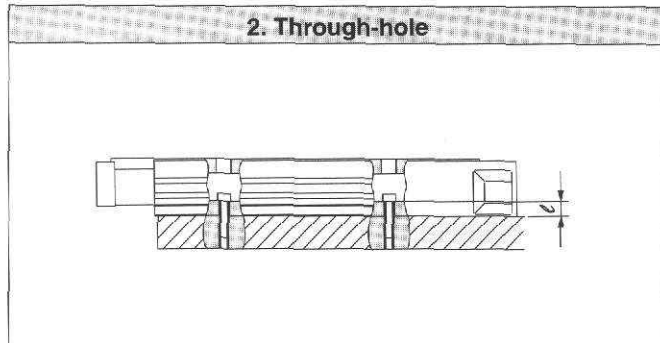
Actuator can be mounted from two directions according to machinery or work requirements.



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth ( $l$ mm)
LXF	M5x0.8	4.4(44.9)	8

#### ⚠ Caution

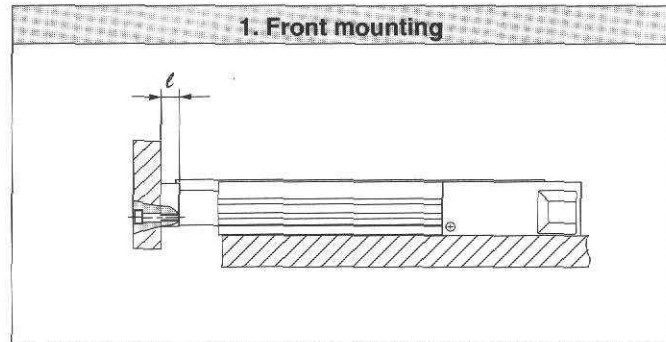
Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.



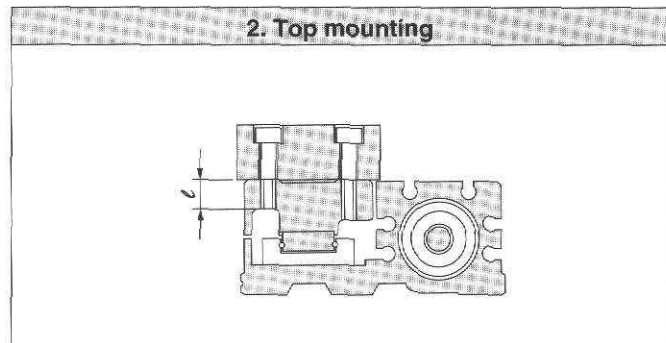
Series	Bolt	Max. tightening torque Nm(kgf-cm)	Body thickness ( $l$ mm)
LXF	M4x0.7	2.1(21.4)	8

#### How to mount work

Work can be mounted on two faces of the actuator.



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Body thickness ( $l$ mm)
LXF	M4x0.7	2.1(21.4)	10



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth ( $l$ mm)
LXF	M4x0.7	2.1(21.4)	8

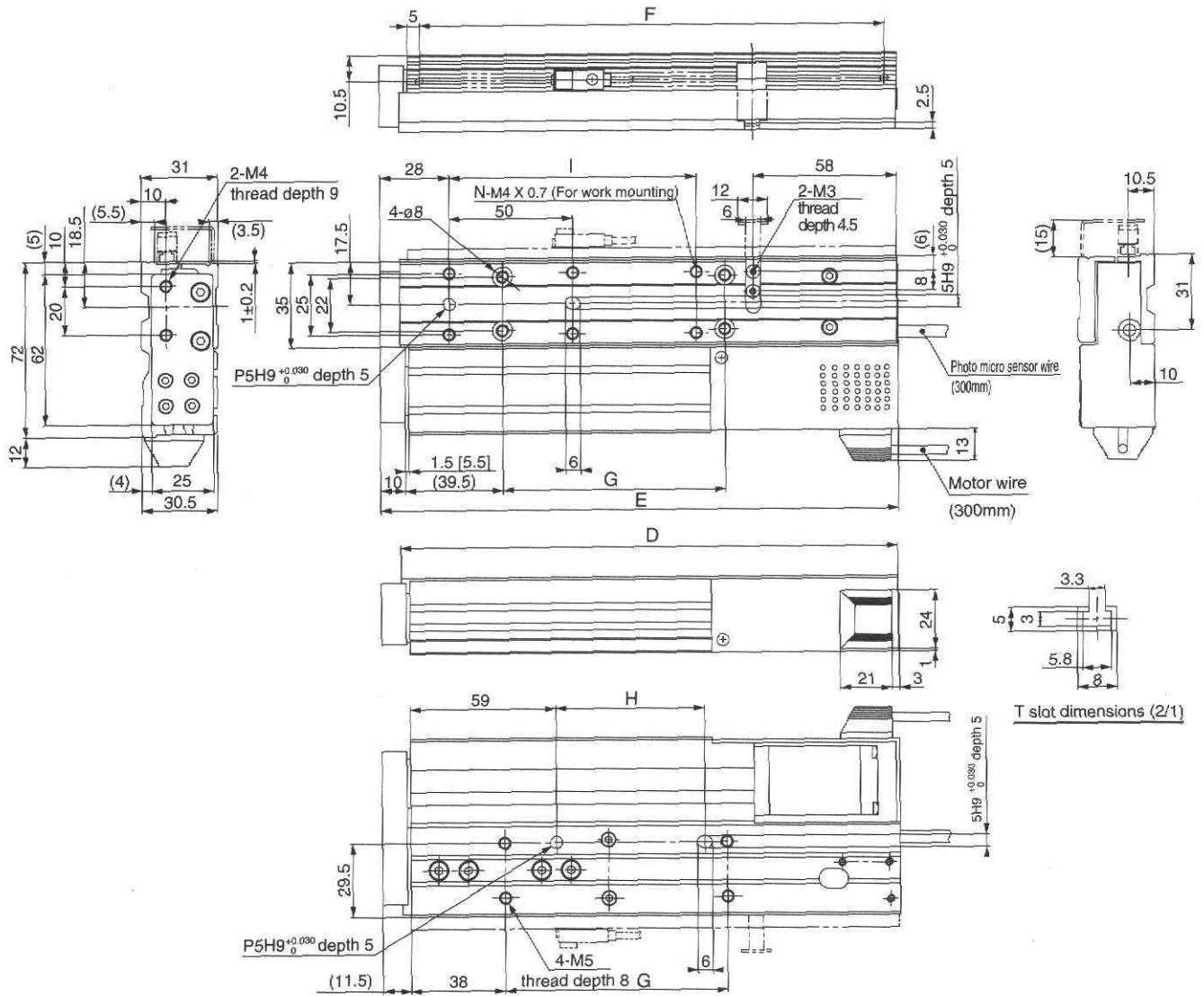
#### ⚠ Caution

Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.

### How To Operate The LXF

The standard LXF series actuator uses a 5-phase uni-polar DC stepper motor. (0.7A/ø). The motor requires a driver to move the motor based on the input commands. The LXF can be operated with either the LC6D-507AD basic stepper driver or other compatible driver. See pages 31-39 for more information on SMC's LC6 series drivers.

LXFH5B

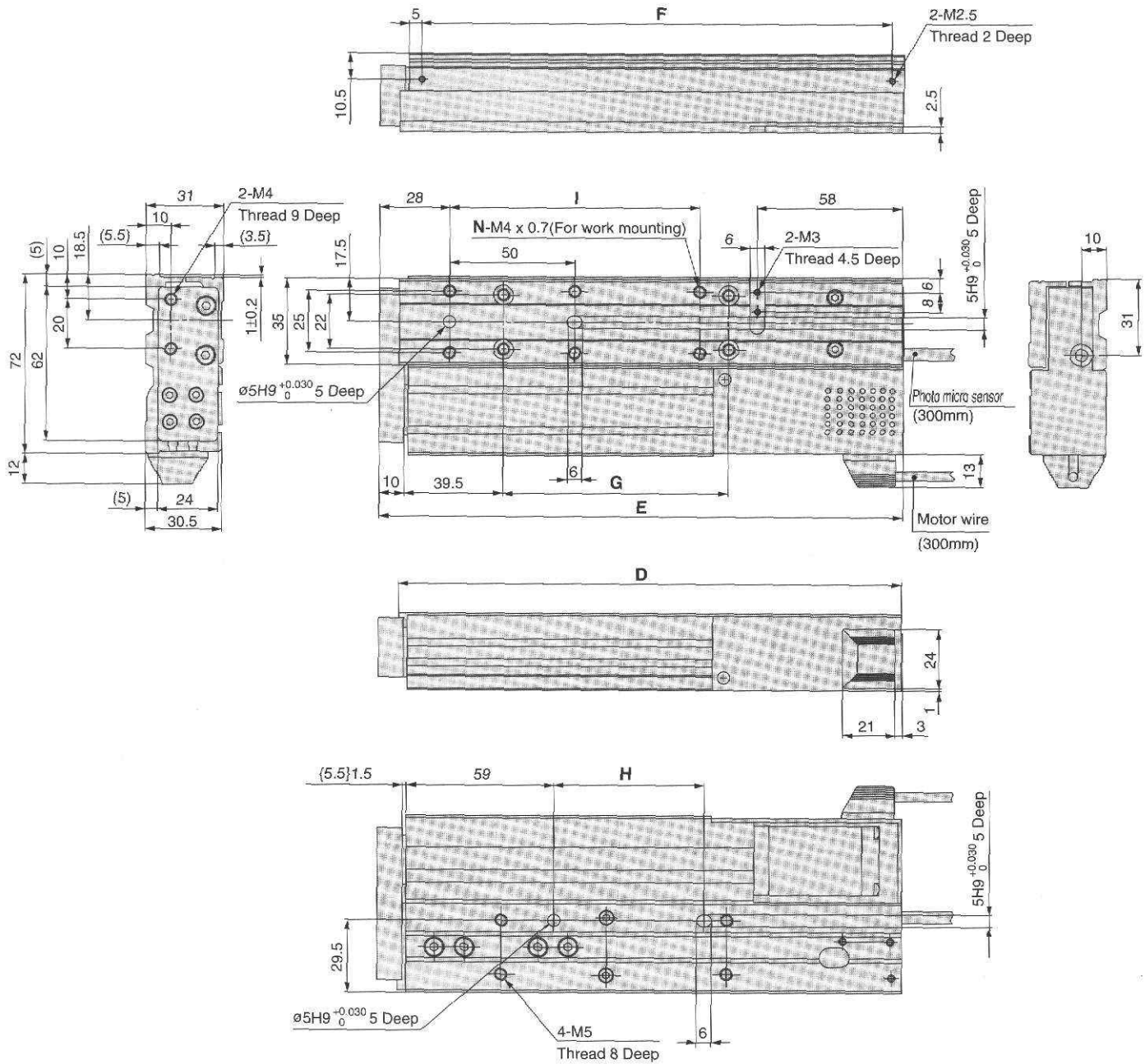


[ ] shows the location at which origin point switch operates.

Model	N	D	E	F	G	H	I
LXFH5B _ - 25	4	151	160	138	60	30	(50)
LXFH5B _ - 50	4	176	185	163	90	60	(50)
LXFH5B _ - 75	6	201	210	188	90	60	100
LXFH5B _ -100	6	226	235	213	90	60	100

### LXFH5S

Scale: 40%

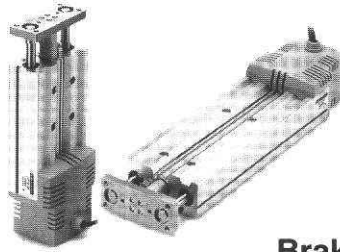


[ ] shows the location at which origin point switch operates.

Model	N	D	E	F	G	H	I
LXFH5S-25	4	151	160	138	60	30	(50)
LXFH5S-50	4	176	185	163	90	60	(50)
LXFH5S-75	6	201	210	188	90	60	100
LXFH5S-100	6	226	235	213	90	60	100

Low Profile  
Electric Actuator  
with Guides

# Series LXP



## Specifications

Model	LXPB2SA	LXPB2SB	LXPB5SA	LXPB5SB
Stroke (mm)	50, 75, 100, 125, 150, 175, 200			
Motor	2-phase stepping motor		5-phase stepping motor	
Screw (mm)	ø8, Lead 6	ø8, Lead 12	ø8, Lead 6	ø8, Lead 12
Max. pay load (horizontal)	6kg	3kg	4kg	2kg
Max. pay load (vertical)	5kg	3kg	4kg	2kg
Max. speed	100mm/s	200mm/s	100mm/s	200mm/s
Positioning repeatability	±0.05mm			
Type of guide	Linear ball bearing			
Operating temperature range	5 to 40°C (No dewing)			

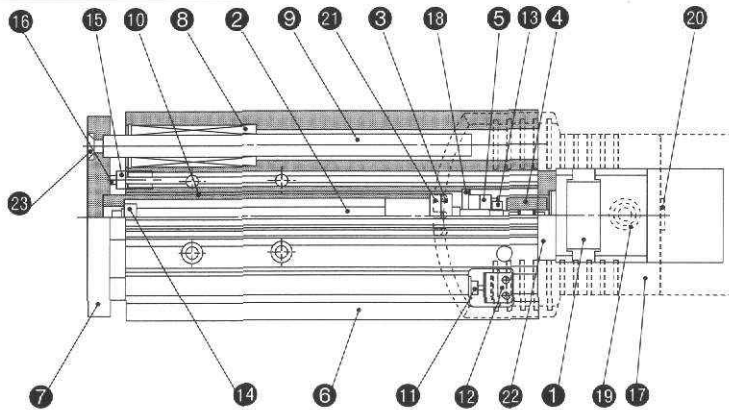
## Brake specifications

Model	Negative actuate type
Static torque	0.1Nm (1kgf-cm) or more
Rated voltage	24V(DC)±5%
Power consumption	5W(at 75°C)

Model	LXPB2BC	LXPB2BD	LXPB5BC	LXPB5BD
Ball screw	ø8 lead 2mm	ø8 lead 5mm	ø8 lead 2mm	ø8 Lead 5mm
Max. allowable weight	Horizontal 60N			
	Vertical 50N(220N)	Vertical 50N(90N)	Vertical 50N(160N)	Vertical 50N(70N)
Max. speed	30mm/s	80mm/s	30mm/s	80mm/s
Positioning repeatability	± 0.03mm		± 0.03mm	
Min. lead *	Half step 0.005mm	0.0125mm	0.002mm	0.005mm
	Full step 0.01mm	0.025mm	0.004mm	0.01mm

\* With one pulse input

## Construction



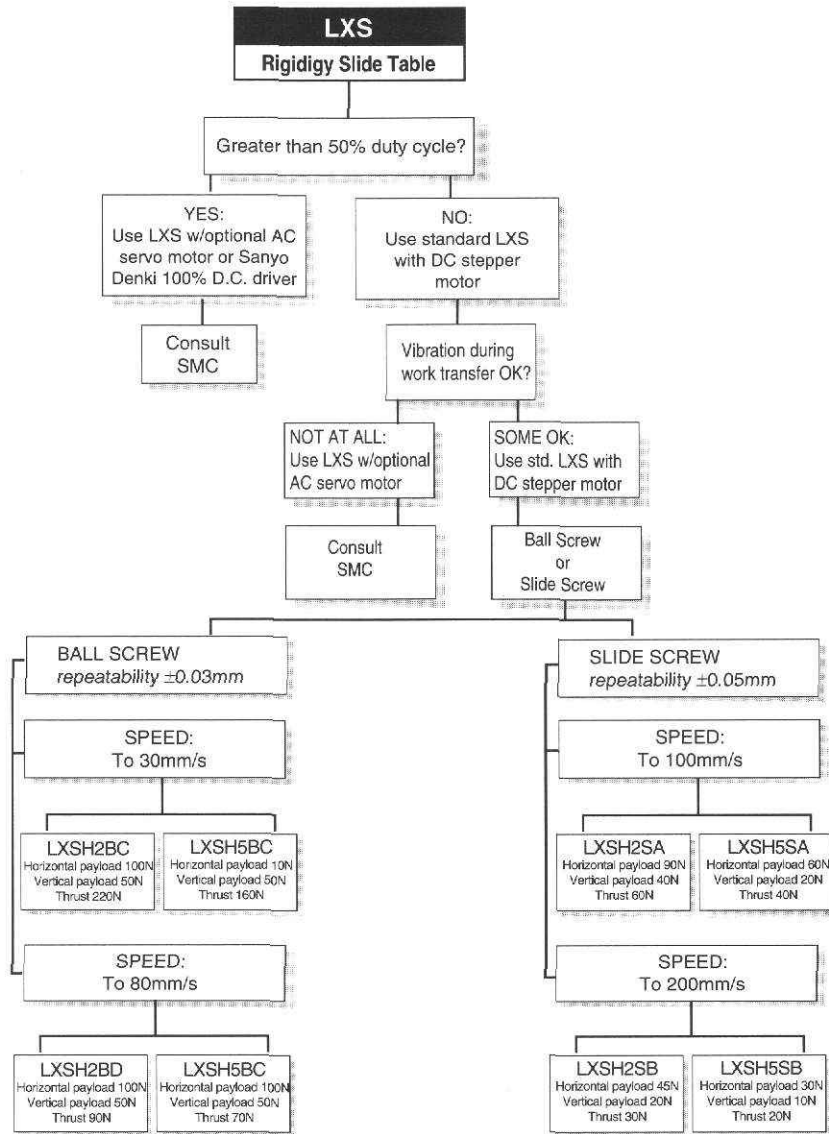
### Component parts

No.	Description	Material	Note
1	Motor	—	Stepping motor
2	Forged screw	Alloy steel	
3	Nut	Resin	
4	Coupling	—	Chromated
5	Bearing	—	Nickel plated
6	Body	Aluminum alloy	
7	Mounting plate	Soft steel	Chromated
8	Linear ball bearing	—	Anodized
9	Guide rod	Bearing steel	
10	Tube	Aluminum alloy	
11	Sensor pin	Stainless steel	

### Component parts

No.	Description	Material	Note
12	Photo micro sensor	—	
13	Lock nut	Carbon steel	Black zinc chromated
14	Stopper nut	Aluminum alloy	
15	Damper bolt	Bearing steel	Nickel plated
16	Damper	Resin	
17	Motor cover	Resin	
18	Tension ring	Stainless steel	
19	Cable cap		
20	Plug		
21	Magnet	—	
22	Adopter	Aluminum alloy	
23	Plate mounting bolt	Carbon steel	Nickel plated





## Duty ratio

When using a stepping motor actuator must be operated at less than 50% of duty ratio independent of payload value. Continuous operation time should be less than 30 seconds.

Duty ratio: ratio of actuator operating time and suspended time in a cycle. It is calculated by the formula below.

$$\text{Duty ratio} = \left\{ \frac{\text{Operating time}}{\text{Operating time} + \text{Suspended time}} \right\} \times 100$$

Refer to the examples.

Continuous operation time: time between the initiation and the end of slider movement

Remark) The operation provisionally ends when slider turns at the stroke end; the operation is no longer "continuous".

### Example 1

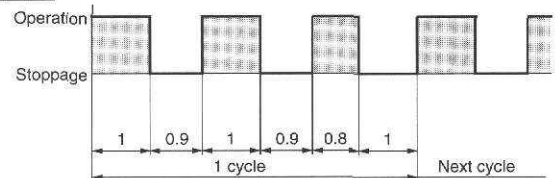


Figure 1

$$\text{Duty ratio} = \left\{ \frac{1 + 1 + 0.8}{1 + 0.9 + 1 + 0.8 + 1} \right\} \times 100 = 50\%$$

∴ Possible to use.

### Example 2

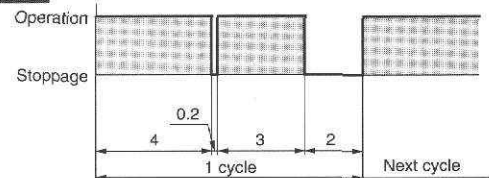


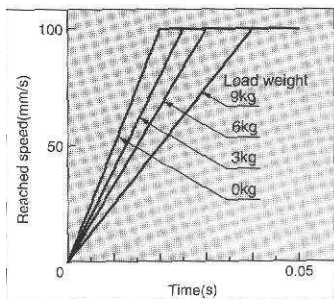
Figure 2

$$\text{Duty ratio} = \left\{ \frac{4 + 3}{4 + 0.2 + 3 + 2} \right\} \times 100 = 76\%$$

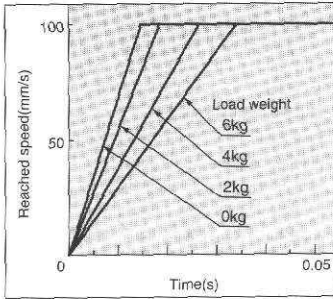
∴ Not possible to use.

