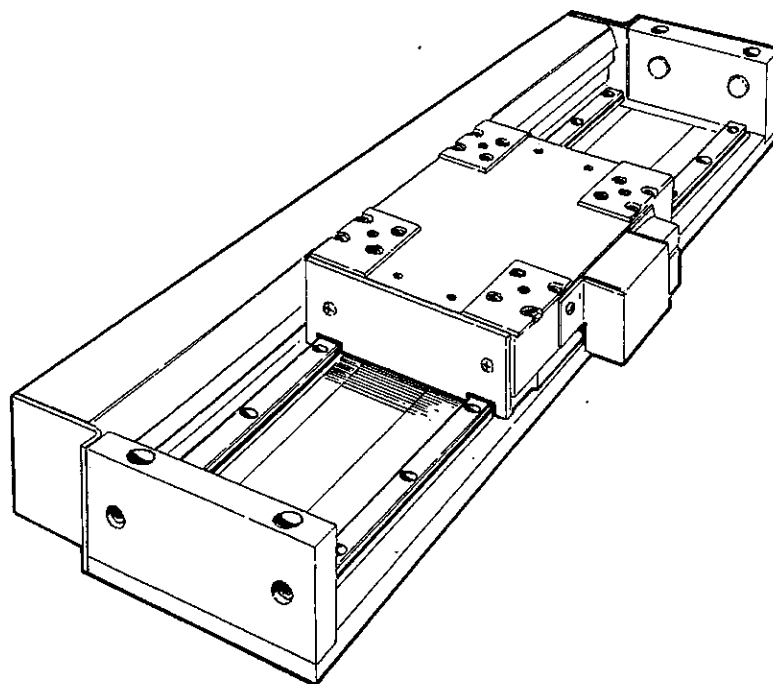


DIRECT DRIVE LINEAR SERVO ACTUATOR  
LM • TM Series





# INTRODUCTION

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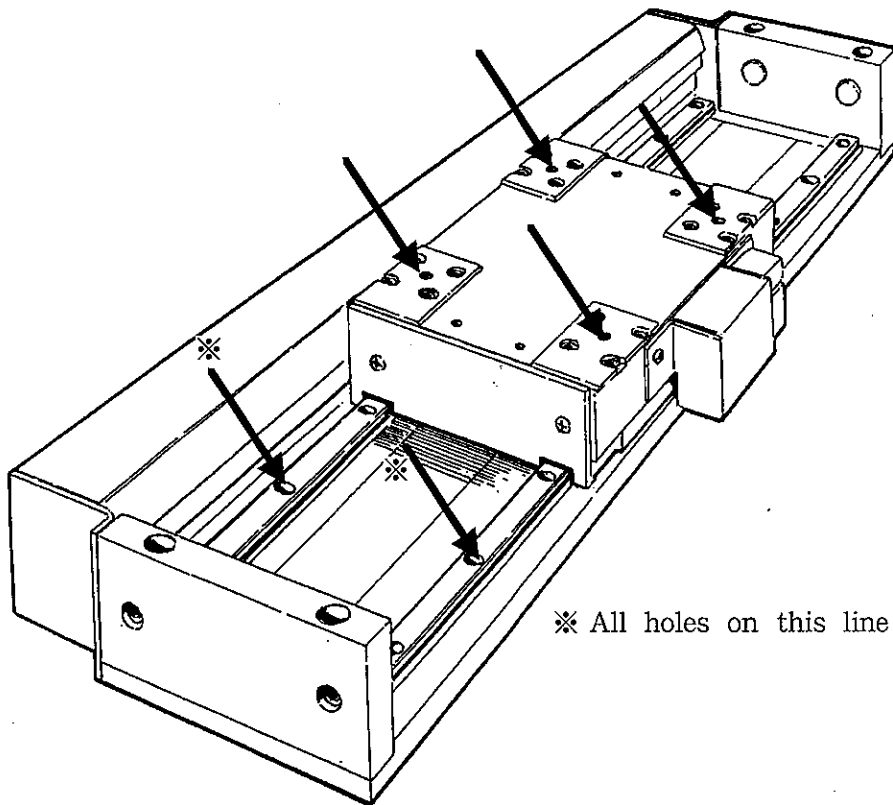
Thank you very much for purchasing our LINEARSERV DD Servo-Actuator. The LINEARSERV is a high-speed, highly accurate linear servo-actuator which can be used in a wide range of field applications related to factory automation, including semiconductor-manufacturing equipment, automatic assembly equipment, high accuracy positioning equipment, etc. This instruction manual covers the model that combines the LM/TM series DD Servo-Actuator. Be sure to read this instruction manual prior to operating the LINEARSERV.