Criteria of Accelerating Speed (Horizontal Orientation)

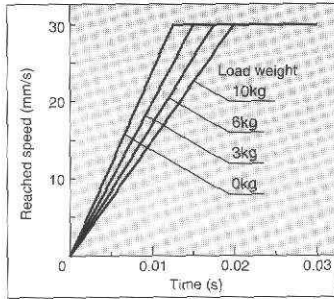
LXPB2SA



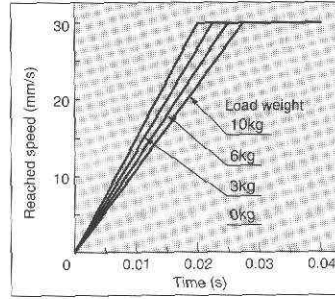
LXPB5SA



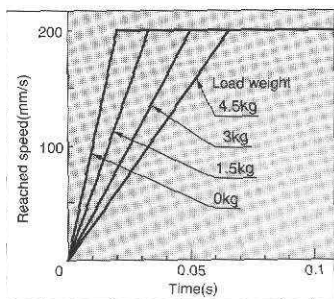
LXPB2BC



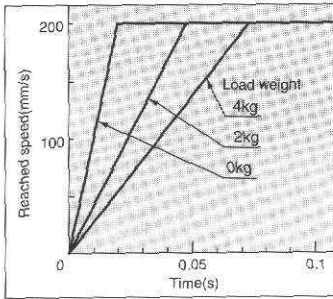
LXPB5BC



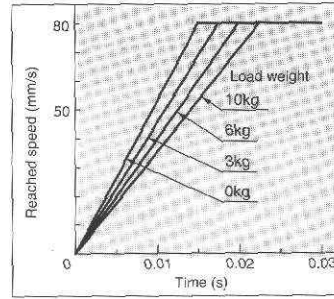
LXPB2SB



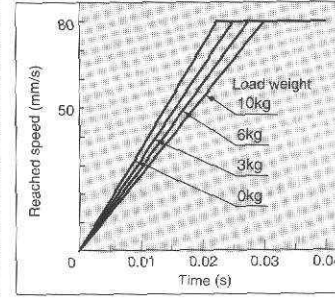
LXPB5SB



LXPB2BD

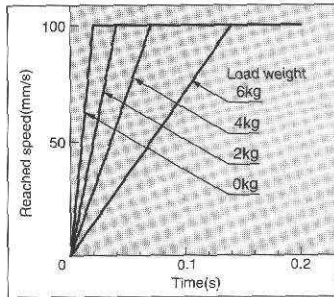


LXPB5BD

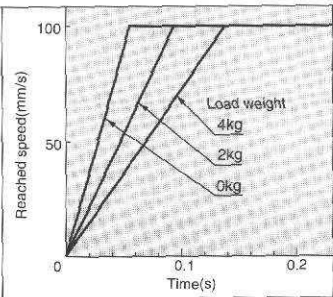


Criteria of Accelerating Speed (Vertical Orientation)

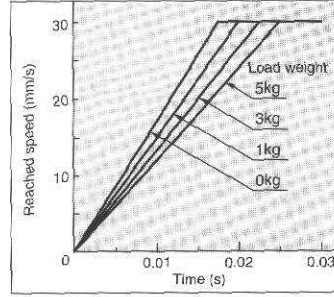
LXPB2SA



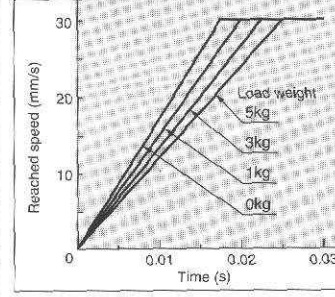
LXPB5SA



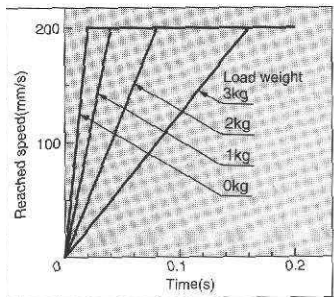
LXPB2BC



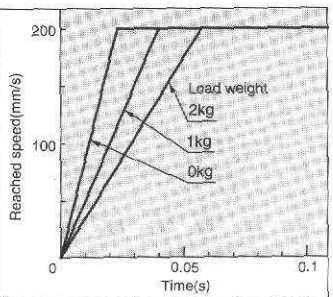
LXPB5BC



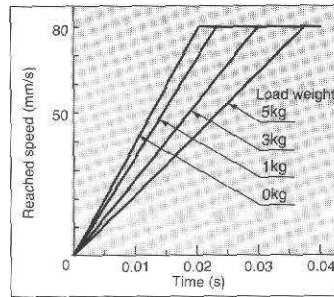
LXPB2SB



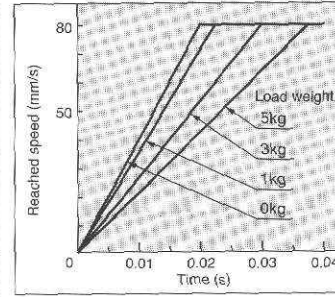
LXPB5SB



LXPB2BD



LXPB5BD



**Caution**

Pay load should be under the maximum pay load.

Accelerating time is decided per pay load and reached speed.

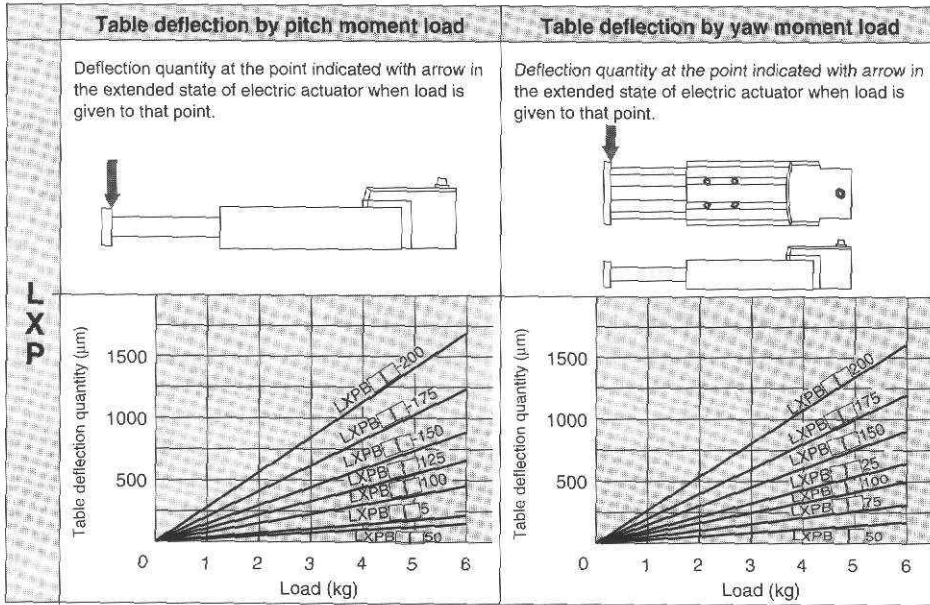
If operating beyond the range shown in these graphs, unit may function improperly.

These graphs consist of data when SMC made DC power supply input type driver unit is used and the excitation is half step.

Data varies depending upon operating conditions.

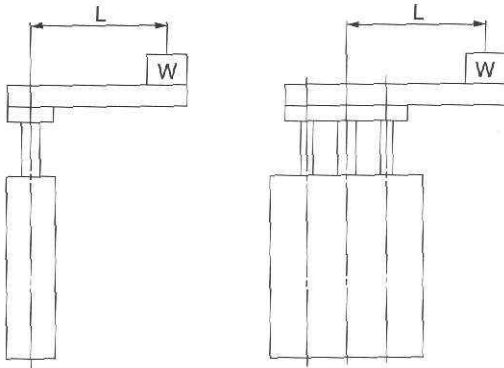
## Table Deflection

### Table Deflection

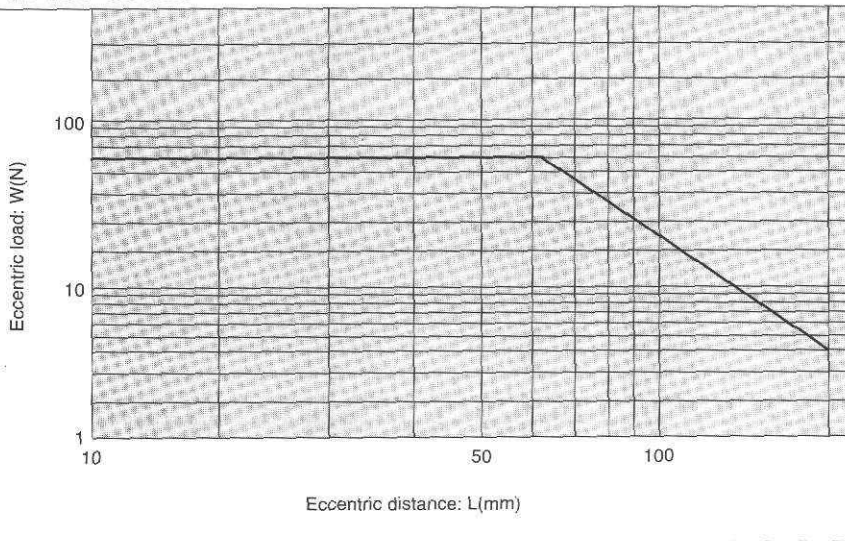


### Working range when LXP is used as lifter

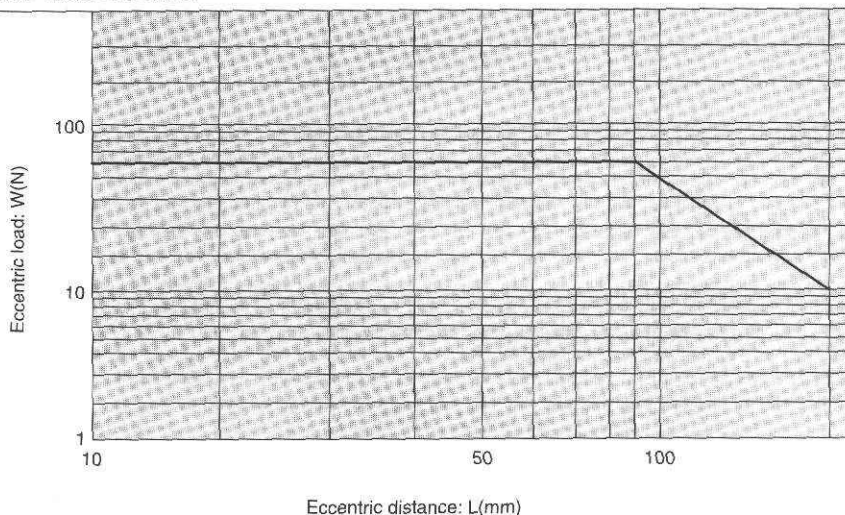
Working range to linear ball bearing. Use within allowable thrust.



#### 50 to 100 stroke



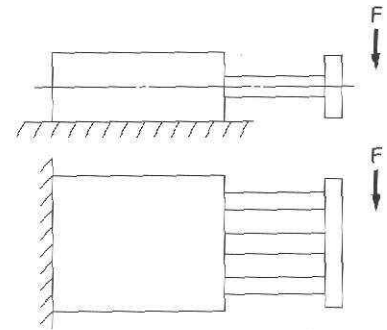
#### Over 100 stroke



### Operating conditions

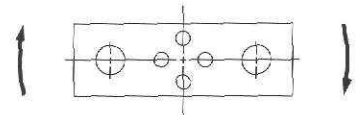
#### Lateral load allowance

Stroke	Load (N)
50	60
75	60
100	58
125	60
150	54
175	48
200	43



#### Plate rotation torque

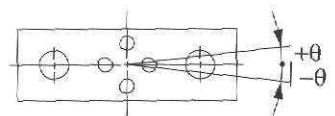
Stroke	Torque (Nm)
50	2.87
75	2.47
100	2.17
125	2.38
150	2.16
175	1.98
200	1.82

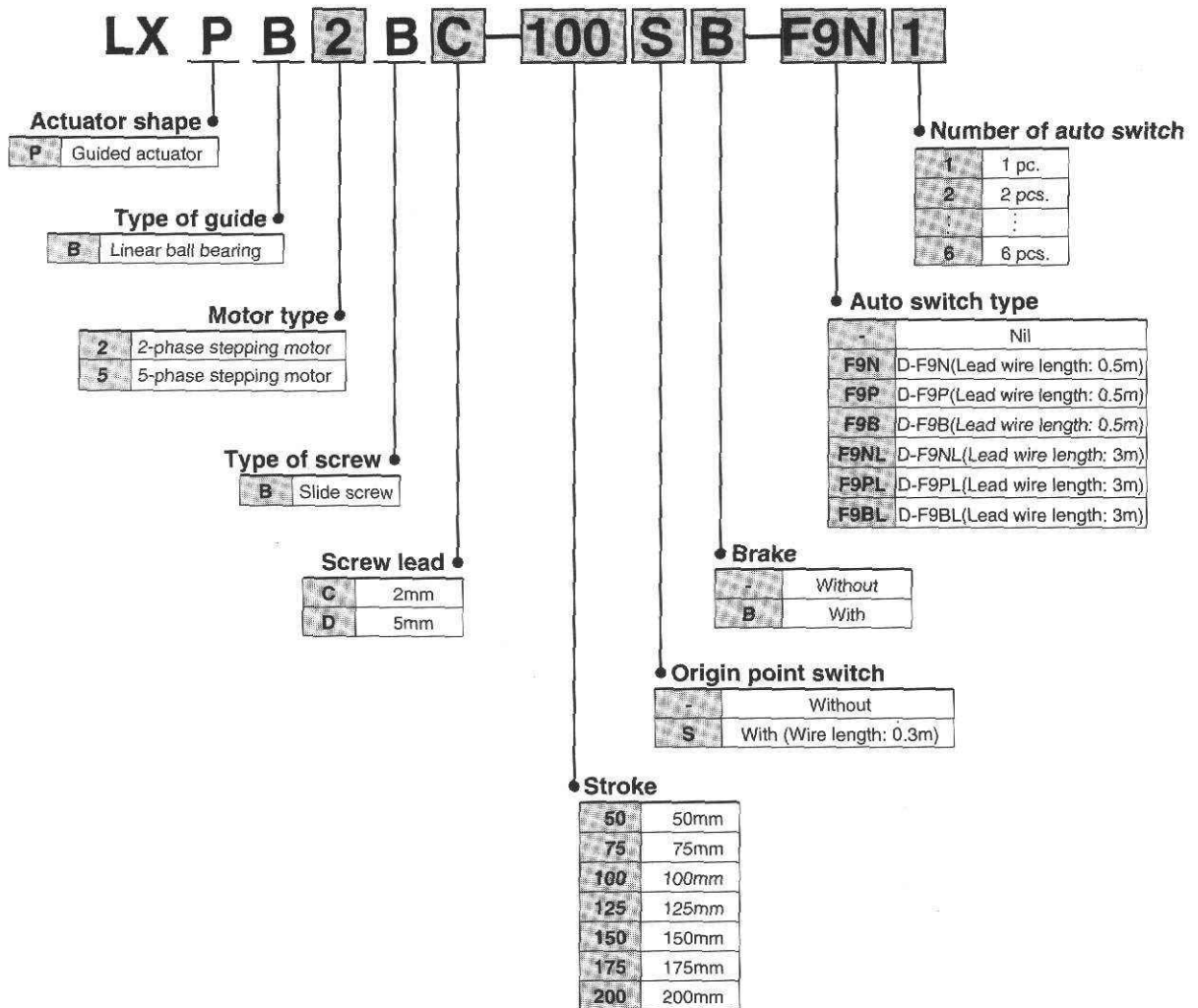


#### Non-rotating accuracy of plate

Non-rotating accuracy  $\theta$

$\pm 0.09^\circ$





### Applicable driver unit

	DC power supply type driver
LXPB2B	LC6D-220AD, LC6C-220AD
LXPB5B	LC6D-507AD

### Origin Home Switch Information

LX series actuators are available with an optional photo micro sensor as an origin home switch to detect when the actuator is fully retracted. The LC6C series positioning driver requires an input from the origin home switch or some other sensor when homing the actuator. The origin home switch can be used for other purposes as well, and likewise other sensors can be used to trigger the home position. Please refer to pages 42 and 45 of this catalog for more information and precautions regarding the optional origin home switch.

**LX P B 2 S B 100 S B F9N 1**

Actuator shape

P	Guided actuator
---	-----------------

Type of guide

B	Linear ball bearing
---	---------------------

Motor type

2	2-phase stepping motor
5	5-phase stepping motor

Type of screw

S	Slide screw
---	-------------

Screw lead

A	6mm
B	12mm

Number of auto switch

1	1 pc.
2	2 pcs.
⋮	⋮
6	6 pcs.

Auto switch type

	Nil
F9N	D-F9N(Lead wire length: 0.5m)
F9P	D-F9P(Lead wire length: 0.5m)
F9B	D-F9B(Lead wire length: 0.5m)
F9NL	D-F9NL(Lead wire length: 3m)
F9PL	D-F9PL(Lead wire length: 3m)
F9BL	D-F9BL(Lead wire length: 3m)

Brake

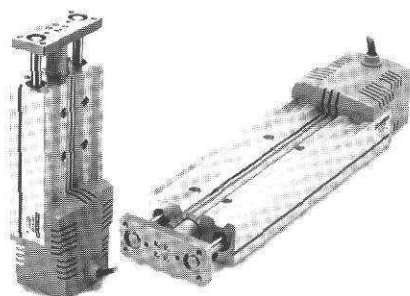
-	Without
B	With

Origin point switch

-	Without
S	With (Wire length: 0.3m)

Stroke

50	50mm
75	75mm
100	100mm
125	125mm
150	150mm
175	175mm
200	200mm



Applicable auto switch

Part number	Type	Wiring method/ output type	Indicator light	Electrical entry	Lead wire length(m)	
					0.5(-)	3(L)
D-F9N	Solid-state switch	3-wire/NPN	With	In-line	•	•
D-F9P		3-wire/PNP	With	In-line	•	•
D-F9B		2-wire	With	In-line	•	•

\* Refer to page 47 for further specifications of auto switch.

Applicable driver unit

	DC power supply type driver
LXPB2S	LC6D-220AD, LC6C-220AD
LXPB5S	LC6D-507AD

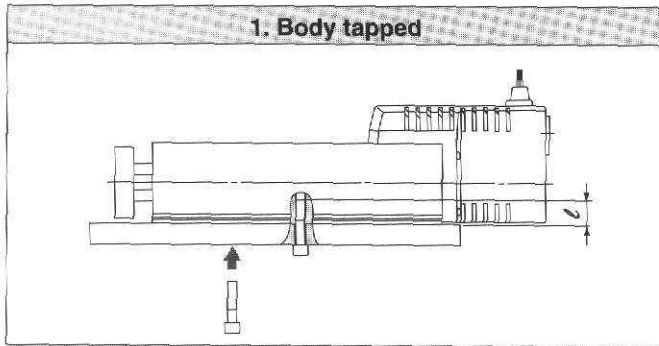
Origin Home Switch Information

X series actuators are available with an optional photo micro sensor as an origin home switch to detect when the actuator is fully retracted. The LC6C series positioning driver requires an input from the origin home switch or some other sensor when homing the actuator. The origin home switch can be used for other purposes as well, and likewise other sensors can be used to trigger the home position. Please refer to pages 42 and 45 of this catalog for more information and precautions regarding the optional origin home switch.

## How To Mount LXP

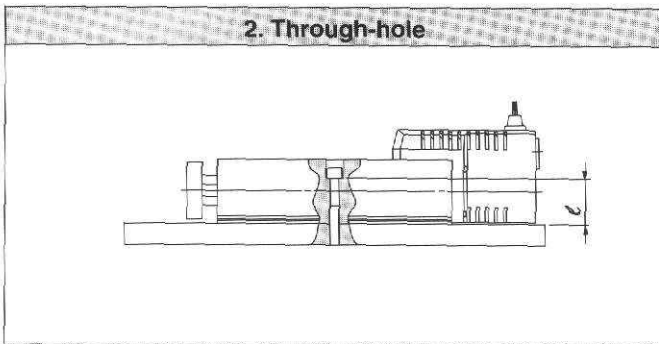
### How to mount actuator

#### 1. Body tapped



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (ℓmm)
LXP	M6x1	7.4(75.5)	12

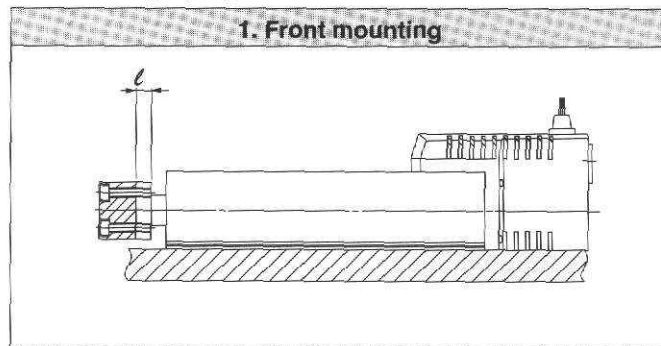
#### 2. Through-hole



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Body thickness (ℓmm)
LXP	M5x0.8	4.4(44.9)	37.5

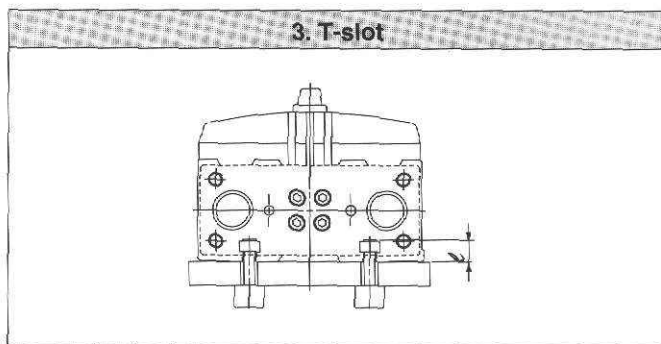
### How to mount work

#### 1. Front mounting



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (ℓmm)
LXP	M6x1	7.4(75.5)	10

#### 3. T-slot



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (ℓmm)
LXP	M5x0.8	7.4(75.5)	8.5

### ⚠ Caution

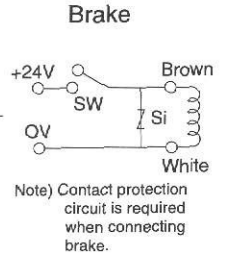
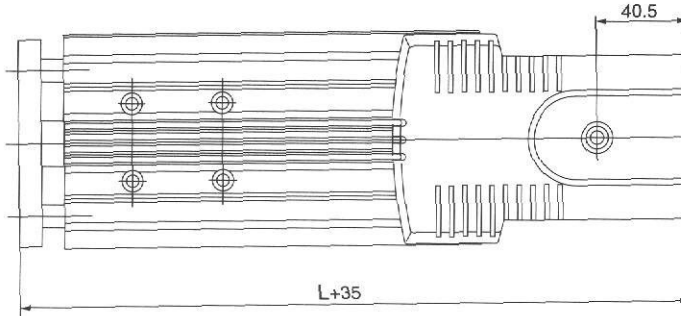
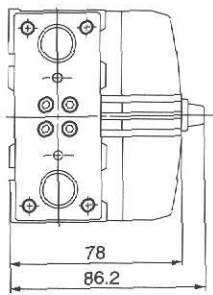
Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.

### How To Operate The LXP

The standard LXP series actuator is available with either a 2-phase (2.0A/ø) or a 5-phase (0.7A/ø) uni-polar DC stepper motor. The motor requires a driver to move the motor based on the input commands. The LXP can be operated with either the LC6D-220AD (2ø) or LC6D-507AD (5ø) basic stepper driver, the LC6C-220AD (2ø) positioning driver, or other compatible driver. See pages 40~46 for more information on SMC's LC6 series drivers.