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## Warning on Operation

1. Ensure that the power is switched off when removeing the side panel of the driver for jumper setting, etc. Dangerously high voltage is present inside the unit.
2. Because the surface of the motor is magnetic, materials easily affected by magnetism must be kept away from or must not be close to the motor.
3. Because glass materials are incorporated in the motor, avoid mechanical shock or vibration.
4. Never disassemble or modify the LINEARSERV. When such disassembly or modification is required, consult Yokogawa Precision Corporation or its authorized agency.  
Yokogawa Precision Corporation, or its authorized agency, accepts no responsibility for a disassemble or modified LINEARSERV without permission.
5. Never touch the bolts (except indicated by arrow in the following figure) which fix of the each parts of the motor. Loosening or tightening those volts may result in faulty movements.



6. If the motor is used with oscillating movements with a small distance (20mm or less), then carry out a running – in operation with back – and – forth movement about 10 times, each move an length of full stroke. The running – in operation must be carried out every 10,000 times of back and forth oscillation movements in order to ensure proper lubrication of the bearings.
7. Never carry out a withstanding voltage test. Carrying out this test ever accidentally may damage the circuits. When such withstanding voltage tests are required, consult Yokogawa Precision Corp. or its authorized agency.

# CONTENTS

<b>INTRODUCTION .....</b>	<b>i</b>
<b>Warning on Operation.....</b>	<b>ii</b>
 <b>1. PRODUCT OUTLINE</b>	
1.1 LINEARSERV, LM/TM Series .....	1-1
1.2 Standard Product Configuration.....	1-2
1.3 Model and Suffix Codes .....	1-3
 <b>2. FUNCTIONAL DESCRIPTION</b>	
2.1 Motor .....	2-1
2.2 Driver.....	2-1
2.3 Driver (Front Panel) .....	2-2
 <b>3. PREPARATION FOR OPERATION</b>	
3.1 Initial Setting .....	3-1
(1) Setting of the Jumper Switches in the Driver Box .....	3-1
(2) Jumper Settings Done Prior to Shipment.....	3-1
3.2 Control Mode Setting .....	3-3
(1) Control Mode Types .....	3-3
(2) Functions and Details on Jumpers and Switches .....	3-4
3.3 Connection .....	3-6
3.4 I/O Signals .....	3-6
(1) Input .....	3-6
(2) Output .....	3-7
3.5 Installation .....	3-7
3.6 Service Life .....	3-8
3.7 Definitions and Measurement Methods of Specification Accuracies .....	3-10

## 4. CAUTION ON OPERATION

4.1	Cautions on I/O Signals .....	4-1
(1)	Position Command Pulse Input Signal .....	4-1
(2)	Motor Rotating Direction Command Input Signal .....	4-1
(3)	Velocity Command Input .....	4-1
(4)	Current Command Input .....	4-1
(5)	Current Limit Input .....	4-1
(6)	Velocity Monitoring Output .....	4-2
(7)	A/B Phase, UP/DOWN Pulse Output Signals .....	4-2
(8)	Origin Pulse Output Signal .....	4-3
(9)	ERR Output Signal .....	4-4
4.2	Power On/Off .....	4-4