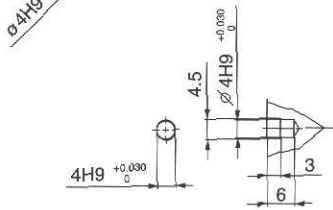
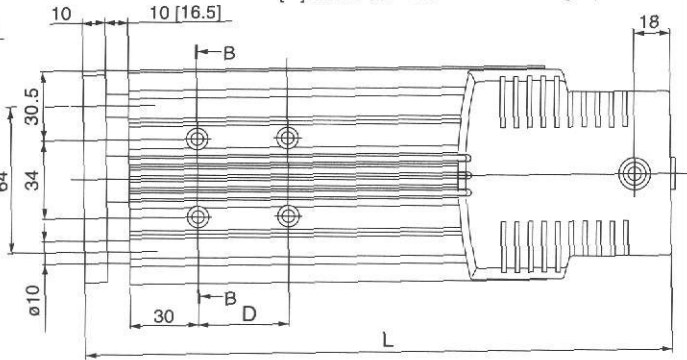
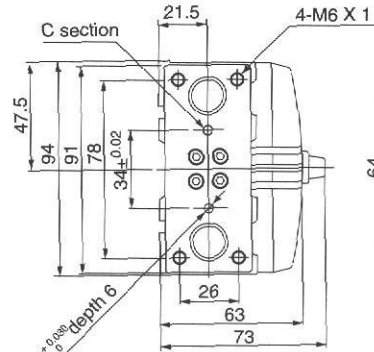
LXPB\_B\_

With brake

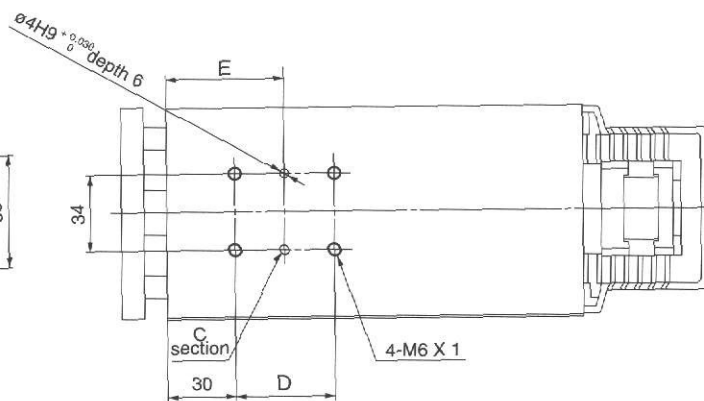
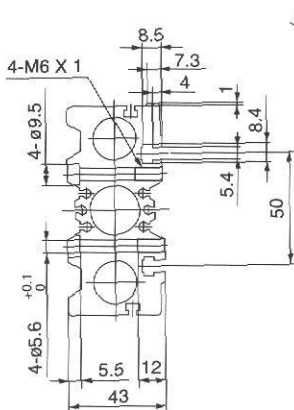
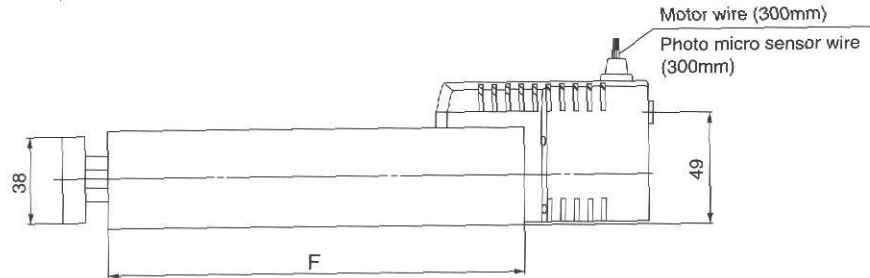


[ ] shows the location at which origin point switch operates.

Without brake



C section details



Cross section BB

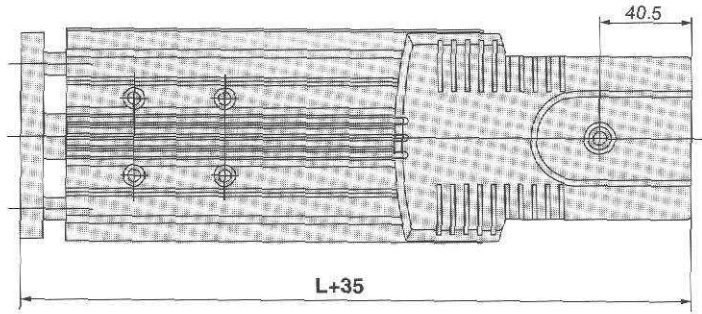
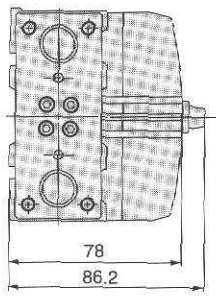
Model	D	E	F	L
LXPB_B_- 50	44	52	154	231
LXPB_B_- 75			179	256
LXPB_B_-100			204	281
LXPB_B_-125	120	90	246	323
LXPB_B_-150			271	348
LXPB_B_-175			296	373
LXPB_B_-200			321	398



### LXPB S

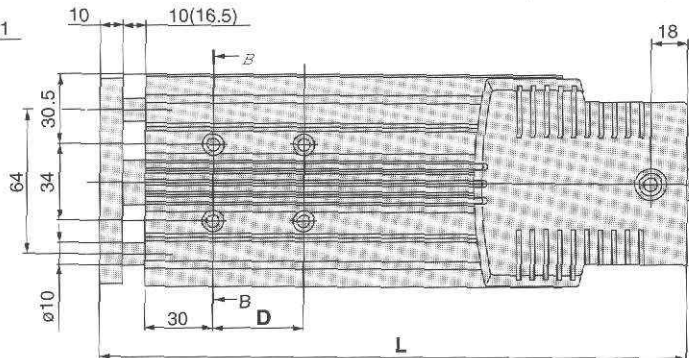
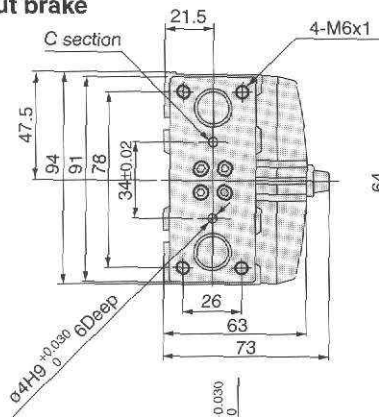
With brake

Scale: 30%

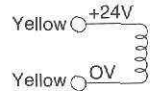


[ ] shows the location at which origin point switch operates.

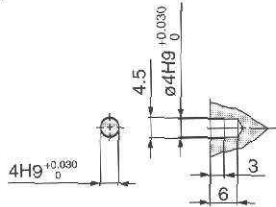
Without brake



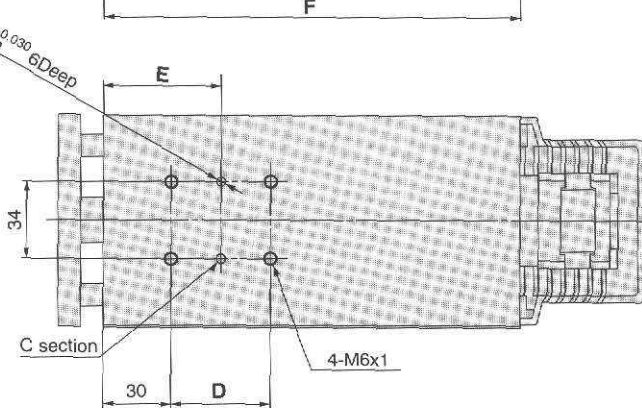
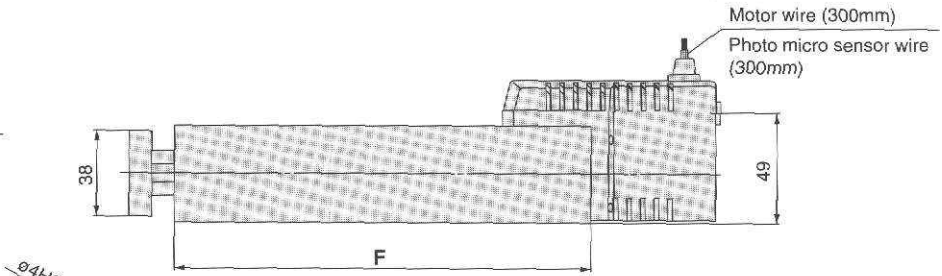
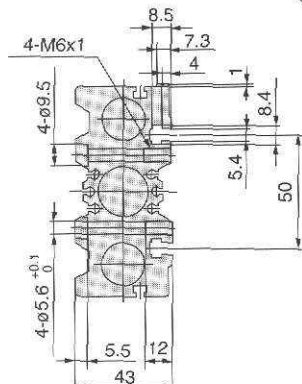
**Brake electric circuit**



Note) Contact protection circuit is required when connecting brake.

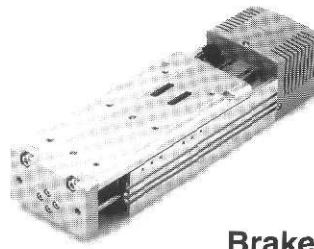


**C section detail**



**Cross section BB**

Model	D	E	F	L
LXPB S -50	44	52	154	231
LXPB S -75			179	256
LXPB S -100			204	281
LXPB S -125	120	90	246	323
LXPB S -150			271	348
LXPB S -175			296	373
LXPB S -200			321	398



## Specifications

Model	LXSH2SA	LXSH2SB	LXSH5SA	LXSH5SB
Stroke (mm)	50, 75, 100, 125, 150			
Motor	2-phase stepping motor		5-phase stepping motor	
Screw (mm)	ø8 Lead 6	ø8 Lead 12	ø8 Lead 6	ø8 Lead 12
Max. pay load (horizontal)	9kg	4.5kg	6kg	3kg
Max. pay load (vertical)	4kg	2kg	2kg	1kg
Max. speed	100mm/s	200mm/s	100mm/s	200mm/s
Positioning repeatability	±0.05mm			
Type of guide	High rigidity linear guide			
Operating temperature	5 to 40°C (No dewing)			
Static moment allowance	Pitching (Nm)	15.7		
	Rolling (Nm)	15.7		
	Yawing (Nm)	7.84		

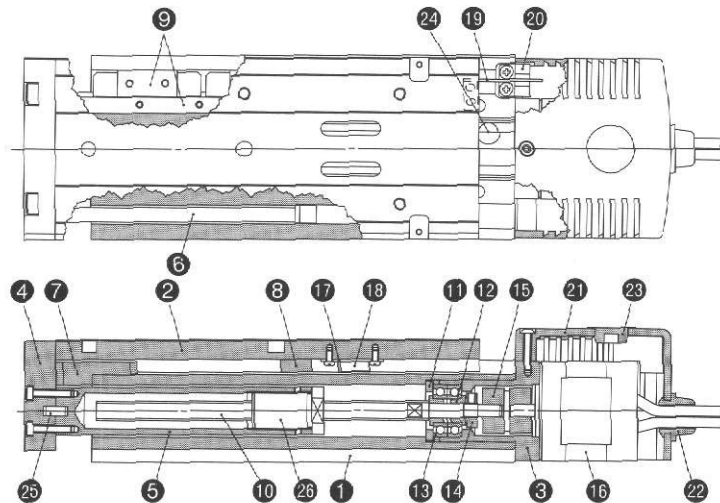
## Brake specifications

Model	Negative actuate type
Static torque	0.1 Nm(1 kgf-cm) or more
Rated voltage	24V (DC) ±5%
Power consumption	5W(at 75°C)

Model	LXSH2BC	LXSH2BD	LXSH5BC	LXSH5BD	
Ball screw	ø8 lead 2mm	ø8 lead 5mm	ø8 lead 2mm	ø8 Lead 5mm	
Max. allowable weight	Horizontal	100N			
	Vertical	50N(220N)	50N(90N)	50N(160N)	50N(70N)
Max. speed	30mm/s	80mm/s	30mm/s	80mm/s	
Positioning repeatability	± 0.03mm		± 0.03mm		
Min. lead *	Half step	0.005mm	0.0125mm	0.002mm	0.005mm
	Full step	0.01mm	0.025mm	0.004mm	0.01mm

\* With one pulse input

## Construction

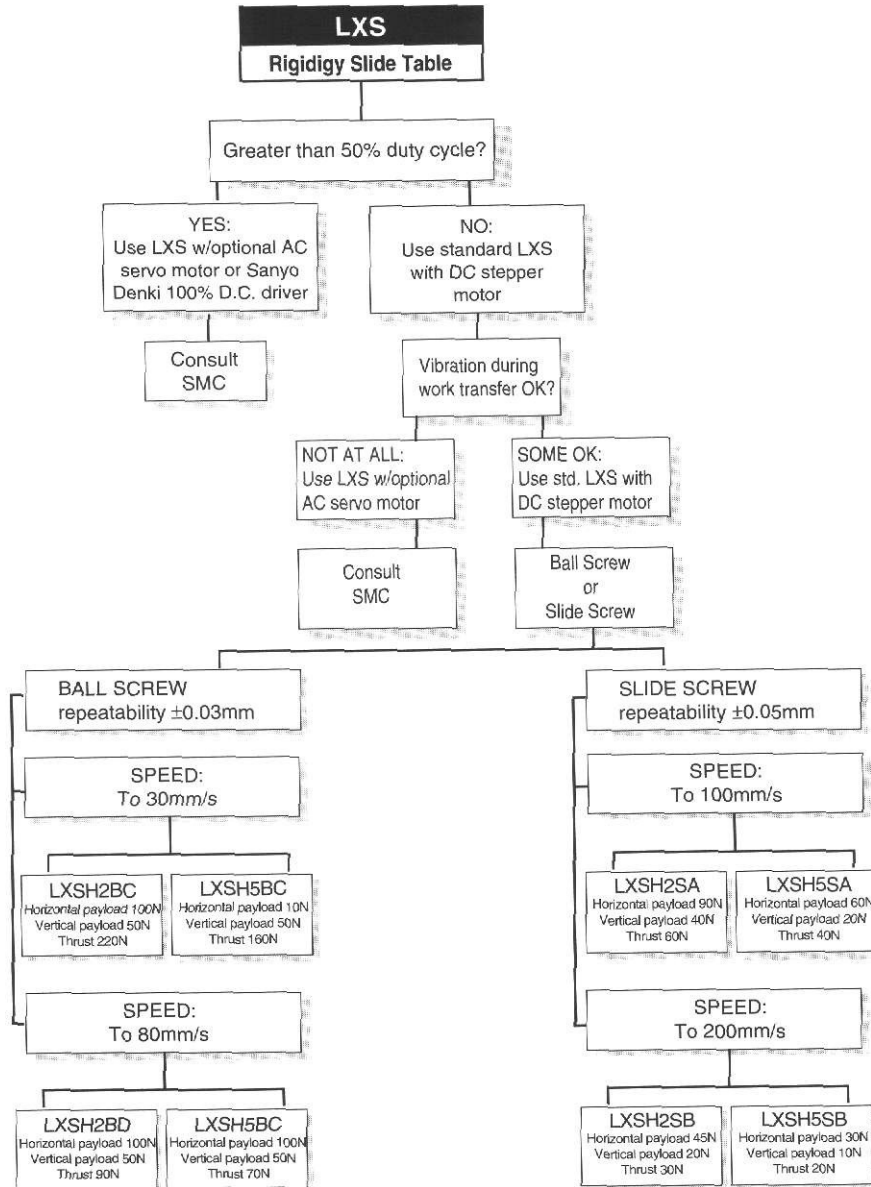


## Component parts

No.	Description	Material	Note
1	Body	Aluminum alloy	Anodized
2	Table	Aluminum alloy	Anodized
3	Adopter	Aluminum alloy	Anodized
4	Plate	Aluminum alloy	Anodized
5	Tube	Aluminum alloy	Anodized
6	Rod ass'y	—	With magnet
7	Stopper A	—	With damper
8	Stopper B	Aluminum alloy	
9	Linear guide (block, rail)	—	
10	Acme screw (shaft)	Alloy steel	
11	Tension ring	Stainless steel	
12	Bearing retainer	Stainless steel	
13	Bearing	—	

## Component parts

No.	Description	Material	Note
14	Lock nut	Carbon steel	Black zinc chromated
15	Coupling	—	
16	Motor	Resin	
17	Magnet holder	Rare earth magnet	
18	Magnet	Mild steel	
19	Sensor plate	—	Model with origin point switch
20	Photo micro sensor	Resin	Model with origin point switch
21	Motor cover		
22	Plug A		
23	Plug B		
24	Cap	Carbon steel	
25	Parallel pin	Resin	
26	Nut		



## Duty ratio

When using a stepping motor actuator must be operated at less than 50% of duty ratio independent of payload value. Continuous operation time should be less than 30 seconds.

Duty ratio: ratio of actuator operating time and suspended time in a cycle. It is calculated by the formula below.

$$\text{Duty ratio} = \left\{ \frac{\text{Operating time}}{\text{Operating time} + \text{Suspended time}} \right\} \times 100$$

Refer to the examples.

Continuous operation time: time between the initiation and the end of slider movement

Remark) The operation provisionally ends when slider turns at the stroke end; the operation is no longer "continuous".

### Example 1

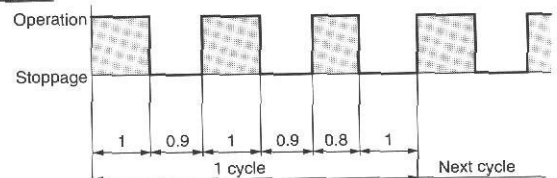


Figure 1

$$\text{Duty ratio} = \left\{ \frac{1 + 1 + 0.8}{1 + 0.9 + 1 + 0.8 + 1} \right\} \times 100 = 50\%$$

∴ Possible to use.

### Example 2

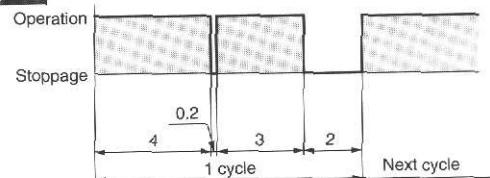


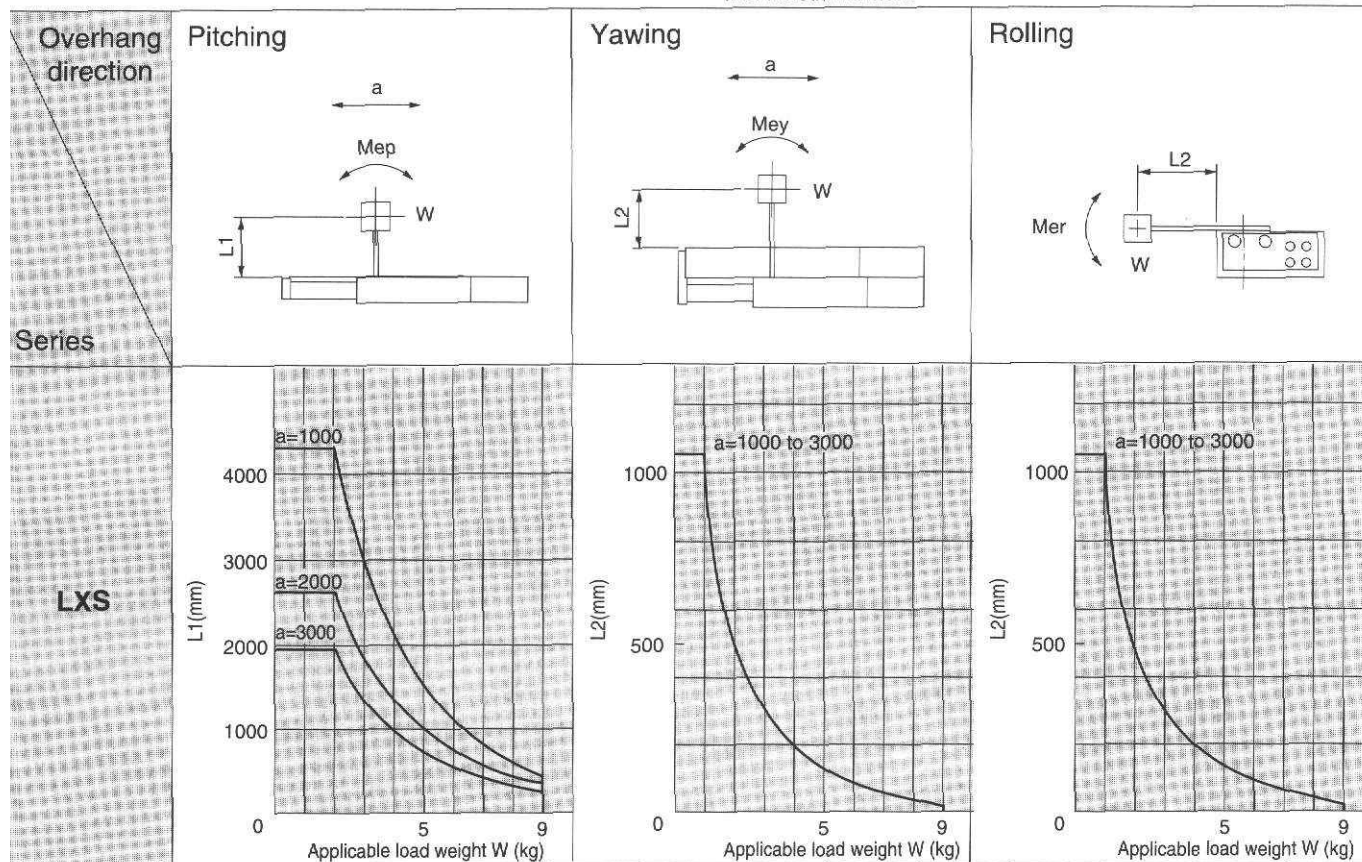
Figure 2

$$\text{Duty ratio} = \left\{ \frac{4 + 3}{4 + 0.2 + 3 + 2} \right\} \times 100 = 76\%$$

∴ Not possible to use.

Table receives moment from each direction according to center of gravity of work. Overhang of work should be within the range shown in the figures below.

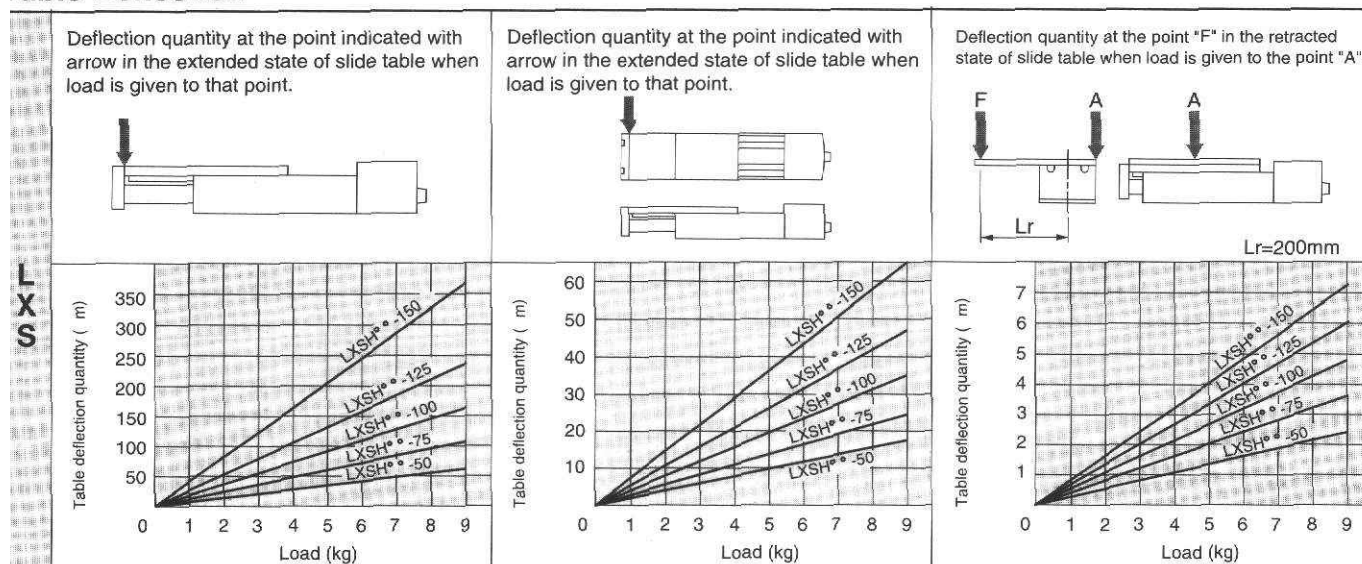
W: Applicable load weight (kg)  
 L1, L2: Overhang distance to the center of gravity of work (mm)  
 a: Acceleration of work (mm/sec<sup>2</sup>)  
 Me: Kinetic moment



**How to use the graph**

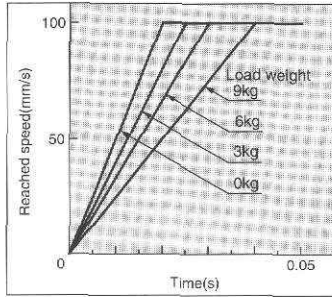
- 1. If work overhangs to the direction of "L1" or "L2", 70% of applicable load weight shown in the graph is the upper limit.
- 2. The graph above shows the case of horizontal orientation of actuator. If using in vertical, static moment should NOT exceed static moment allowance.
- 3. Above graph is based on calculation; therefore, there may be differences from values of actual usage. Safe margin must be taken into consideration when designing. See the specifications of each model for static moment allowance.