## 5. CONTROL MODE AND ADJUSTMENT

5.1	Position Control Mode Adjustment .....	5-1
(1)	I-PD Position Control .....	5-1
(2)	P Position Control .....	5-2
(3)	Position Control System Adjustment Procedure .....	5-2
(4)	Procedure for Adjustment Without Measuring Instruments .....	5-4
5.2	Velocity Control Mode Adjustment .....	5-5
(1)	PI Velocity Control .....	5-5
(2)	P Velocity Control .....	5-5
(3)	Adjustment of Velocity Control System .....	5-5
5.3	Thrust Control Mode Adjustment .....	5-6
5.4	Mechanical Resonance Notch Filter Adjustment .....	5-7

## 6. MAINTENANCE AND INSPECTION

6.1	Motor .....	6-1
6.2	Servo Driver .....	6-1

## 7. TROUBLESHOOTING AND MEASURES

7.1	Motor Problems and Measures .....	7-1
7.2	LED Displays .....	7-3

## 8. REFERENCE

8.1	Standard Specification .....	8-1
(1)	Motor .....	8-1
(2)	Driver .....	8-1
(3)	Environmental Specifications .....	8-1
8.2	External Dimensions .....	8-2
(1)	Motor .....	8-2
(2)	Driver .....	8-7
(3)	Head amplifier .....	8-7
8.3	Velocity vs Thrust Characteristics .....	8-8
8.4	Driver Block Diagram .....	8-9

# 1. PRODUCT OUTLINE

## 1.1 LINEARSERV, LM/TM Series

The LINEARSERV, LM/TM Series is a linear positioning actuator which adopts a direct drive method. The features of the actuator are that it has our unique interpolated optical linear encoder using a glass scale; fully closed high-precision positioning control; and a smooth driving characteristic.

Absolute accuracy: 10  $\mu\text{m}$  or less/700 mm

Positioning repeatability: 0.1 to 0.5  $\mu\text{m}$

Small vibration: Fluctuation is 1% of the velocity.

Ratio of thrust to weight: 7G

The above four items prove the high-precision positioning characteristics that the LM series has. A mechanically field-proven linear guide is incorporated in the LINEARSERV LM series, ensuring highly stiff linear guidance to each load. The driver section has an I-PD positioning control function, enables high-precision positioning easily like handling a pulse motor, using a serial pulse command interface, and does not require complicated adjustment work. The volume of the actuator is three times smaller than our conventional actuators, realizing easy and simple use.

There is a driver model for each motor.

The drivers are available in types so that they can correspond to motor types.

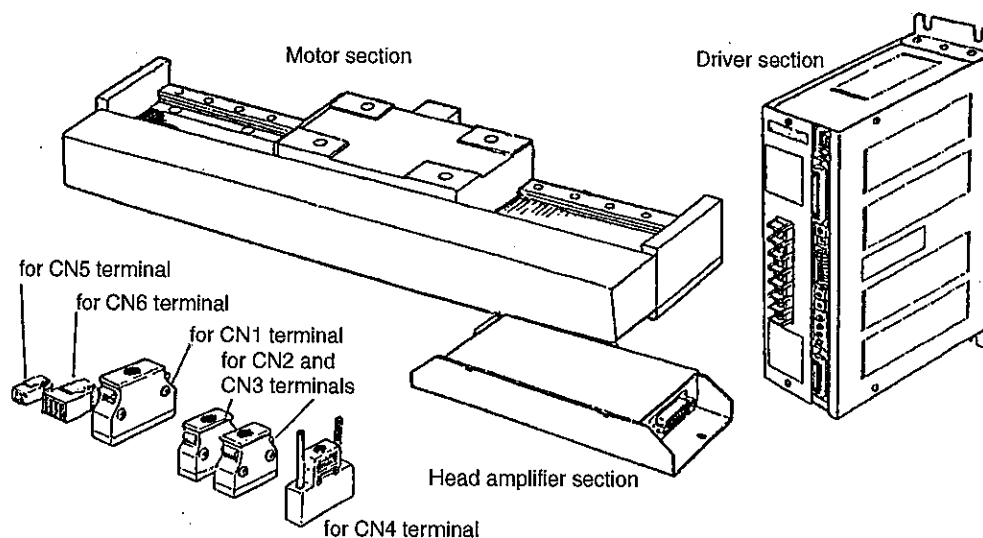
The drivers are available also with 100 – 115V and 200 – 230V power supply type.

Max. torq	Motor model letter	Driver model letter
50N	LM□05□0□00 – 0□□□*1C	TM□050104□ – □S□*1C
100N	LM□10□0□00 – 0□□□*1C	TM□100104□ – □S□*1C
300N	LM□30□0□00 – 0□□□*1C	TM□300104□ – □S□*1C

## 1.2 Standard Product Configuration

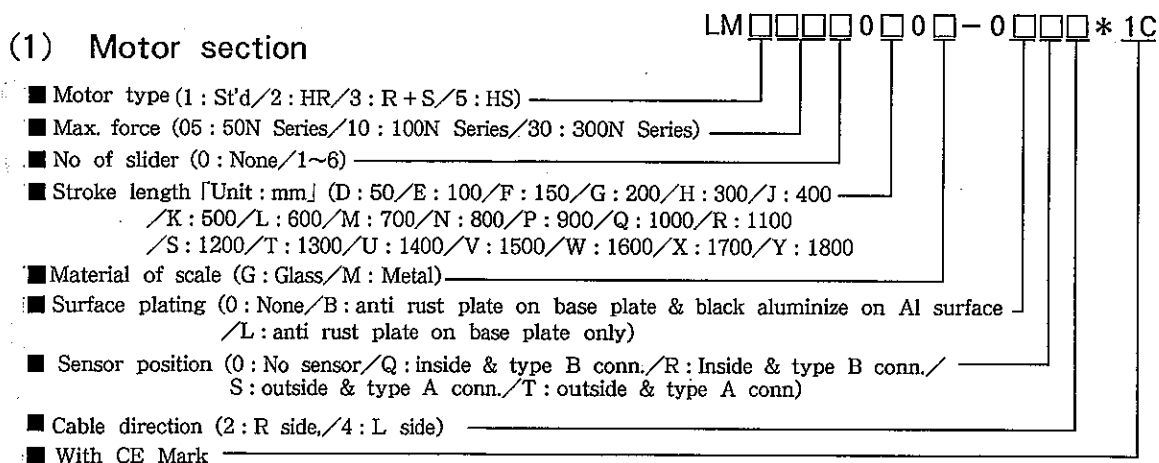
The standard product set consists of the following components. When unpacked, make sure that the product is the correct model, and that the types and quantities of standard accessories are also correct.

Part			Q'ty	
Main unit	Motor		1	
	Driver		1	
	Head amplifier		1	
Standard accessories	Motor	Connector (for CN5 terminal)	1	AMP (housing) for 4-pin connector/#172167-1 or 172338-1 AMP (housing) for 12-pin connector/#172170-1 or 172341-1 20 AMP (socket) 170365-3 connectors, 10 AMP 170366-3 connectors
		Connector (for CN6 terminal)	1	
	Driver	Connector (for CN1 terminal)	1	Manufactured by Fujitsu Connector: FCN241J050-G/E Cover: FCN230C050-D/E
		Connector (for CN2 terminal)	1	Manufactured by Fujitsu Connector: FCN241J020-G/E Cover: FCN230C020-C/E
	Head amplifier	Connector (for CN3 terminal)	1	Manufactured by Fujitsu Connector: FCN241J020-G/E Cover: FCN230C020-C/E
		Connector (for CN4 terminal)	1	Manufactured by JAE Connector: DA-15PF-N Cover: DA-C8-J10-F4-1