**Table Deflection**

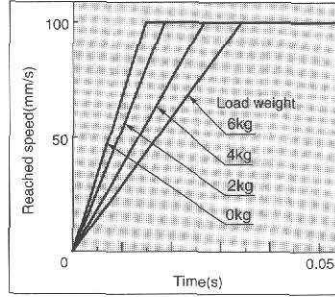


### Criteria of Accelerating Speed (Horizontal Orientation)

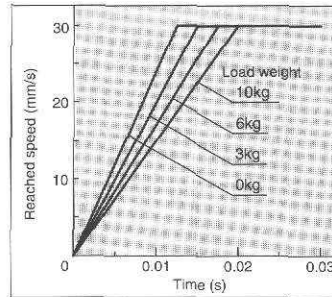
**LXSH2SA**



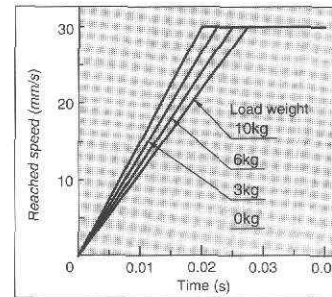
**LXSH5SA**



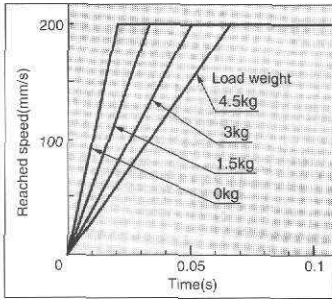
**LXSH2BC**



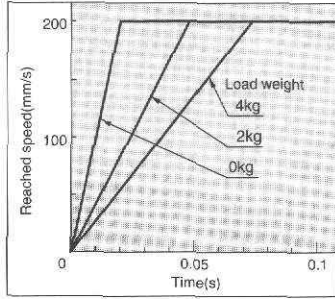
**LXSH5BC**



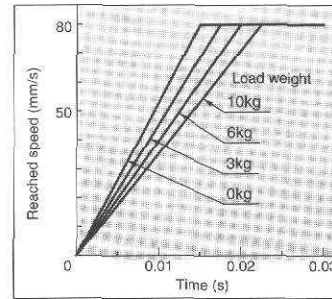
**LXSH2SB**



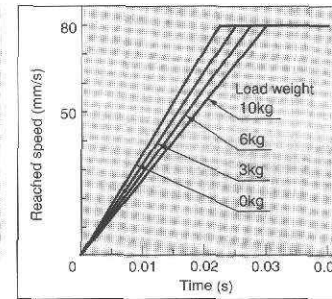
**LXSH5SB**



**LXSH2BD**

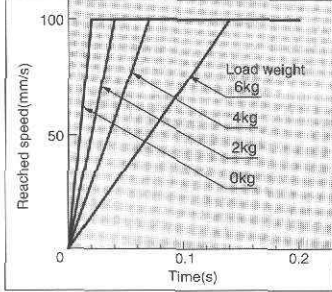


**LXSH5BD**

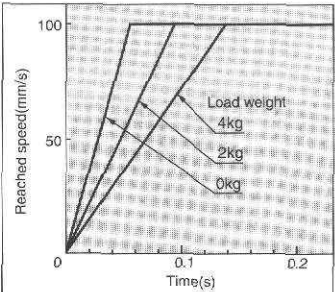


### Criteria of Accelerating Speed (Vertical Orientation)

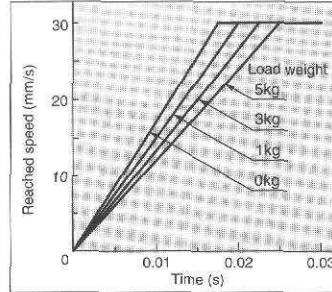
**LXSH2SA**



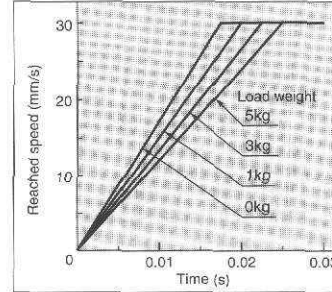
**LXSH5SA**



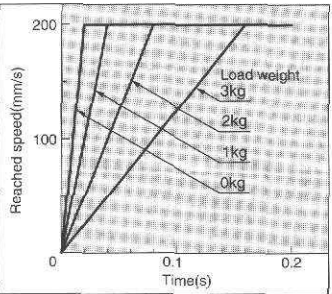
**LXSH2BC**



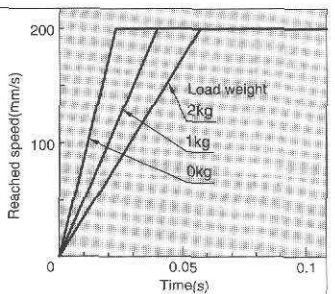
**LXSH5BC**



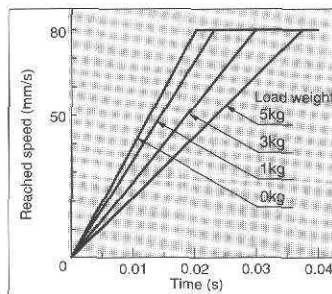
**LXSH2SB**



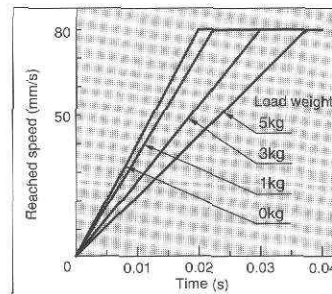
**LXSH5SB**



**LXSH2BD**



**LXSH5BD**



### ⚠ Caution

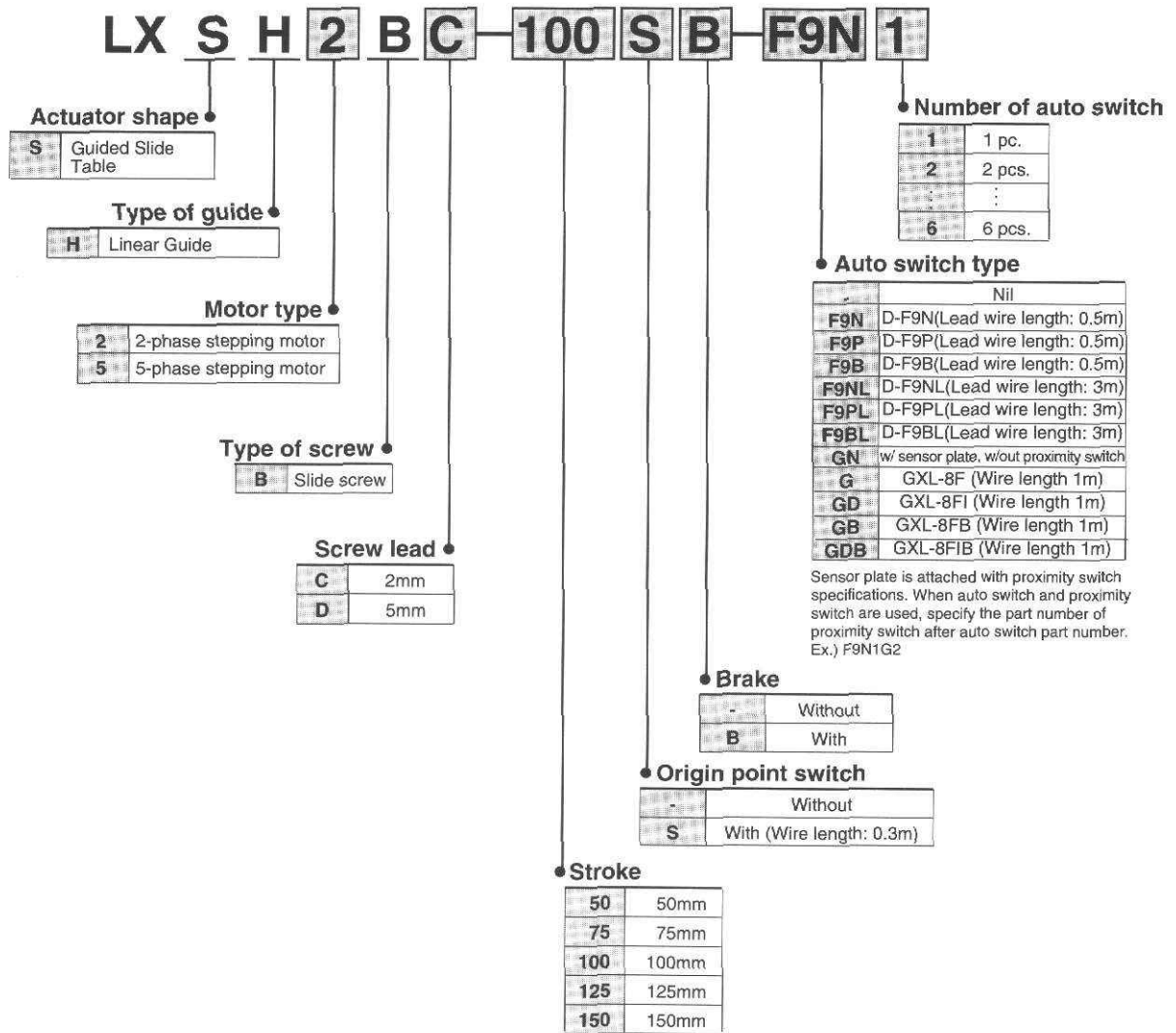
Pay load should be under the maximum pay load.

Accelerating time is decided per pay load and reached speed.

If operating beyond the range shown in these graphs, unit may function improperly.

These graphs consist of data when SMC made DC power supply input type driver unit is used and the excitation is half step.

*a* varies depending upon operating conditions.



**Proximity Sensor Information**

The LX series uses SUNX brand GXL-8F series micro proximity sensors. For more information on these sensors, please visit the SUNX website at [www.sunxramco.com](http://www.sunxramco.com)

Designator	G	GD	GB	GDB
SUNX Part Number	GXL-8F	GXL-8FB	GXL-8FI	GXL-8FIB
Sensing Type	Approach-ON	Depart-ON	Approach-ON Varied Frequency*	Depart-ON Varied Frequency*
Output	NPN Open-Collector (100mA)			
Sensing Direction	Front			
Sensing Range	2.5mm ±20% (rated), 0~1.8mm (normal)			
Indication	Red LED when ON			
Cable Length	1m, extendable up to 100m			

\*Units with the suffix "I" are varied oscillating frequency type. Use this type when installing 12mm or closer to the nearest sensor. Separate by at least 2mm when using three or more sensors.

**Applicable driver unit**

	DC power supply type driver
<b>LXSH2S</b>	LC6D-220AD, LC6C-220AD
<b>LXSH5S</b>	LC6D-507AD

**LX S H 2 S B 100 S B F9N 1**

● **Actuator shape**

<b>S</b>	Guided slide table
----------	--------------------

● **Type of guide**

<b>H</b>	Linear guide
----------	--------------

● **Type of motor**

<b>2</b>	2-phase stepping motor
<b>5</b>	5-phase stepping motor

● **Type of screw**

<b>S</b>	Slide screw
----------	-------------

● **Screw lead**

<b>A</b>	6mm
<b>B</b>	12mm

● **Stroke**

<b>50</b>	50mm
<b>75</b>	75mm
<b>100</b>	100mm
<b>125</b>	125mm
<b>150</b>	150mm

● **Number of auto switch**

<b>1</b>	1 pc.
<b>2</b>	2 pcs.
<b>⋮</b>	<b>⋮</b>
<b>6</b>	6 pcs.

● **Type of auto switch**

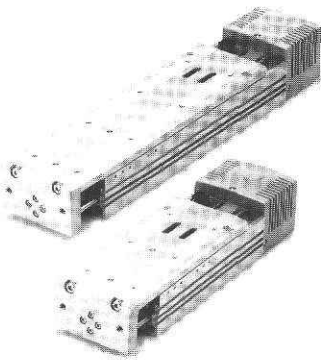
<b>-</b>	Nil
<b>F9N</b>	D-F9N(Lead wire length: 0.5m)
<b>F9P</b>	D-F9P(Lead wire length: 0.5m)
<b>F9B</b>	D-F9B(Lead wire length: 0.5m)
<b>F9NL</b>	D-F9NL(Lead wire length: 3m)
<b>F9PL</b>	D-F9PL(Lead wire length: 3m)
<b>F9BL</b>	D-F9BL(Lead wire length: 3m)

● **Brake**

<b>-</b>	Without brake
<b>B</b>	With brake

● **Origin Point switch**

<b>-</b>	Without
<b>S</b>	With (Wire length 0.3m)



### Applicable auto switch

Part number	Type	Wiring/output	Indicator light	Electrical entry	Lead wire length (m)	
					0.5m(-)	3m(L)
<b>D-F9N</b>	Solid-state switch	3-wire/NPN	With	In-line	•	•
<b>D-F9P</b>		3-wire/PNP	With	In-line	•	•
<b>D-F9B</b>		2-wire	With	In-line	•	•

\*Refer to page 47 for the further auto switch specifications.

### Applicable driver unit

	DC power supply type driver
<b>LXSH2S</b>	LC6D-220AD, LC6C-220AD
<b>LXSH5S</b>	LC6D-507AD

### Origin Home Switch Information

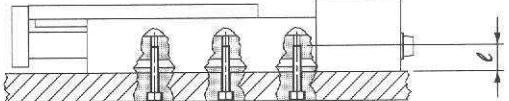
LX series actuators are available with an optional photo micro sensor as an origin home switch to detect when the actuator is fully retracted. The LC6C series positioning driver requires an input from the origin home switch or some other sensor when homing the actuator. The origin home switch can be used for other purposes as well, and likewise other sensors can be used to trigger the home position. Please refer to pages 42 and 45 of this catalog for more information and precautions regarding the optional origin home switch.

### How to mount LXS

#### How to mount actuator

Actuator has 3-way mounting method as shown below. Select the optional method according to your requirements.

**1. Body tapped**

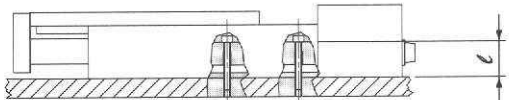


Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (mm)
LXS	M6x1	7.4(75.5)	20

#### ⚠ Caution

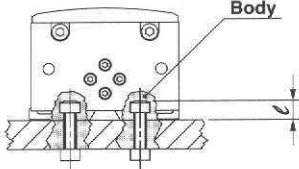
Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.

**2. Through-hole**



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (mm)
LXS	M5x0.8	4.4(44.9)	28

**3. T-slot**



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (mm)
LXS	M6x1	7.4(75.5)	10

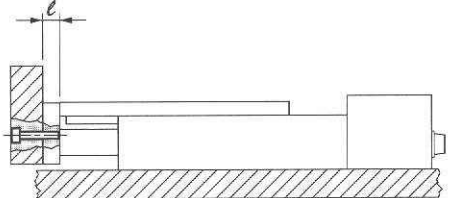
#### ⚠ Caution

Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.

#### How to mount work

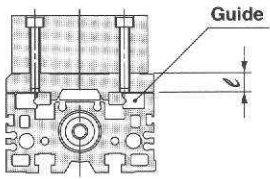
Work can be mounted on 2-face of actuator body.

**1. Front mounting**



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (mm)
LXS	M6x1	7.4(75.5)	13

**2. Top mounting**



Series	Bolt	Max. tightening torque Nm(kgf-cm)	Max. tightening depth (mm)
LXS	M5x0.8	4.4(44.9)	10

#### ⚠ Caution

Bolt should be at least 0.5mm shorter than the max. tightening depth to prevent bolt from pressing the body.

### How To Operate The LXS

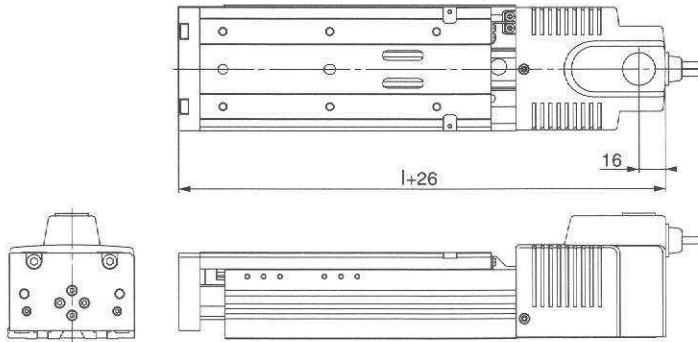
The standard LXS series actuator is available with either a 2-phase (2.0A/ø) or a 5-phase (0.7A/ø) uni-polar DC stepper motor. The motor requires a driver to move the motor based on the input commands. The LXS can be operated with either the LC6D-220AD (2ø) or LC6D-507AD (5ø) basic stepper driver, the LC6C-220AD (2ø) positioning driver, or other compatible driver. See pages 40-46 for more information on SMC's LC6 series drivers.



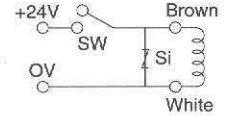
## Dimensions - LXSH Ball Screw Type

### LXSH\_B\_

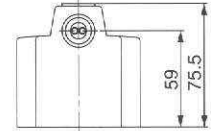
With brake



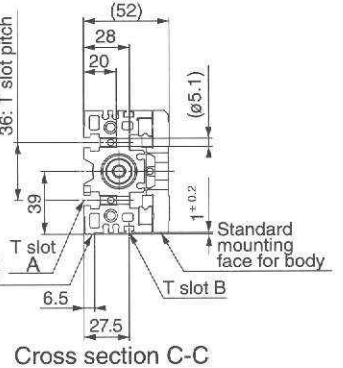
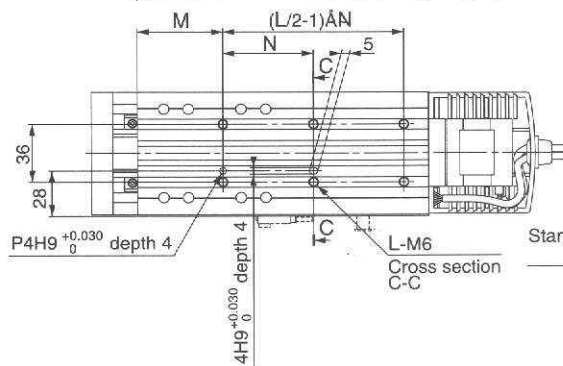
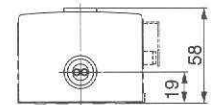
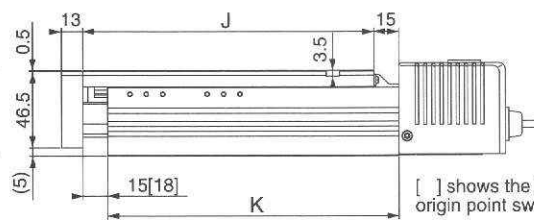
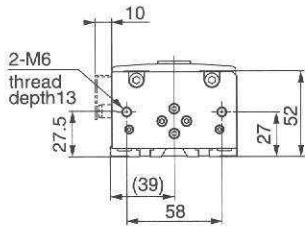
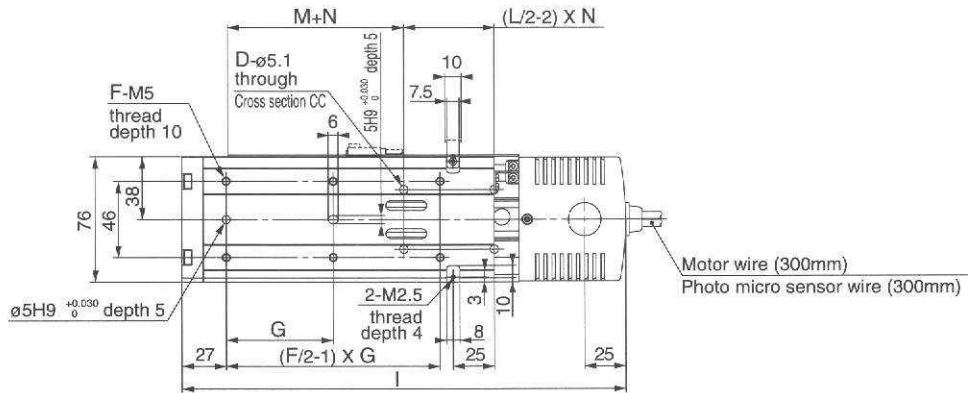
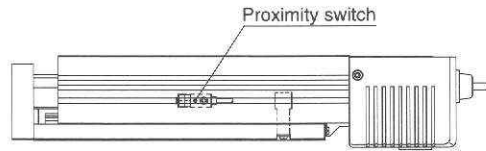
### Brake electrical circuit



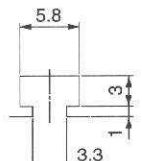
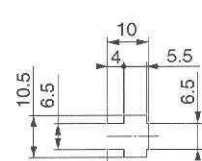
Note) Contact protection circuit is required when connecting brake.



Without brake



Model	D	F	G	I	J	K	L	M	N
LXSH_B_-50	4	6	65	270	177	177	6	52	55
LXSH_B_-75	4	6	75	295	202	202	6	47	65
LXSH_B_-100	4	8	65	320	227	227	6	47	75
LXSH_B_-125	4	8	70	345	252	252	6	47	85
LXSH_B_-150	6	8	75	370	277	277	8	47	65



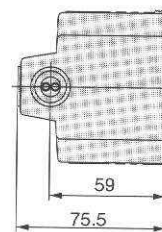
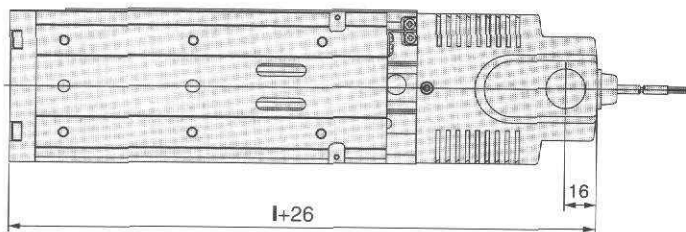
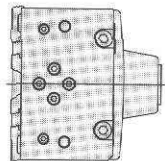
T-slot A dimensions

T-slot B dimensions

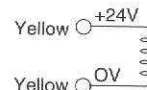
LXSH□□S□

With brake

Scale: 25%



Brake electrical circuit



Without brake

2-M6 Thread 13 Deep

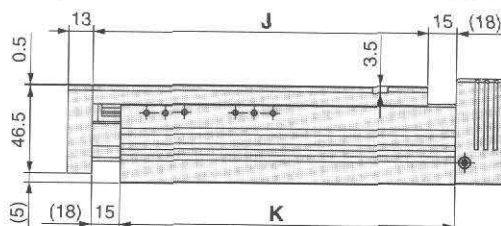
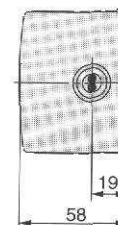
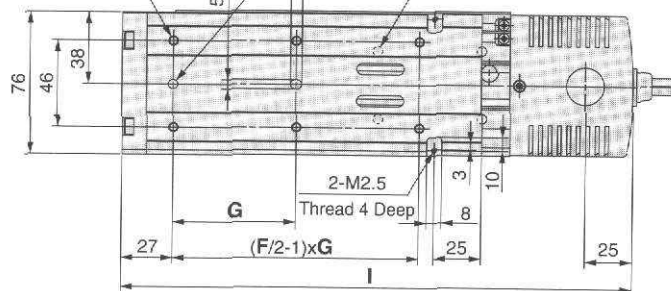
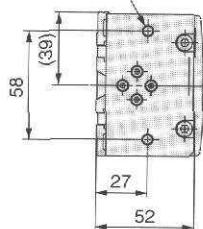
F-M5 Thread 10 Deep

5H9<sup>+0.030</sup><sub>0</sub> 5 Deep

ø5H9<sup>+0.030</sup><sub>0</sub> 5 Deep

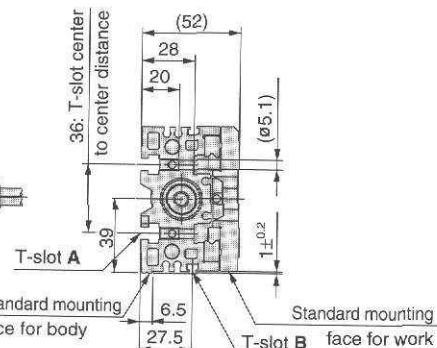
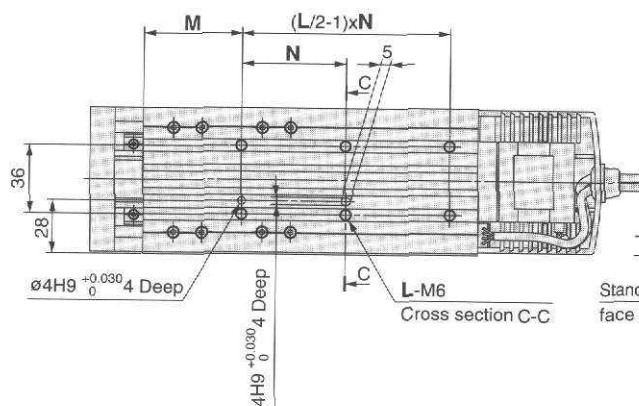
D-ø5.1 Through-hole  
Cross section C-C

Note) Contact protection circuit is required when connecting brake

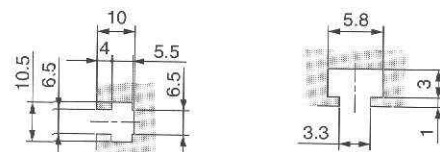


Motor wire(300mm)  
Photo micro sensor wire(300mm)

[ ] shows the location at which origin point switch operates.



Cross section C-C



T-slot A dimensions T-slot B dime SMC

Model	D	F	G	I	J	K	L	M	N
LXSH□□S□-50	4	6	65	270	177	177	6	52	55
LXSH□□S□-75	4	6	75	295	202	202	6	47	65
LXSH□□S□-100	4	8	65	320	227	227	6	47	75
LXSH□□S□-125	4	8	70	345	252	252	6	47	85
LXSH□□S□-150	6	8	75	370	277	277	8	47	65

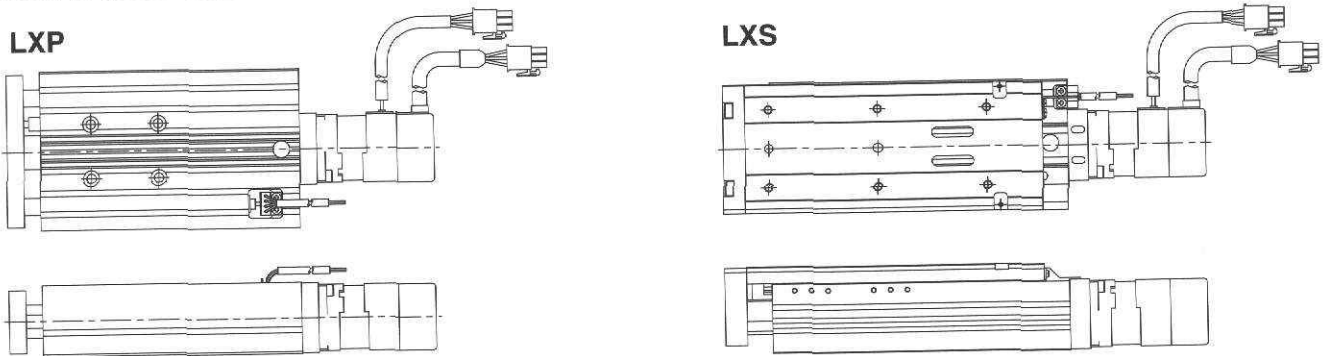
## AC Servo Motor Specifications

Reference No.	Manufacturer	Power supply voltage for driver unit	Brake	Motor part number	Driver unit part number	Applicability			
						LXF	LXP	LXS	
1 <small>Note 1)</small>	Tamagawa Seiki	100VAC	Without	TS4501N	Note 1)	—	Applicable	Applicable	
2 <small>Note 1)</small>			With	TS4501N		—	Applicable	Applicable	
3 <small>Note 1)</small>		200VAC	Without	TS4501N		—	Applicable	Applicable	
4 <small>Note 1)</small>			With	TS4501N		—	Applicable	Applicable	
5	Panasonic (Matsushita Electric Industrial Company Ltd.)	100VAC	Without	MSM2AZ21A	MSS2A121P	Applicable	—	—	
6		200VAC	Without	MSM2AZ21A	MSS2A321P	Applicable	—	—	
7		100VAC	Without	MSM3AZP1A	MSD3A1P1E	—	Applicable	Applicable	
8			With	MSM3AZP1B	MSD3A1P1E	—	Applicable	Applicable	
9		200VAC	Without	MSM3AZP1A	MSD3A3P1E	—	Applicable	Applicable	
10			With	MSM3AZP1B	MSD3A3P1E	—	Applicable	Applicable	
11		Mitsubishi Electric	100VAC	Without	HC-PQ033	MR-C10A1	—	Applicable	Applicable
12				With	HC-PQ033B	MR-C10A1	—	Applicable	Applicable
13			200VAC	Without	HC-PQ033	MR-C10A	—	Applicable	Applicable
14				With	HC-PQ033B	MR-C10A	—	Applicable	Applicable
15	Yasukawa Electric	100VAC	Without	SGME-A3BF12	SGDE-A3BP	—	Applicable	Applicable	
16			With	SGME-A3BF12B	SGDE-A3BP	—	Applicable	Applicable	
17		200VAC	Without	SGME-A3AF12	SGDE-A3AP	—	Applicable	Applicable	
18			With	SGME-A3AF12B	SGDE-A3AP	—	Applicable	Applicable	

Note 1) AC servo motor is basically available in combination with driver unit. However, in the case of Ref. No. 1 to 4, Series LC1 should be separately ordered due to unavailability of driver unit with AC servo motor. Please contact SMC for its part number when ordering due to special product.

Note 2) AC servo motor equipped model does not have motor cover.

### AC servo motor model external view



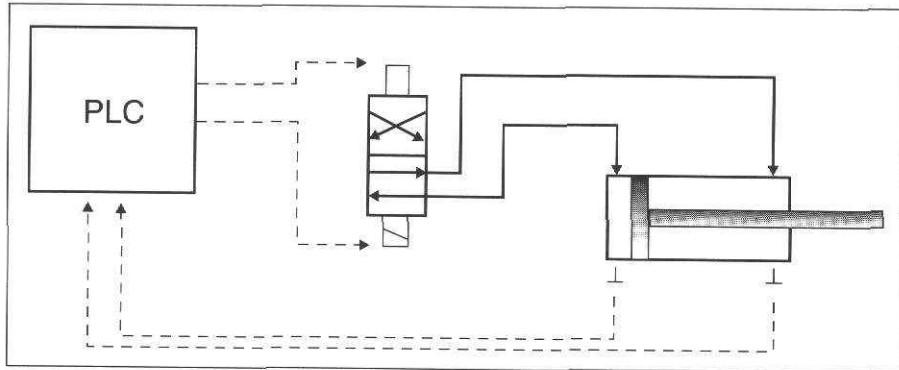
Series	Motor Manufacturer	Motor Output	Driver Voltage	Suffix	Typical part number
LXS	Mitsubishi	30W	100VAC	-X18	LXSHABD-100SB-F9N2-X18
			200VAC	-X19	LXSHABD-100SB-F9N2-X19
	Panasonic	30W	100VAC	-X15	LXSHABD-100SB-F9N2-X15
			200VAC	-X16	LXSHABD-100SB-F9N2-X16
	Tamagawa	30W	100VAC	-X12	LXSHABD-100SB-F9N2-X12
			200VAC	-X13	LXSHABD-100SB-F9N2-X13
Yaskawa	30W	100VAC	-X21	LXSHABD-100SB-F9N2-X21	
		200VAC	-X22	LXSHABD-100SB-F9N2-X22	
LXP	Mitsubishi	30W	100VAC	-X18	LXSHABD-100SB-F9N2-X18
			200VAC	-X19	LXSHABD-100SB-F9N2-X19
	Panasonic	30W	100VAC	-X15	LXSHABD-100SB-F9N2-X15
			200VAC	-X16	LXSHABD-100SB-F9N2-X16
	Tamagawa	30W	100VAC	-X12	LXSHABD-100SB-F9N2-X12
			200VAC	-X13	LXSHABD-100SB-F9N2-X13
	Yaskawa	30W	100VAC	-X21	LXSHABD-100SB-F9N2-X21
			200VAC	-X22	LXSHABD-100SB-F9N2-X22

**Different Actuator Operation Methods**

DC stepper motor actuators and AC servo motor actuators are not that different from familiar pneumatic cylinders and actuators. Electric actuators give you more control and precision, and in return they require more explicit instructions than pneumatic actuators. Compare the basic differences in the illustrations below.

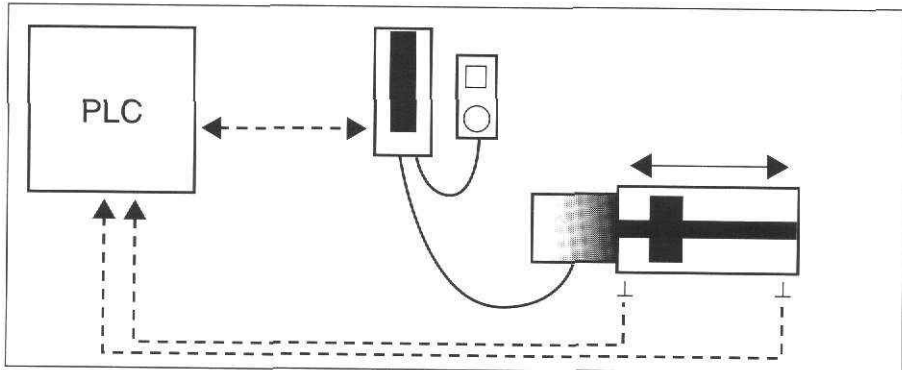
**Pneumatic System**

The PLC is programmed to turn the outputs on or off based on the various inputs. In this example there is an output to each solenoid on the pneumatic valve, and 2 inputs from the auto-switches on the cylinder, for a total of four I/O points. The solenoid valve directs the air pressure to move the cylinder piston, and the auto-switches tell whether the rod is extended or retracted.



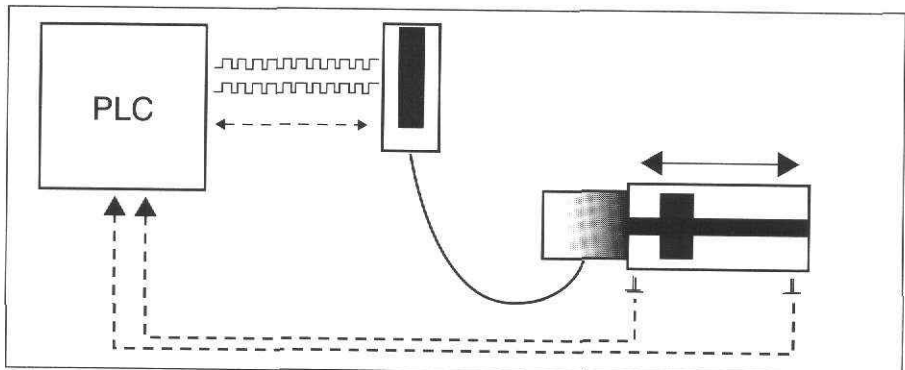
**DC Stepper System (LC6C)**

The Valve and tubing are replaced with a driver and wiring. The PLC is programmed like before, but the driver is also pre-loaded (using a teaching pendant) with different moves, speeds, and acceleration rates. The PLC then uses I/O to tell the driver which moves to make, and the driver reports back when it's done. This gives you multi-point positioning and speed control of your actuator.



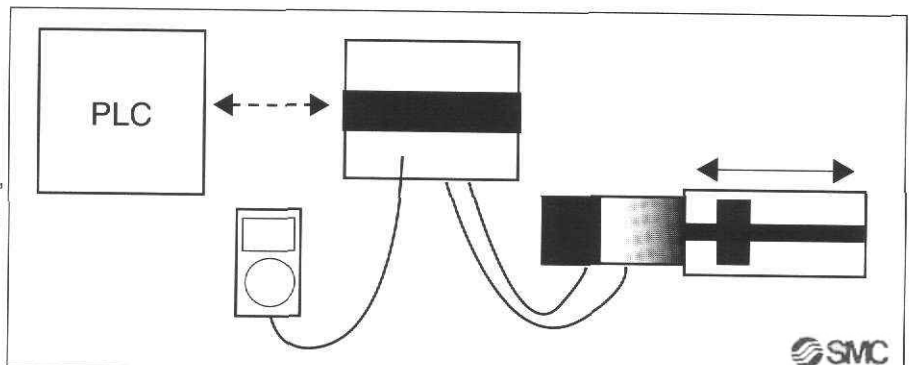
**DC Stepper System (LC6C)**

Here too, the valve and tubing are replaced with a driver and wiring. This time the PLC is programmed to send out quick pulses instead of steady ON or OFF I/O. Most PLCs have high-speed pulse outputs built in, and plug-in cards are available too. This lets you take total control over the actuator by pulsing the motor clockwise and counter-clockwise for your moves.



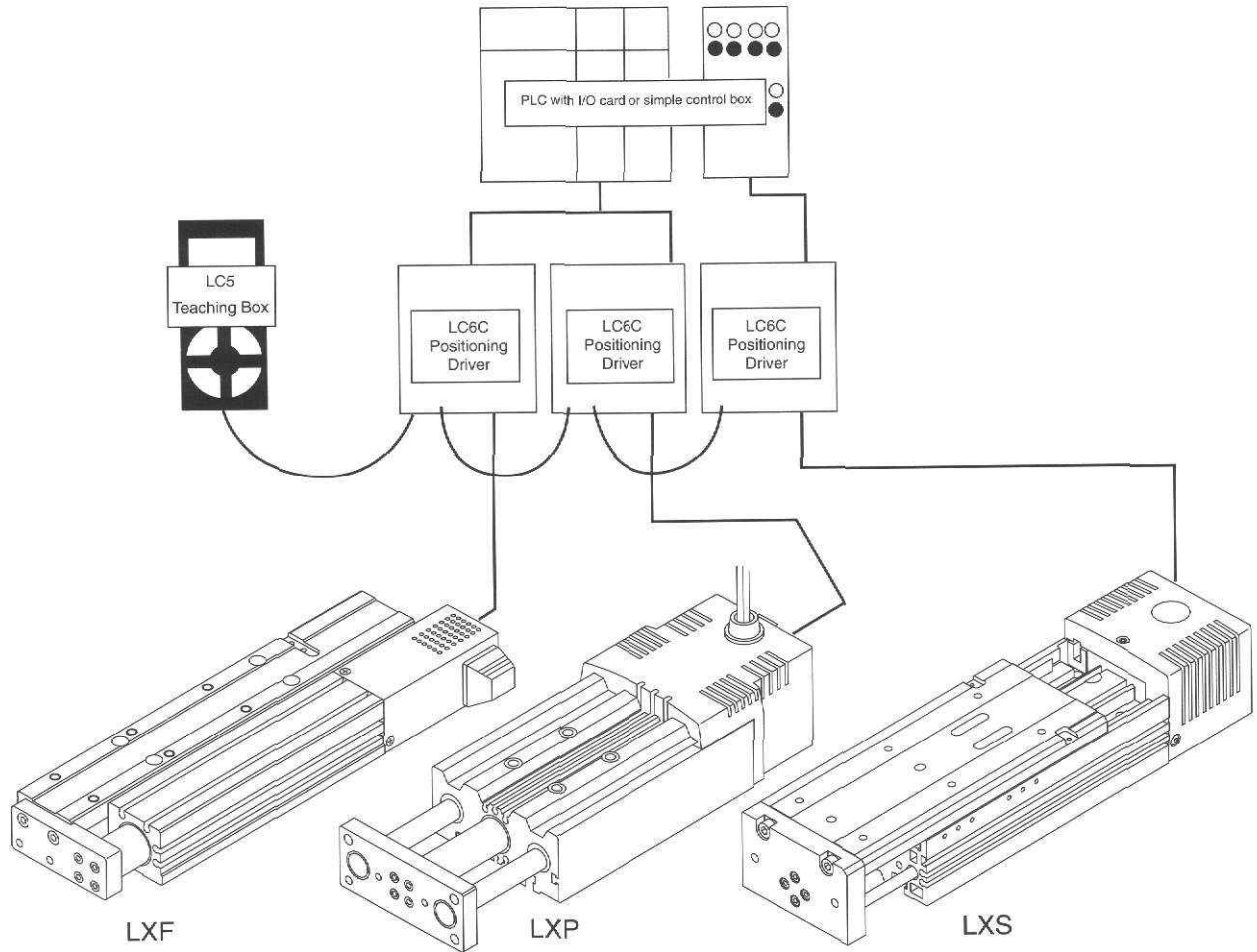
**AC Servo System**

The AC servo system uses a driver like the DC stepper system (LC6C) above, but also has a controller for automatic acceleration, position, & velocity control. You preload positions, speeds, and routines into the controller, and then use the PLC to run them. The driver uses the controller instructions to turn the motor, and the encoder tells the controller the current position. SMC's LC1 is both a controller and driver in one.



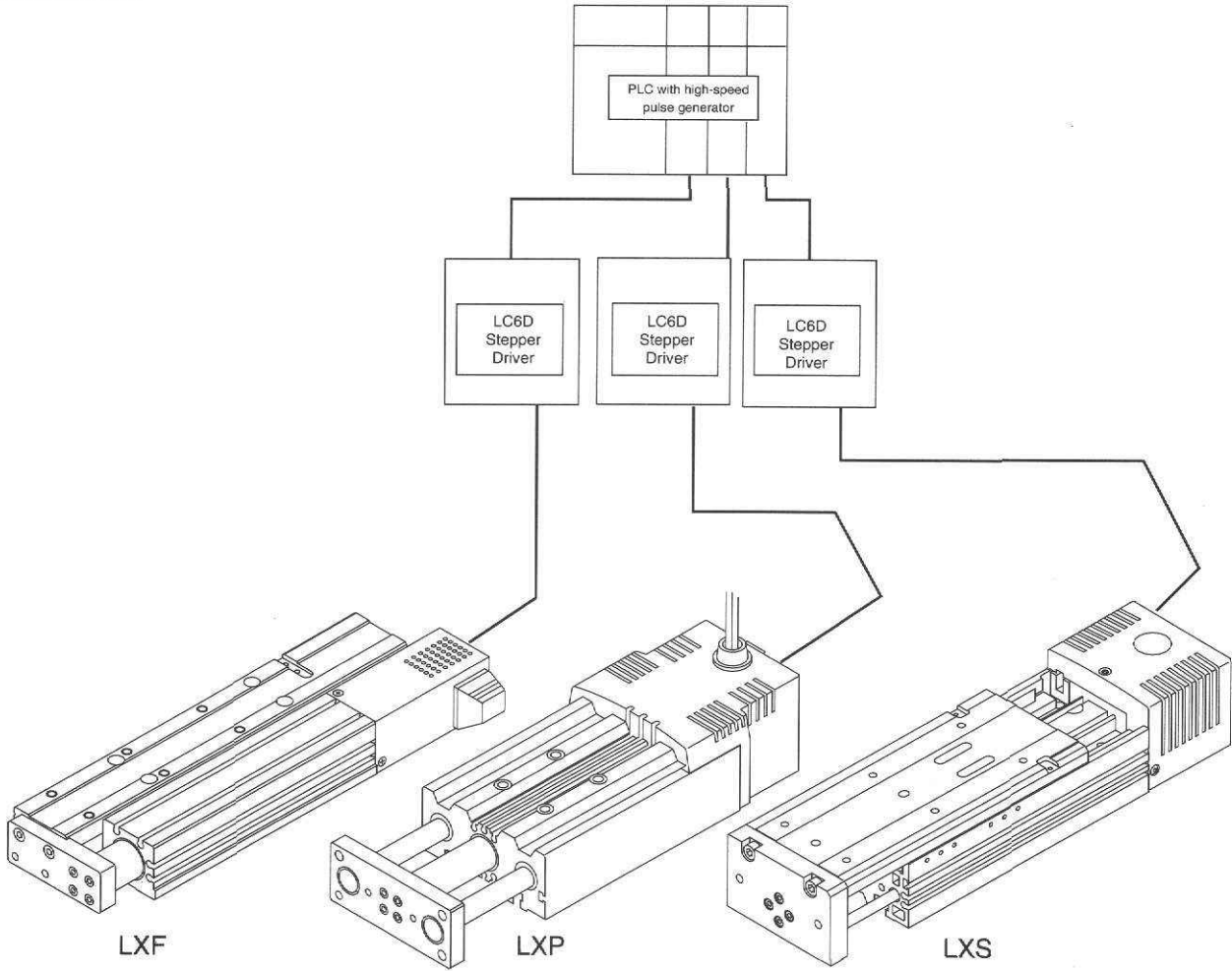
### LX Control Methods - LC6C

The LC6C is a easy to use yet full function positioning driver for 2-phase LX series actuators. Simply pre-program up to 28 incremental or absolute moves and 8 speed profiles using the LC5 teaching box. Then select amove using a control box or I/O from your PLC. The LC6C automatically moves the LX the desired amount, and gives an "all done" output when complete. To make things easier, up to sixteen LC6C drivers can be preset at once using a single LC5 teaching box. See page 40 for more information on the LC6C.



### LX Control Methods - LC6D

The LC6D is a basic DC stepper motor driver designed especially for 2-phase and 5-phase LX series actuators. LC6D takes a pulse signal from the PLC counter or other source and excites the motor in full or half steps. The LC6D features photo-coupler I/O isolation, an automatic current reduction when the motor is stopped, and an on-demand power down feature to disengage the motor. The LC6D is rated for a 50% duty cycle. 100% duty cycle micro-stepping drivers are available for this series from Sanyo Denki America\* or Applied Motion Products\*\*. See page 45 for more information on the LC6D

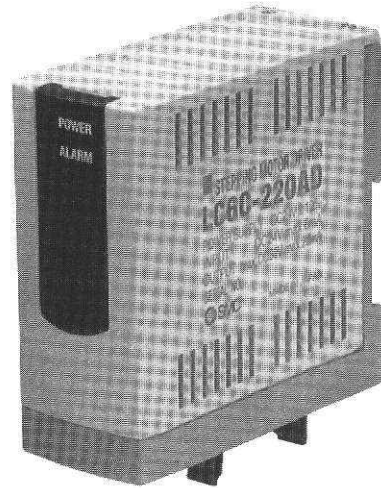


\* Contact Sanyo Denki America at (734)414-8640 for information on their PMM-MD-53031-10 series driver

\*\* Contact Applied Motion Products at (800) 525-1609 for information on their Si3540 series driver/indexer.

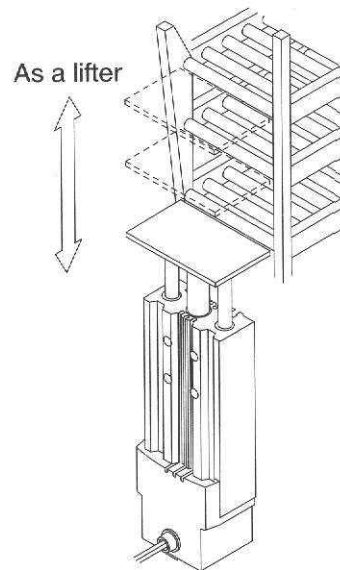
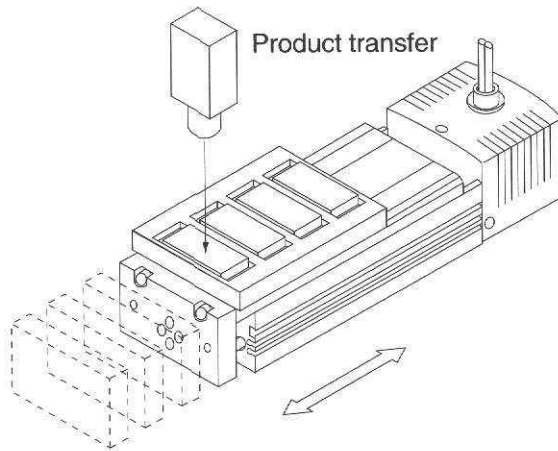
## Series LC6C Positioning Driver

- Driver LC6D has built-in pulse control function
- Position information can be set up to a maximum of 28 points
- Point movement can be easily accomplished with a PLC, etc.
- Compatible with Series LX electric actuator 2-phase stepping motor

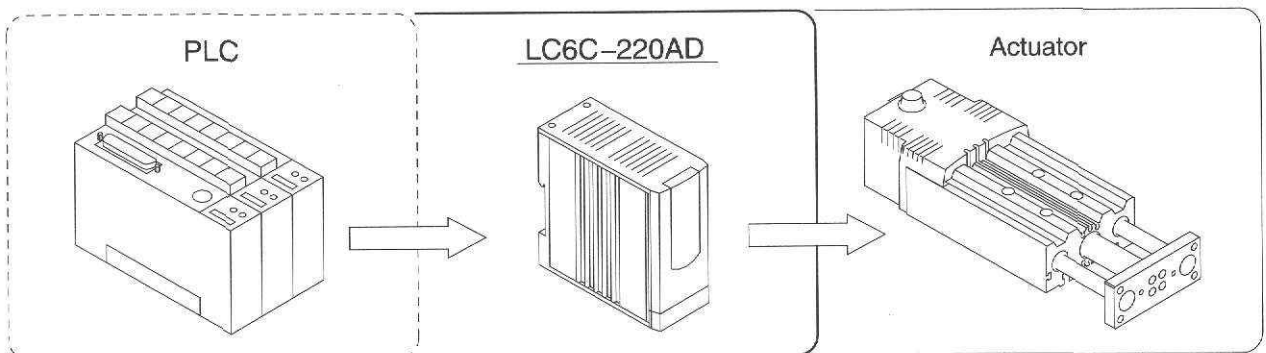


## Application examples

Can be used in operation patterns like these.

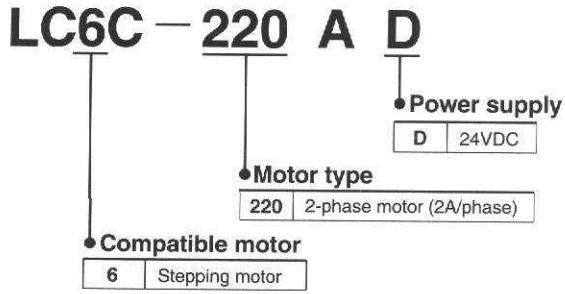


## System configuration



To be provided by customer.

How to Order

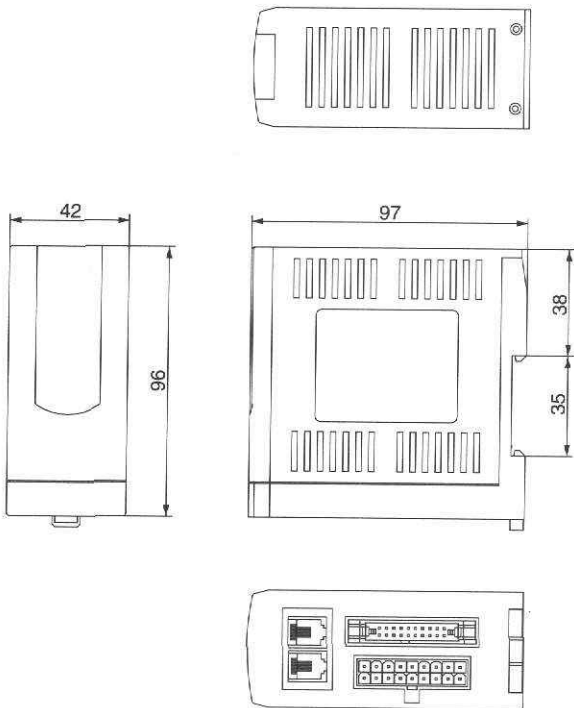


Specifications

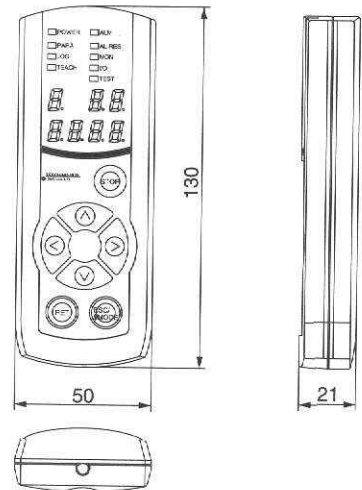
Compatible actuator	LX□□2□□-□□□□□
Power supply	24VDC ± 10% Max. 3.0A
Number of setting positions	28 points
Position setting method	Setting with dedicated teaching box (LC5-1-T1-02)
Position control method	Absolute and incremental moves Speed: 6 to 200mm/s (with feed screw lead of 12mm)
Input signal capacity	Optically isolated input 24VDC Max. 6mA
Output signal capacity	Optically isolated output Max. 30VDC or less Max. 20mA
Parameter setting	Position data setting, Speed acceleration setting, etc.
Indication LED	LED for power supply, LED for alarm
Operating temperature	5 to 40°C

Dimensions

LC6C-220AD



Dedicated teaching box  
LC5-1-T1-02



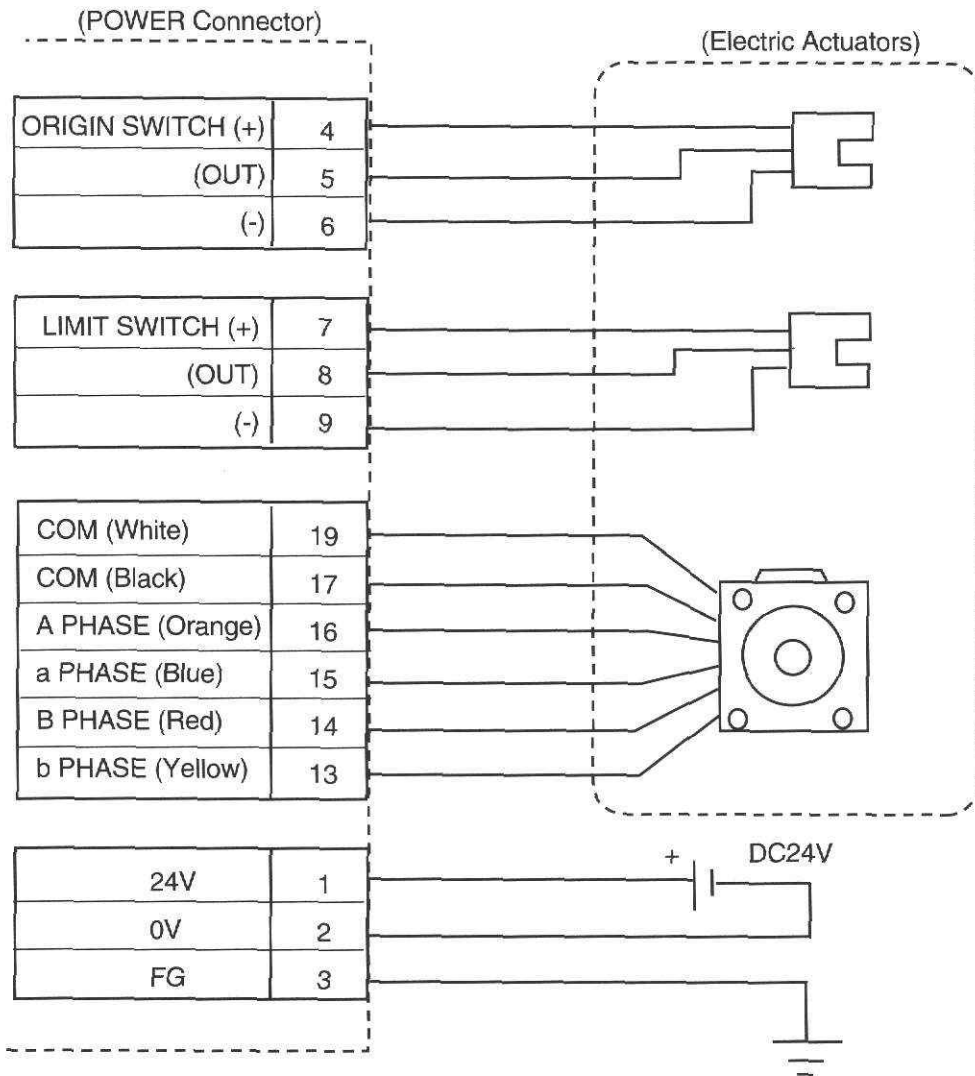
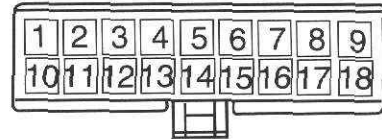


## Series LC6C

### Connecting Example

• **Power Connector**

Molex Inc. part number 39-01-2180 (receptacle), 39-00-0039 (pins). Uses crimp tool 11-01-0014 and pin extraction tool number 11-03-0044.

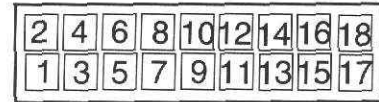


# Series LC6C

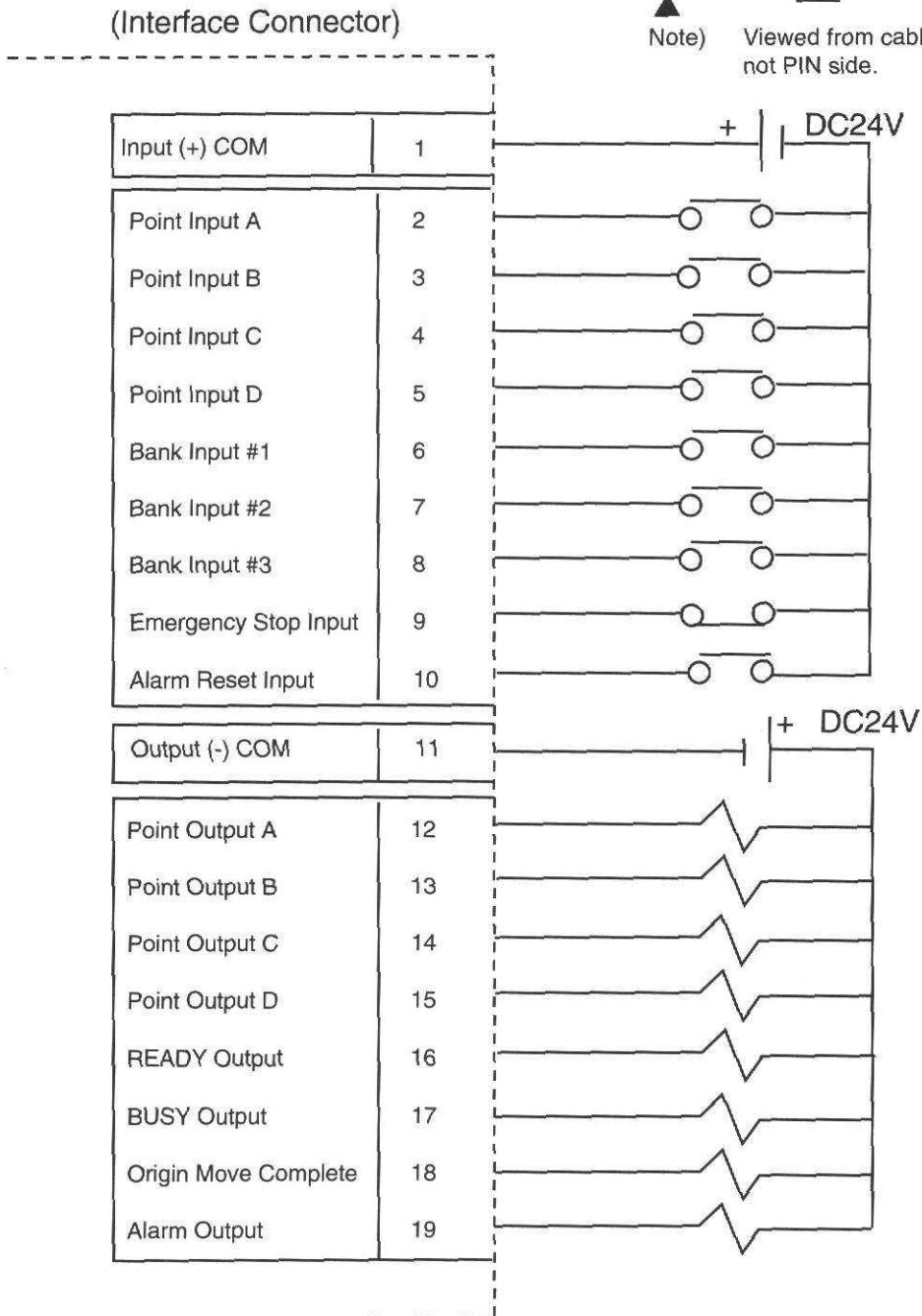
## Connecting Example

• **Interface Connector**

Omron part number XG4M-2030



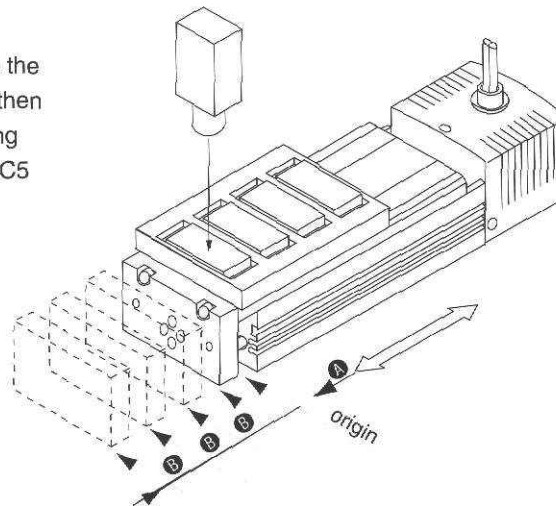
Note) Viewed from cable side not PIN side.



## Program Example

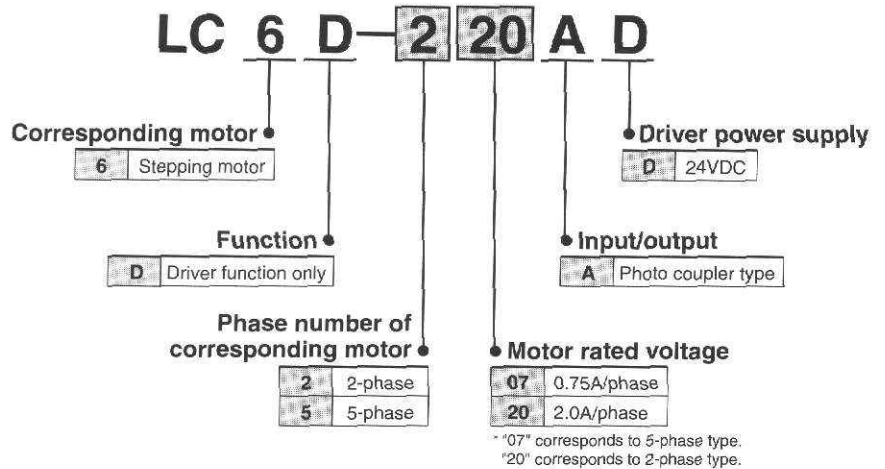
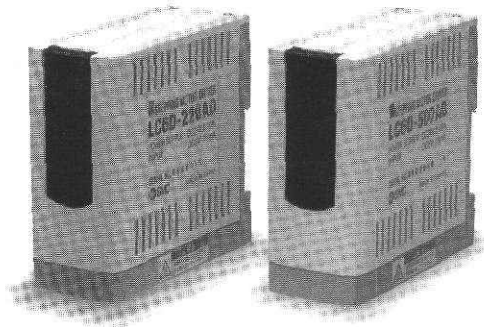
### LC6C Program Example LXS Work Transfer

Below is an example of a work-transfer program. Move the actuator out 800 pulses to inspect the first work piece, then increment out 1,000 pulses three times for the remaining three work pieces and finally return to home. Use the LC5 teaching box to preset the LC6C with the position and speed/acceleration information.



#	Operation	LX/LC6C Actions & Reactions
1	Initialize	<ol style="list-style-type: none"> <li>1. OV to Emergency Stop input.</li> <li>2. No alarm output should be on.</li> </ol>
2	Move actuator to origin/home.	<ol style="list-style-type: none"> <li>1. Set bank 1, 2, &amp; 3 inputs off.</li> <li>2. Set point A input on.</li> <li>3. Busy output is on while actuator homes.</li> <li>4. Busy output turns off, and origin return output turns on.</li> <li>5. Set point A input off, and point A output turns off.</li> </ol>
3	Load 4 work pieces.	
4	Move from home to point A (800 pulses)	<ol style="list-style-type: none"> <li>1. Set bank 1 input on, 2 &amp; 3 off.</li> <li>2. Set point A input on.</li> <li>3. Busy output is on while actuator moves.</li> <li>4. Busy output turns off; point A output turns on.</li> <li>5. Set point A input off, and point A output turns off.</li> </ol>
5	First work piece is inspected.	
6	Move from present position to next piece (increment + 1,000 pulses).	<ol style="list-style-type: none"> <li>1. Set bank 1 input on, 2 &amp; 3 off.</li> <li>2. Set point B input on.</li> <li>3. Busy output is on while actuator moves.</li> <li>4. Busy output turns off; point B output turns off.</li> <li>5. Set point B input off, and point B output turns off.</li> </ol>
7	Repeat steps 5 and 6 three more times.	
8	Return to home.	<ol style="list-style-type: none"> <li>1. Set bank 1, 2, &amp; 3 inputs off.</li> <li>2. Set point A input on.</li> <li>3. Busy output is on while actuator homes.</li> <li>4. Busy output turns off, and origin return output turns on.</li> <li>5. Set point A input off, and point A output turns off.</li> </ol>
9	Return to step #2 to repeat.	

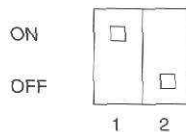
How to Order



Specifications

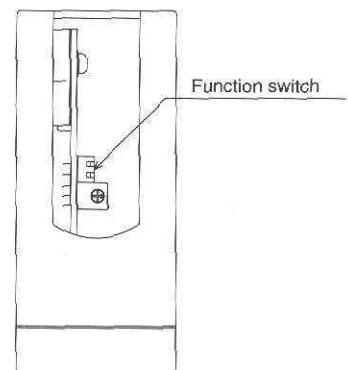
	LC6D-220AD	LC6D-507AD
Power supply	24VDC±10%, 3A	24VDC±10%, 2.5A
Excitation (Step angle) *	Full step (1.8°) Half step (0.9°)	Full step (0.72°) Half step (0.36°)
Motor current	2.0/phase	0.75/phase
Input signal	Photo coupler input (input impedance 330Ω)	
Max. input frequency	10kHz at Full step 20kHz at Half step	
Function **	Auto current down*, Power down input	
Connecting method	Connector	
Ambient temperature	5 to 40°C	
Ambient humidity	35 to 85% (No dewing)	
Corresponding actuator	LXSH2S LXPB2S	LXFH5S LXSH5S LXPB5S

\*Set by function change switch. Product is set as shown below when shipped from factory.



- 1. ON: Excitation/Half step
- 2. OFF: Auto current down function

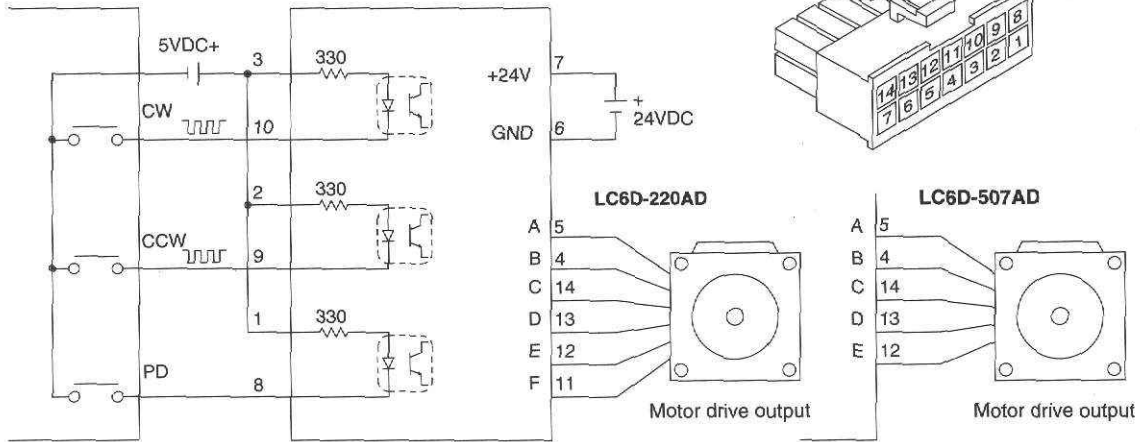
	ON	OFF
1	Half step	Full step
2	Release	Setting



\*\*Function:  
Auto current down; Function to automatically reduce 50% of current output to motor when stopped.  
Power down input; Current flow to motor is shut down by this input, and motor goes to non-excitatic

### Connecting example

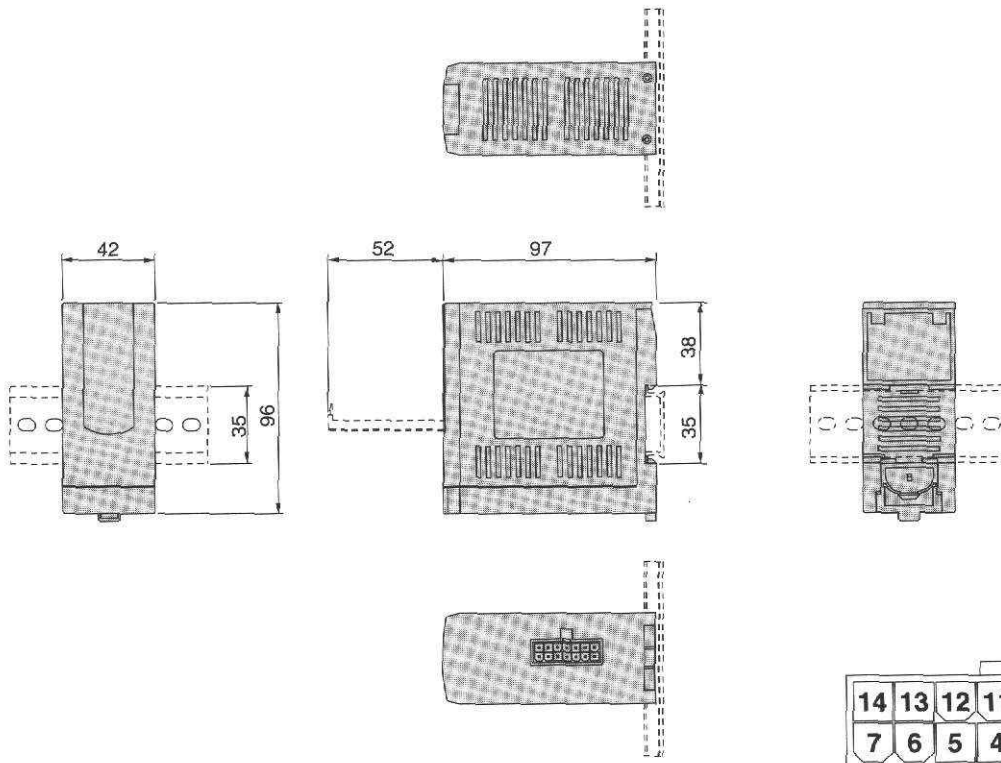
Positioning unit



Signal code	Function	Pin
+24V	Driver power supply +24V	7
GND	Driver power supply ground	6
CW+	CW pulse input terminal (+)	3
CW-	CW pulse input terminal (-)	10
CCW+	CCW pulse input terminal (+)	2
CCW-	CCW pulse input terminal (-)	9
PD+	Power down input terminal (+)	1
PD-	Power down input terminal (-)	8

Signal code	Function	Pin
A	Motor drive output A	5
B	Motor drive output B	4
C	Motor drive output C	14
D	Motor drive output D	13
E	Motor drive output E	12
F	Motor drive output F (*LC6D-2□□□□* only)	11

### Dimensions



Driver





### Applicable auto switch

Model	Auto switch	Specifications	Electrical entry	
LXF LXP LXS	Solid state auto switch	D-F9N	Grommet	In-line
		D-F9P		
		D-F9B	2 wire	

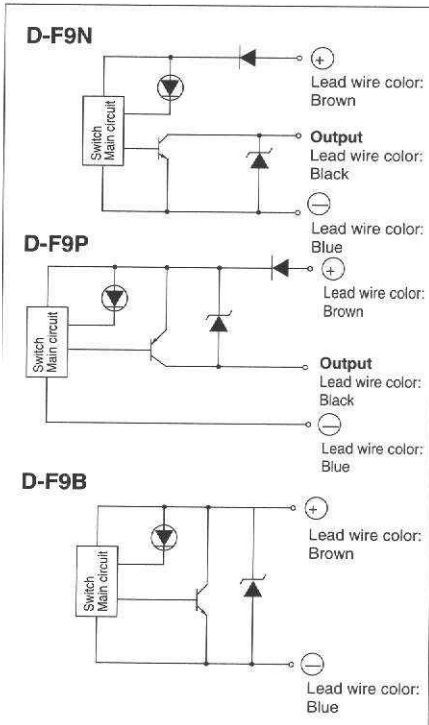
\*All the solid state auto switches are equipped with indicator light.

### Auto switch specifications

Part number	Output	Power supply	Load voltage	Load current	Internal voltage drop	Leak current	Application
D-F9N	NPN	10DC to 28V	28VDC or less	50mA or less	0.4V or less	10 mA or less at 24VDC	24VDC Relay PLC
D-F9P	PNP		—		1.5V or less		
D-F9B	—	—	24VDC (10 to 28VDC)	5 to 30mA	4.5V or less	1 mA or less at 24VDC	

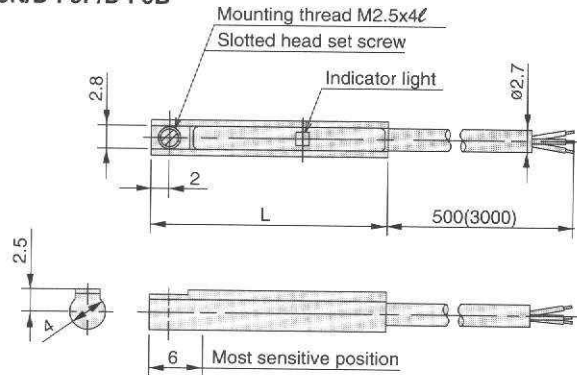
- Lead wire-----Oil proof vinyl heavy insulation cable,  $\phi 2.7$ , 0.15mm<sup>2</sup> x 3 wire (brown, black, blue) 0.18mm<sup>2</sup> x 2 wire (brown, blue)
- Insulation resistance-----50M $\Omega$  or more at 500VDC (Between lead case and cable)
- Withstand voltage-----1,000 VAC for 1 min. (Between lead case and cable) •Indicator light-----Light at ON
- Ambient temperature-----10 to 60°C •Operating time-----1 ms or less
- Shock resistance-----1000m/s<sup>2</sup> /102G

### Auto switch internal circuit



### Auto switch dimensions

#### D-F9N/D-F9P/D-F9B



Part No.	L (mm)
D-F9N	22
D-F9P	26.5
D-F9B	26.5

### How to mount auto switch

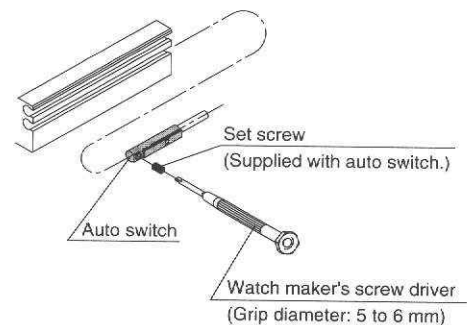
#### ⚠ Caution

##### Auto switch mounting tool

Use watch maker's screw driver with a grip diameter of 5 to 6 mm to tighten the set screw which is delivered with auto switch.

##### Tightening torque

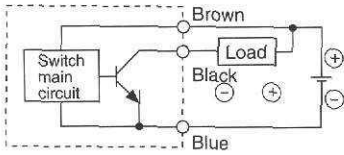
The tightening torque should be 0.05 to 0.1Nm.



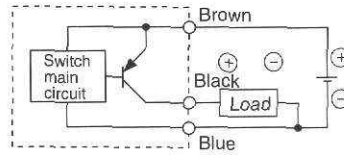
### Basic wiring

#### 3 wire NPN

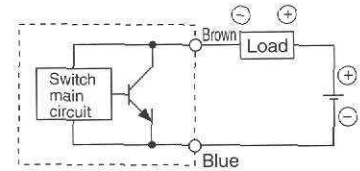
(When power source for switch and load is common.)



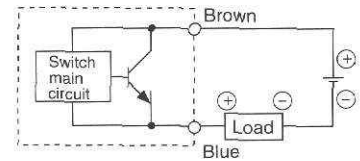
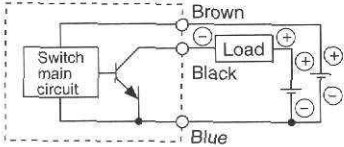
#### 3 wire PNP



#### 2 wire

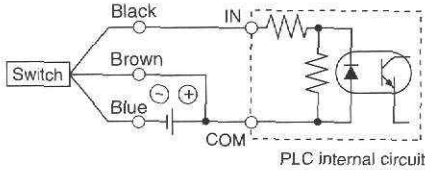


(When power source for switch and load is not common.)

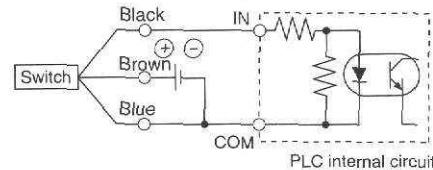


### Typical PLC (sequence controller) connection circuits

#### 3 wire NPN/Sink input

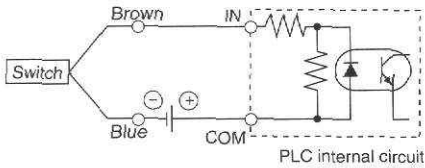


#### 3 wire PNP/Source input

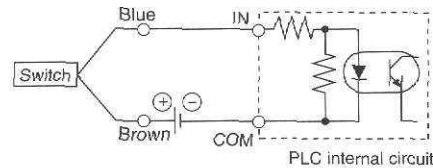


Connect according to the input specification of PLC because the connection method varies with the input specification of PLC.

#### 2 wire

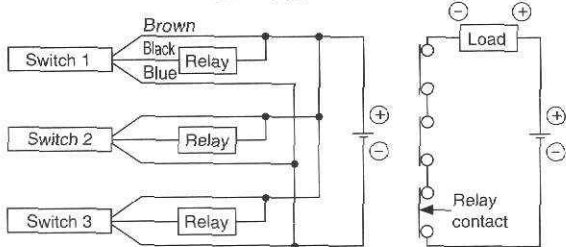


#### 2 wire

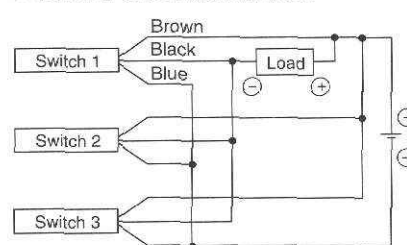


### AND(serial), OR(parallel) connection examples

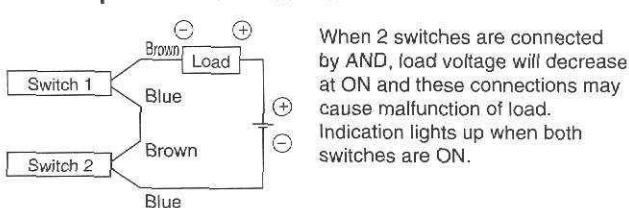
#### 3 wire NPN/AND connection



#### 3 wire NPN/OR connection

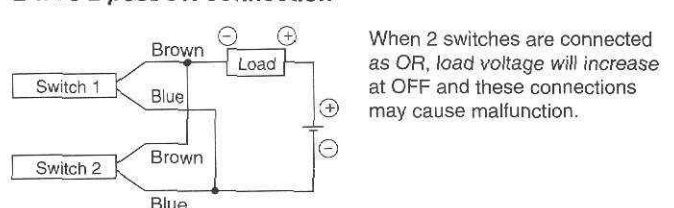


#### 2 wire 2 pcs./AND connection



When 2 switches are connected by AND, load voltage will decrease at ON and these connections may cause malfunction of load. Indication lights up when both switches are ON.

#### 2 wire 2 pcs./OR connection



When 2 switches are connected as OR, load voltage will increase at OFF and these connections may cause malfunction.

$$\begin{aligned} \text{Load voltage at ON} &= \text{Supply voltage} - \text{Residual voltage} \times 2 \text{ pcs.} \\ &= 24\text{V} - 4\text{V} \times 2 \text{ pcs.} \\ &= 16\text{V} \end{aligned}$$

Example) Supply voltage 24VDC  
Switch internal voltage drop 4V

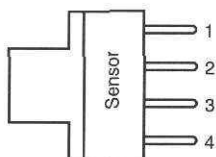
$$\begin{aligned} \text{Load voltage at OFF} &= \text{Leakage current} \times 2 \text{ pcs.} \times \text{Load impedance} \\ &= 1\text{mA} \times 2 \text{ pcs.} \times 3\text{k}\Omega \\ &= 6\text{V} \end{aligned}$$

Example) Load impedance 3kΩ  
Switch leakage current 1mA

## Standard photo micro sensor for origin point

### Specifications

Supply voltage	5VDC to 24VDC $\pm 10\%$ , Ripple(p-p) 10% or less
Power consumption	35mA or less
Controlled output	5VDC to 24VDC, Load current(Ic) 100mA, Residual voltage 0.8V or less 5VDC to 24VDC, Load current(Ic) 40mA, Residual voltage 0.4V or less
Ambient temperature	Operation: -25 to +55°C (At holding: -30 to 80°C)
Ambient humidity	Operation: 5 to 85%RH (At holding: 5 to 95%RH)

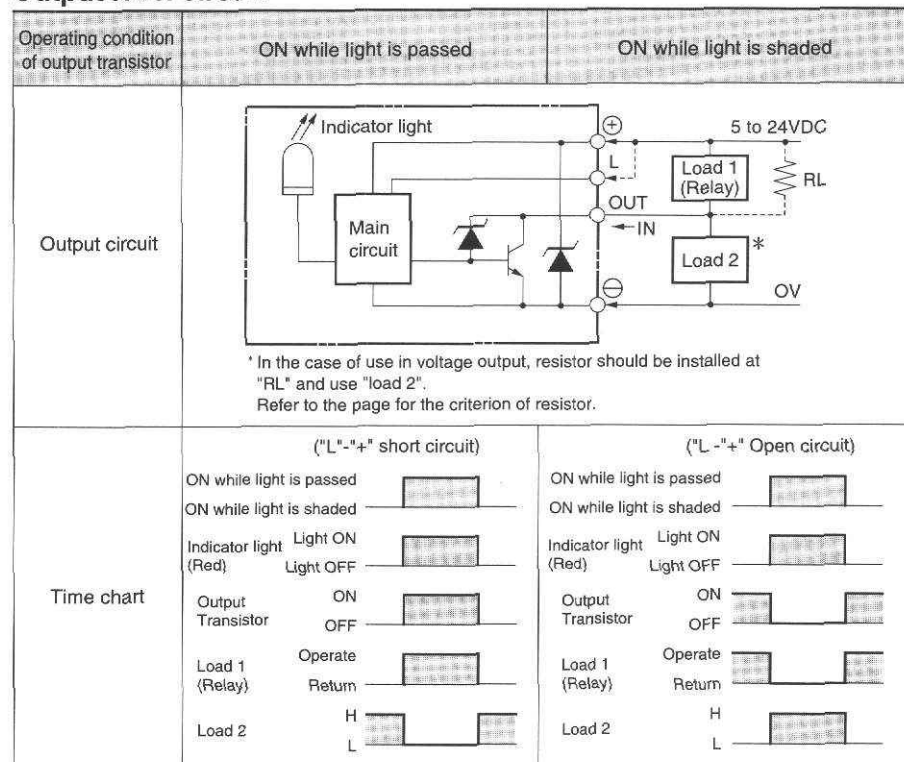


### Terminal positioning

1	Brown	Vcc	⊕
2	White	L*	
3	Black	OUTPUT	
4	Blue	DND(0V)	⊖


\*ON while light is shaded. If "L" terminal and "+" terminal are shorted, it changed to ON while light is passed.

### Output level circuit







# Common Terms Related To Electric Actuators

<b>3-Phase Motor, 5-Phase Motor</b>	A five-phase motor runs much smoother than a two-phase motor because it has two more magnetic poles than a two-phase motor does. This means there is less torque ripple or vibration from resonance. However, actuators with five-phase motors have slightly lower payload ratings than those with two-phase motors.
<b>Ball Screw</b>	Both ball screws and slide screws consist of a rolling contact on a lead screw. For ball screws, the rolling contact is a housing with recirculating ball bearings inside. The lead screw has machined grooves for the ball bearings to roll in. SMC offers two types of ball screw: a ground type (higher precision, higher cost) and a rolled type (lower precision, lower cost).
<b>Closed Loop Control System</b>	A closed loop control system is a system that utilizes a feedback device (encoder, resolver, and so on) to enhance performance of the system by providing better acceleration and speed capabilities as well as better system stability. The closed loop control system also provides assurance that the programmed position is actually achieved. <i>See also Open Loop Control System.</i>
<b>Duty Cycle</b>	Duty cycle is the variation of torque or speed or both with time during a specified operating cycle. The LC6 stepper driver has a duty cycle of 50%, regardless of actuator load. Also, LC6 continuous operation may not exceed thirty seconds. Continuous operation is defined as the time from when the slider begins to move until it stops moving (not just pauses at stroke end). $\text{duty cycle} = \frac{\text{run time}}{\text{run time} + \text{stopped time}} \times 100$
<b>Full Step</b>	A full step is a logic pattern that will produce one unit of incremental motion from a stepper motor (the increments being determined by the stepper motor structure). For example, SMC's 5-phase LX actuator motors are divided into 500 steps. Thus, one pulse in full step mode equals $(360^\circ / 500) = 0.72^\circ$ of shaft rotation. <i>See also Stepping.</i>
<b>Half Step</b>	A half step is the unit of incremental motion that is 1/2 the basic motion step. SMC's 2-phase LX actuator motors are divided into 200 steps. Each pulse in half step mode equals $0.9^\circ$ of rotation. <i>See also Stepping.</i>
<b>Indexer</b>	An indexer is the part of a stepper motor controller that retains the motion command data to determine the move sequence, such as a single move or a series of moves that are stored in "memory", available for continuous positioning tasks. SMC's LC6 does not have this feature.
<b>Input Frequency</b>	The LC6 driver's input signal is a square-wave pulse. The internal circuit can only 'listen to' a certain number of these wave cycles per second. These are listed in terms of <i>kilohertz</i> , meaning 'thousand cycles.' 
<b>Linear Guide</b>	A crossed roller linear guide bearing offers twice the load carrying capability of a ball bearing guide, making it ideal for applications needing high precision, high rigidity, high repeatability, and low friction.
<b>Linearity</b>	Linearity is a measure of the degree to which the output of a control device maintains a constant relationship to the input over a range of input values.
<b>Open, Open or Closed</b>	In motion control, these terms are used to describe a system having some sort of speed or position feedback (to compare to the original commands). SMC's electric actuators equipped with DC stepper motors are open loop; that is, there is no feedback other than auto-switches. SMC's AC servo electric actuators are closed loop if an application has irregular or unpredictable loads, a closed-loop system may be desirable over an open-loop one. <i>See also Closed Loop Control System, Open Loop Control System.</i>
<b>Micro-Step</b>	The subdivision of a full-step into some finer increment than the half-step. A micro step is a logic patterns that will produce regular increments smaller than a half step. Micro-stepping is a function of the driver; SMC's LC6 driver does not have this feature.
<b>Open Loop Control System</b>	An open loop control system is a system that utilizes the stepper motor inherent positioning capabilities to provide precise positioning. There is no position confirmation feedback from the motor itself. <i>See also Closed Loop Control System.</i>
<b>Servo</b>	A servo system is a control system that employs feedback in order to control a desired output such as speed or position. A servo mechanism will detect and attempt to correct deviations from the desired output. Servo systems can offer higher speed, torque, and acceleration flexibility than step motor systems. Also, a servo is a closed-loop system, providing position and velocity feedback, whereas stepper motors are open loop systems.
<b>Slide Screw</b>	Slide screws are simpler than ball screws. The lead screw and rolling contact are machined with a trapezoidal pitch, and are in direct contact when moving. Slide screws give worse positioning repeatability, but are much less expensive than ball screws.
<b>Stepper Motor</b>	The stepper motor is the device that accepts the translated electrical current from the stepper driver and converts it to actual incremental motion stepper motors are inexpensive, simple to position, and offer high torque and good resolution, but no position feedback.
<b>Stepping</b>	Stepping is the process of supplying a proper logic pattern of drive signals that cause the stepper motor driver to supply the required stepper motor windings with current at appropriate times to create incremental motion. Full-stepping, half-stepping, and micro-stepping are a function of the stepper motor driver, and not the motor itself. <i>See also Full Step, Half Step, Micro Step.</i>

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger". To ensure safety, be sure to observe ISO 4414 <sup>Note 1)</sup>, JIS B 8370 <sup>Note 2)</sup> and other safety practices.

 **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 possible result of serious injury or loss of life.

Note 1) ISO 4414 : Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems.

Note 2) JIS B 8370 : Pneumatic system axiom.

## Warning

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

Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

### **2 Only trained personnel should operate pneumatically operated machinery and equipment.**

Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

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

1. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for this equipment and exhaust all residual compressed air in the system.
3. Before machinery/equipment is re-started, take measures to prevent shooting/out of cylinder piston rod etc. (Bleed air into the system gradually to create back-pressure.)

### **4 Contact SMC if the product is to be used in any of the following conditions:**

1. Conditions and environments beyond the given specifications, or if product is used outdoors.
2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

### Designing

#### ⚠ Caution

1. A protective cover should be used for installations which could present danger to the operator.  
In cases where the work or moving sections of the actuator may present a hazard to the operator, installation should be such that the operator cannot directly access the moving sections.
2. Take care in mounting the actuator or work so that components cannot be loosened.
3. If dangerous situation at the interruption of service of electricity or at product failure can be predicted, safety mechanism should be installed so that machinery/human operator will not be damaged. Suspending system or lift also needs to be considered as countermeasure to prevent object from dropping down. should be installed so that machinery/human body will not be damaged. Suspending system or lift also needs to be considered countermeasure to prevent object from dropping down.

### Selecting product

#### ⚠ Warning

1. Specifications should be confirmed. Use equipment within the Specifications.

### Operating environment

#### ⚠ Warning

1. Do not use in the corrosive atmosphere.
2. If actuator is to be used in an area with excessive dust or dripping/splashing of water/oil, a protective cover should be used.
3. Actuators equipped with auto switches are not suitable for use in a strong magnetic field.
4. Do not use in an installation where cutting oil will directly contact the machinery.
5. Do not use in an environment where cutting powder, dust, spatter etc. are present.
6. Equipment must be thermally isolated from any heat source so that no heat is conducted to the equipment.
7. Do not use in areas where actuator will be subjected to vibration or shock.

### Mounting

#### ⚠ Caution

1. Do not operate until confirming whether equipment can function properly.
2. Mount products after having read and understood operating manual well.
3. Mounting surface of body/table should not be marked with scratches.  
Flatness of mounting surface may be compromised; play in guide section, increased sliding resistance, etc. can occur.
4. Do not give strong shock or heavy moment when mounting work.
5. Flatness of mounting surface should be less than 0.05mm.  
Low quality of flatness of work or base etc. will cause play on guide section or increase on sliding resistance.
6. Appropriate connection method should be taken and accurate alignment is required if connecting to external support/guide mechanism.
7. Do not mount in the areas where actuator will be subjected to vibration or shock.  
Power-swing\* or damage may occur. Consult SMC if mounting in this kind of environment.  
\*Loss of synchronism
8. Repeatable bending force or tension to motor cable should be avoided.

### Maintenance

#### ⚠ Danger

1. Before performing wiring operation or system check, measure the voltage level by tester one minute after switch off of power supply. Otherwise, it may result in electric shock.
2. Wiring operation or system check should be made by qualified personnel.
3. Do not touch nor operate the switch with wet hand to avoid receiving electric shock.
4. Cable should not be damaged, stressed, pinched, nor loaded heavy weight.
5. Do not use equipment in environment where dusts, particles, cutting powder, spatter, etc. are in direct contact with equipment.
6. Equipment must be thermally isolated from any heat source so that no heat is conducted to the equipment.
7. Do not use in areas where actuator will be subjected to vibration or shock.

### Wiring

#### ⚠ Caution

1. Driver unit and motor should only be mounted on non-combustible surfaces. If mounting directly on or near combustible material, it could result in a fire.
2. If failure occurs on driver unit, disconnect the power supply to the driver. Fire could result from the continued supply of power.
3. Do not apply any voltage to any terminal other than that designated in Operating Manual. Otherwise, electric circuit will be damaged.
4. Connection to wrong terminal or wrong polarity (+, -) must be avoided, otherwise, electric circuit will be damaged.
5. While energizing or right after the power supply is switched off, do not touch the equipment due to very high motor temperature.
6. If continuously operating stepping motor, maintain the duty ratio mentioned in this catalog or Operating Manual. If the duty ratio is not maintained or is disregarded, coil breakage may be caused by high temperature.

## Precautions

### Brake Precautions

Read carefully before handling. There exists a very slight possibility of the failure of the brake mechanism; should this occur, inertial running may be seen in the system. To prepare for such a failure, safety measures for machinery should be considered and implemented. Redundant safety measures should be taken particularly for use as a safety brake.

#### Construction

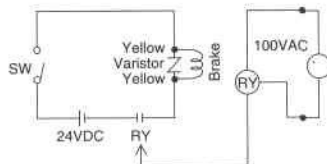
#### **⚠ Danger**

- Do not use in flammable or explosive atmosphere.**  
Slip at the activation or braking may generate sparks. Never use in grease or combustible gas atmosphere which has possibility of flash or explosion.
- Not applicable for braking.**  
This brake is non-excitation type designed only for holding and emergency stoppage. If repeatedly used for braking, its original performance and specifications can easily deteriorate within a short time and brake releasing becomes unavailable. If using in this way, brake will be damaged and holding performance will definitely be compromised leading to accidents such as runaway of machinery.

#### Before mounting

#### **⚠ Danger**

- Use the appropriate wire size for the power supply capacity.**  
If sufficient wire size is used, insulation coating will be melted and electric shock or fire may result.
- Start operation after confirming proper electrical wiring for the brake.**  
The brake is locked at de-energized state. 24VDC is needed to release the lock. A circuit example is shown below for reference.



#### Operation

#### **⚠ Danger**

- Immediately stop the operation whenever extraordinary operation noise is heard or vibration is felt. In the case where extraordinary operation noise is heard or vibration is felt, product may have been improperly mounted. Unless operation is stopped for the inspection, machinery may be seriously damaged.

#### Maintenance

#### **⚠ Danger**

- Do not apply oil nor water.**  
If water or oil is applied to sliding friction surface or even body, torque performance will be compromised drastically and the system may overrun causing human injury.

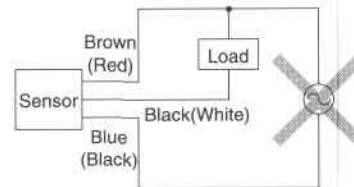
### Photo Micro Sensor

Read carefully before handling.

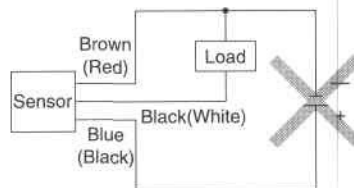
#### Incorrect usage

#### **⚠ Caution**

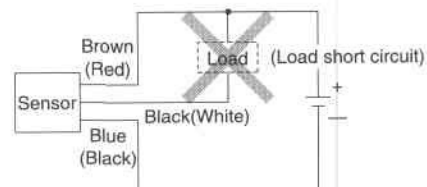
- Do not operate beyond the rated voltage range.**  
If applying voltage over the rated voltage range, equipment may be damaged.



- Avoid incorrect wiring such as polarity of power supply.**  
Otherwise, equipment may be damaged.



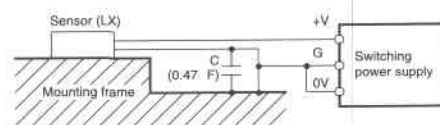
- Do not short circuit the load. (Do not connect to power supply.)**  
Otherwise, equipment may be damaged.



#### Proper usage: Power supply

#### **⚠ Caution**

- The following conditions should be satisfied when using switch regulator.
- Mounting frame is connected to "0V" line of power supply close to the sensor to reduce impedance of the frame so that induction noise will not enter the mounting frame.

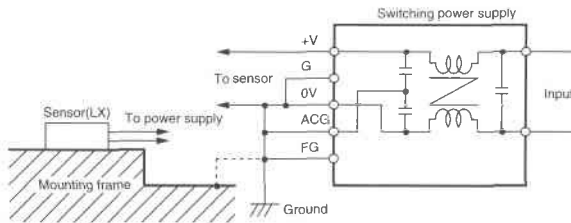


**Proper usage: Power supply**

**⚠ Caution**

- Noise filter terminal (neutral terminal to "ACG") on switching power supply is connected the power supply's body frame "FG" and "0V" of the power supply.

If the connected circuit is grounded to the earth or mounting frame body, its operation can be more stable. (Recommended by power supply manufacturers.)

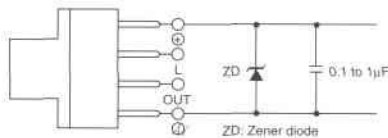


- Insert an approximately 10 mm width insulation plate made of plastics in between sensor body and mounting frame.

**Proper usage: Surge voltage**

**⚠ Caution**

If surge voltage is generated on the power supply line, according to the operating conditions, circuit should be equipped with zener diode "ZD", 30 to 35V, or condenser, 0.1μF, etc. in order to eliminate the surge voltage. Do not start the operation before confirming disappearance of surge voltage.



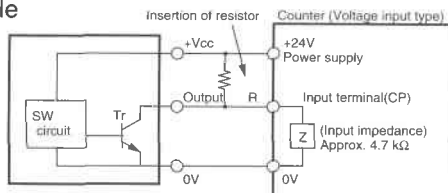
**Proper usage: Voltage output**

**⚠ Caution**

Insert resistor in between power supply and the output to enable connecting open collector output sensor to voltage input specification.

4.7kΩ of resistor is generally used. Suited wattage of resistor is 1/2W for 24V and 1/4W for 12V.

Example



**Proper usage: Voltage output**

**⚠ Caution**

In the case resistor R = 4.7 kΩ

At "H" level,

Input voltage V<sub>H</sub>

$$= \frac{Z}{R+Z} V_{CC} = \frac{4.7k}{4.7k+4.7k} \times 24V = 12V$$

At "L" level,

Input voltage V<sub>L</sub> ≤ 0.4V

Load voltage I<sub>c</sub>

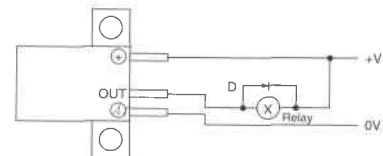
$$= \frac{V_{CC}}{R} = \frac{24V}{4.7k} = 5.1mA \leq 10mA$$

See the sensor specifications for residual voltage against load voltage.

**Others**

**⚠ Caution**

- Voltage cable/power cable should not be in the same piping or duct where wiring of Photo Micro Sensor is in; otherwise, the system may malfunction or be damaged due to induction. Separate wiring or individual wiring is required to avoid such a trouble.
- Avoid mounting in the following locations since failure may occur.
  - Place where the ambient is dusty.
  - Place where the ambient is corrosive gas.
  - Place where water, oil, and/or chemical material are sprayed and/or directly contact the equipment.
  - Outdoor and/or place where equipment is directly exposed to strong light; e.g. the sun light.
- Use product within the ambient temperature range indicated in its specifications.
- Operate after having checked its mounting condition if it is loosened or play is seen on it caused by vibration or shock.
- If organic solvent, acid, alkaline, aroma group carbon-hydrogen, or fatty chloride group carbon-hydrogen touches the sensor, it may melt.
- If operating with small size dielectric load such as relay, wire as shown in the figure below. (Reverse voltage suppression diode should be connected.)



## Auto Switch Precautions 1

Be sure to read before handling

### Design/Selection

## ⚠ Warning

### 1. Confirm specifications.

Do not use switches with load current, voltage, temperature, impact beyond the specification range.

### 2. Parallel mounting of actuator

When using two or more auto switch capable actuator or more mounted parallel to one another, the distance between actuator bodies should be 40 mm or more to avoid possible incorrect operation caused by magnetic force from neighboring actuators.

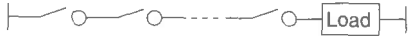
### 3. Wiring should be as short as possible.

Lead wire should be less than 100 meters.

### 4. Internal voltage drop

The internal voltage drop of 2-wire solid-state switch is larger than that of reed switch. 12VDC relay is not available.

If the switches are connected in series as shown in the following figure, it makes the voltage drop greater due to the internal resistance of the light emitting diodes (Refer to the internal resistance voltage in the auto switch specification). The load may not operate due to the internal voltage drop.



If used in less than the specified voltage, the load may not operate due to the internal voltage drop. The allowable range of the load should be confirmed. Select the auto switch using the following formula.

$$\text{Power voltage} - \text{Internal drop voltage} > \text{Min. operating voltage of load.}$$

### 5. Current leakage

(Solid-state switch)

2-wire solid-state switch has a current flow in the load to operate the internal circuit at off.

Please use the following formula:

$$\frac{\text{Load operating current}}{\text{(Input off current at controller)}} > \text{Current leakage}$$

If not, switch will remain in the ON condition. In such a case use the 3-wire type.

### 6. Do not use a load which generates a surge voltage.

(Solid-state switch)

An output part connected to a zener diode for protection against surge may be damaged by repeated surges. Use an auto switch with built-in surge absorbing element when directly driving a load that generates a surge such as a relay or solenoid valve.

### 7. Secure the maintenance space.

Space for maintenance should be taken into consideration when designing machinery.

### Installation/Adjustment

## ⚠ Warning

### 1. Do not drop or cause impact to switch.

Do not drop, apply excessive impact (more than 300m/s<sup>2</sup> for reed switch, more than 1000m/s<sup>2</sup> for solid-state switch) when handling. Damage could occur to the inside as well as the body.

### 2. Do not pull the lead wire with excessive force. Do not pull the lead wire to move the cylinder.

It may cause breakage of lead wire or damage to the internal switch element due to the applied stress.

### 3. Tighten the screw within the specified torque range.

Tightening with over the specified torque may damage the mounting screw, bracket or switch. If tightening with smaller torque than the specified range, the mounting position may slide.

### 4. Set the switch at the center of operating range.

Adjust the mounting position of auto switch to have the piston stopped in the middle of the switch operating range, or the switch may operate erratically. (The most suitable mounting position shown in the catalog is near the borderline of the stroke end.)

### Change of lead wire color

Lead wire colors of SMC switches and related products have been changed in order to meet Nippon Electric Control Equipment Industries Association Standard No.402.

Please note the polarity when installing the switch.

#### 2 wire

	Former	New
Output (+)	Red	Brown
Output (-)	Black	Blue

#### Solid state switch with diagnostic output

	Former	New
Power supply +	Red	Brown
GND	Black	Blue
Output	White	Black
Diagnostic output	Yellow	Orange

#### 3 wire

	Former	New
Output +	Red	Brown
GND	Black	Blue
Output	White	Black

#### Solid state switch with latching diagnostic output

	Former	New
Power supply +	Red	Brown
GND	Black	Blue
Output	White	Black
Latching type diagnostic output	Yellow	Orange

### Wiring

#### Warning

##### 1. Wiring must not be subjected to repeated bending stress or pulling forces.

It may cause the wire to break.

##### 2. Connect the load before supplying power.

(2-wire type)

Switch may fail due to excessive current flow as soon as switch comes ON without load.

##### 3. Check the insulation of wiring.

Do not use wiring with damaged insulation due to risk of a short circuit e.g. contact with other wiring, ground or between terminals etc. An auto switch may be damaged by excessive current flowing into the switch.

##### 4. Avoid close proximity to power or high voltage cable.

Electrical interference might cause malfunction to the control circuit, including the switch, due to noise.

##### 5. Do not short the load.

The short protection circuit is not equipped with not all the PNP type. Take care so that the switch is not broken as soon as the load is shorted. Pay special attention when replacing the power wire (Brown) and output wire (Black).

##### 6. Avoid incorrect wiring.

1) The 2-wire type is equipped with a protection circuit so that the switch will not be damaged by reverse connection, however, the switch is always ON. The switch will be damaged by reverse connection when the load is shorted.

2) In case of 3-wire type

Reverse connection of (+) and (-) is protected by protection circuit, but the switch may be damaged if connecting polarity (+) with blue lead wire and (-) with black lead wire.

### Environment

#### Warning

##### 1. Do not use switches in an environment where auto switch is in direct contact with explosive atmosphere.

The auto switches have no explosion proof construction; it may ignite explosive gas.

Therefore, avoid the use of switch in such an atmosphere.

##### 2. Do not use switches where a magnetic field exists.

It may cause a malfunction or reduce magnetic force of magnet assembled in the actuator. Contact SMC for a strong magnetic field resistant auto switch.

##### 3. Do not use switches in an environment where an auto switch may be continuously exposed to direct water contact.

Use of the auto switch for long periods of time with continuous exposure to water should be avoided. It may cause adverse effect on insulation or switch malfunction due to deteriorated of potting resin.

##### 4. Do not use switches in an environment where oil or chemical is required.

Contact SMC for the use of auto switches in an environment requiring contact with coolant, cleaning solvent, other kinds of oils or chemicals for a short time. It may cause adverse effect on insulation or switch malfunction due to deterioration of potting resin and hardening of lead wire.

##### 5. Do not use switches where operating temperature changes greatly.

Contact SMC for the temperature changes other than normal range.

##### 6. Do not use switches where a large surge voltage is generated.

When electronic type machine lifter, high frequency induction furnace or motor, which generate large surge voltage, is placed near switches, use a switch equipped with a built-in surge adsorption element and avoid the common wiring. It may cause damage or deterioration of switches internal circuit element.

##### 7. Pay attention to any iron powder accumulation or magnetic substance.

If cutting or iron powder from welding spatter is accumulated or magnetic substances are placed nearby, magnetic force of piston magnet may be reduced and switch will not function properly.

### Maintenance

#### Warning

##### 1. The following maintenance should be done regularly.

1) Additional tightening of switch mounting screw

Readjust the mounting position and tighten the screw if screw is loose or mounting position has slid.

2) Confirmation of the lead wire condition Replace switch or repair the lead wire to avoid insulation fault if lead wire is damaged.

### Others

#### Warning

##### 1. Contact SMC for water resistant performance, bending resistance of lead wires, and use in welding applications.

## Driver Unit Precautions

Read carefully before handling

## Usage

**Warning**

- Operating manual should be read carefully to understand and confirm product specifications/characteristics before mounting.
- Avoid using equipment in any mounting method or operation other than that mentioned in the operating manual. Otherwise, it may cause failure or malfunction.
- Never touch the inside of driver unit. It may cause electric shock or failure.
- Motor and driver should be used in the designated combinations.

**Caution**

- Do not disassemble nor modify the equipment. This may cause failure, malfunction or fire.
- Do not touch the driver during energizing or right after de-energized due to high temperature.
- When fire or danger to human is predicted due to abnormal heating, firing or smoking of the driver, shut the power supply to the main body and the system immediately.

## Usage

**Danger**

- Adjusting, mounting or wiring change shouldn't be done before shutting the power supply to the driver. Electric shock may be received.

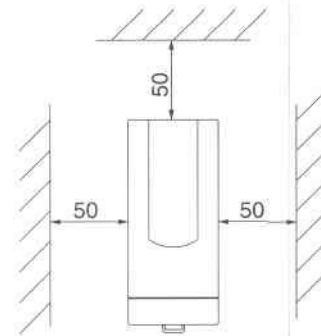
**Danger**

- Wiring should be properly completed.  
Do not apply any voltage to the terminals other than those specified in operating manual. Unit may be damaged.
- Connector should be certainly connected.
- Certain measure against noise should be taken. If noise is on signal line, it may cause malfunction. As the countermeasure, separate strong electrical wire and weak electrical wire, and shorten their wiring length.

## Mounting

**Caution**

- Mount the driver on non-combustible substance. Mounting directly on or closely to combustible material may cause fire.
- Cooling has to be done so that operating temperature of body will be within the range shown in the specifications. For that reason, each face of body should be at least 50mm from other constructions or components.



- Unit should be grounded.
- Avoid mounting the driver on the panel where vibration source such as large size electromagnetic contactor or circuit fuse breaker is also mounted. Even if driver is mounted on the same panel with such a vibration source, it should be separated from the source.
- Design the machinery so that the connector can be freely connected/disconnected after installation.
- Use within the specifications. Do not use in the place where dusts, oil, smoke, conductive dusts, corrosive gas, flammable gas, or so on is generated, in the place where exposed to high temperature, dewing, wind/rain or so on, or in the place where vibration or shock is conducted.



# Common Terms Related To Electric Actuators

## 2-Phase Motor, 5-Phase Motor

A five-phase motor runs much smoother than a two-phase motor because it has two more magnetic poles than a two-phase motor does. This means there is less torque ripple or vibration from resonance. However, actuators with five-phase motors have slightly lower payload ratings than those with two-phase motors.

## Ball Screw

Both ball screws and slide screws consist of a rolling contact on a lead screw. For ball screws, the rolling contact is a housing with recirculating ball bearings inside. The lead screw has machined grooves for the ball bearings to roll in. SMC offers two types of ball screw: a ground type (higher precision, higher cost) and a rolled type (lower precision, lower cost).

## Closed Loop Control System

A closed loop control system is a system that utilizes a feedback device (encoder, resolver, and so on) to enhance performance of the system by providing better acceleration and speed capabilities as well as better system stability. The closed loop control system also provides assurance that the programmed position is actually achieved. *See also Open Loop Control System.*

## Duty Cycle

Duty cycle is the variation of torque or speed or both with time during a specified operating cycle. The LC6 stepper driver has a duty cycle of 50%, regardless of actuator load. Also, LC6 continuous operation may not exceed thirty seconds. Continuous operation is defined as the time from when the slider begins to move until it stops moving (not just pauses at stroke end).

$$\text{duty cycle} = \frac{\text{run time}}{\text{run time} + \text{stopped time}} \times 100$$

## Full Step

A full step is a logic pattern that will produce one unit of incremental motion from a stepper motor (the increments being determined by the stepper motor structure). For example, SMC's 5-phase LX actuator motors are divided into 500 steps. Thus, one pulse in full step mode equals  $(360^\circ \div 500) = 0.72^\circ$  of shaft rotation. *See also Stepping.*

## Half Step

A half step is the unit of incremental motion that is 1/2 the basic motion step. SMC's 2-phase LX actuator motors are divided into 200 steps. Each pulse in half step mode equals  $0.9^\circ$  of rotation. *See also Stepping.*

## Indexer

An indexer is the part of a stepper motor controller that retains the motion command data to determine the move sequence, such as a single move or a series of moves that are stored in "memory", available for continuous positioning tasks. SMC's LC6 does not have this feature.

## Input Frequency

The LC6 driver's input signal is a square-wave pulse. The internal circuit can only 'listen to' a certain number of these wave cycles per second. These are listed in terms of *kilohertz*, meaning 'thousand cycles.'

square waves 

## Linear Guide

A crossed roller linear guide bearing offers twice the load carrying capability of a ball bearing guide, making it ideal for applications needing high precision, high rigidity, high repeatability, and low friction.

## Linearity

Linearity is a measure of the degree to which the output of a control device maintains a constant relationship to the input over a range of input values.

## Loop, Open or Closed

In motion control, these terms are used to describe a system having some sort of speed or position feedback (to compare to the original commands). SMC's electric actuators equipped with DC stepper motors are open loop; that is, there is no feedback other than auto-switches. SMC's AC servo electric actuators are closed loop if an application has irregular or unpredictable loads, a closed-loop system may be desirable over an open-loop one. *See also Closed Loop Control System, Open Loop Control System.*

## Micro-Step

The subdivision of a full-step into some finer increment than the half-step. A micro step is a logic patterns that will produce regular increments smaller than a half step. Micro-stepping is a function of the driver; SMC's LC6 driver does not have this feature.

## Open Loop Control System

An open loop control system is a system that utilizes the stepper motor inherent positioning capabilities to provide precise positioning. There is no position confirmation feedback from the motor itself. *See also Closed Loop Control System.*

## Servo

A servo system is a control system that employs feedback in order to control a desired output such as speed or position. A servo mechanism will detect and attempt to correct deviations from the desired output. Servo systems can offer higher speed, torque, and acceleration flexibility than step motor systems. Also, a servo is a closed-loop system, providing position and velocity feedback, whereas stepper motors are open loop systems.

## Slide Screw

Slide screws are simpler than ball screws. The lead screw and rolling contact are machined with a trapezoidal pitch, and are in direct contact when moving. Slide screws give worse positioning repeatability, but are much less expensive than ball screws.

## Stepper Motor

The stepper motor is the device that accepts the translated electrical current from the stepper driver and converts it to actual incremental motion. Stepper motors are inexpensive, simple to position, and offer high torque and good resolution, but no position feedback.

## Stepping

Stepping is the process of supplying a proper logic pattern of drive signals that cause the stepper motor driver to supply the required stepper motor windings with current at appropriate times to create incremental motion. Full-stepping, half-stepping, and micro-stepping are a function of the stepper motor driver, and not the motor itself. *See also Full Step, Half Step, Micro Step.*



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