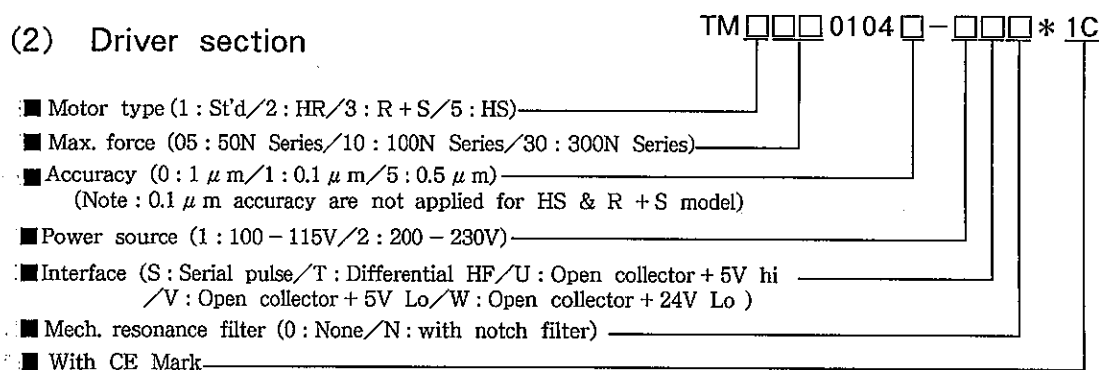


## 1.3 Model and Suffix Codes (HR: High rigidity model/HS: High speed mod/ R + S: High rigidity + high speed model)

### (1) Motor section



### (2) Driver section



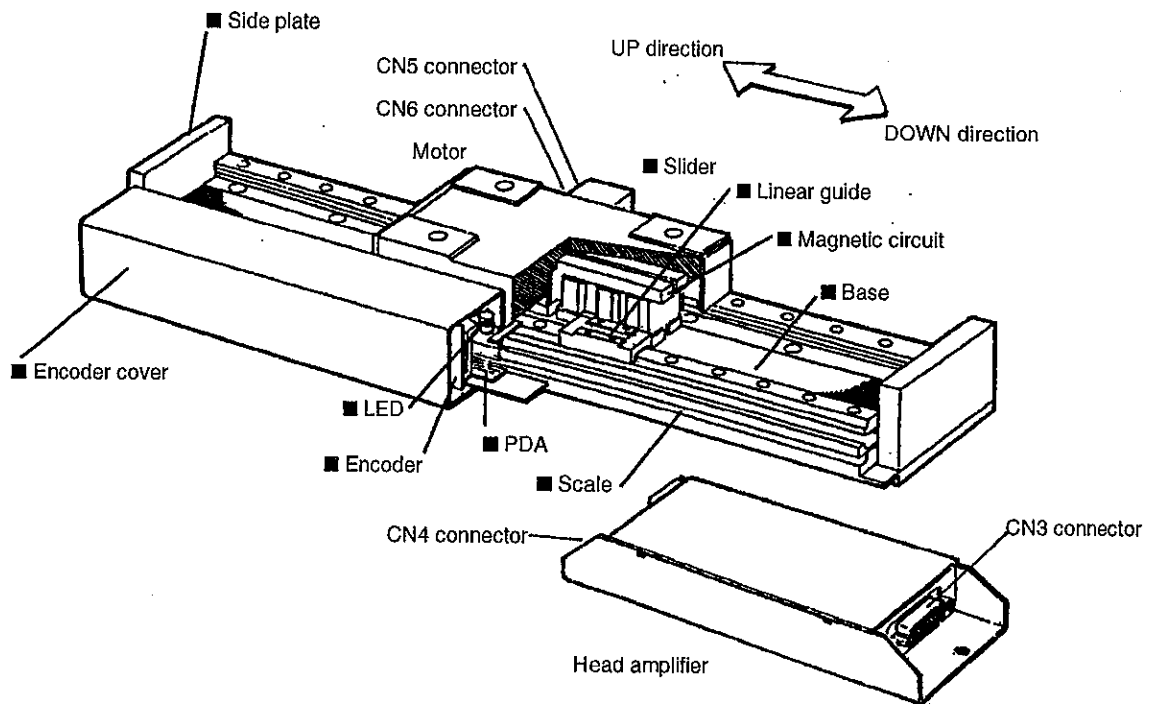
### NOTE

Since the combination of the LINEARSERV motor with head amplifier is fixed, random combinations are not allowed. The driver is compatible within the same model type.

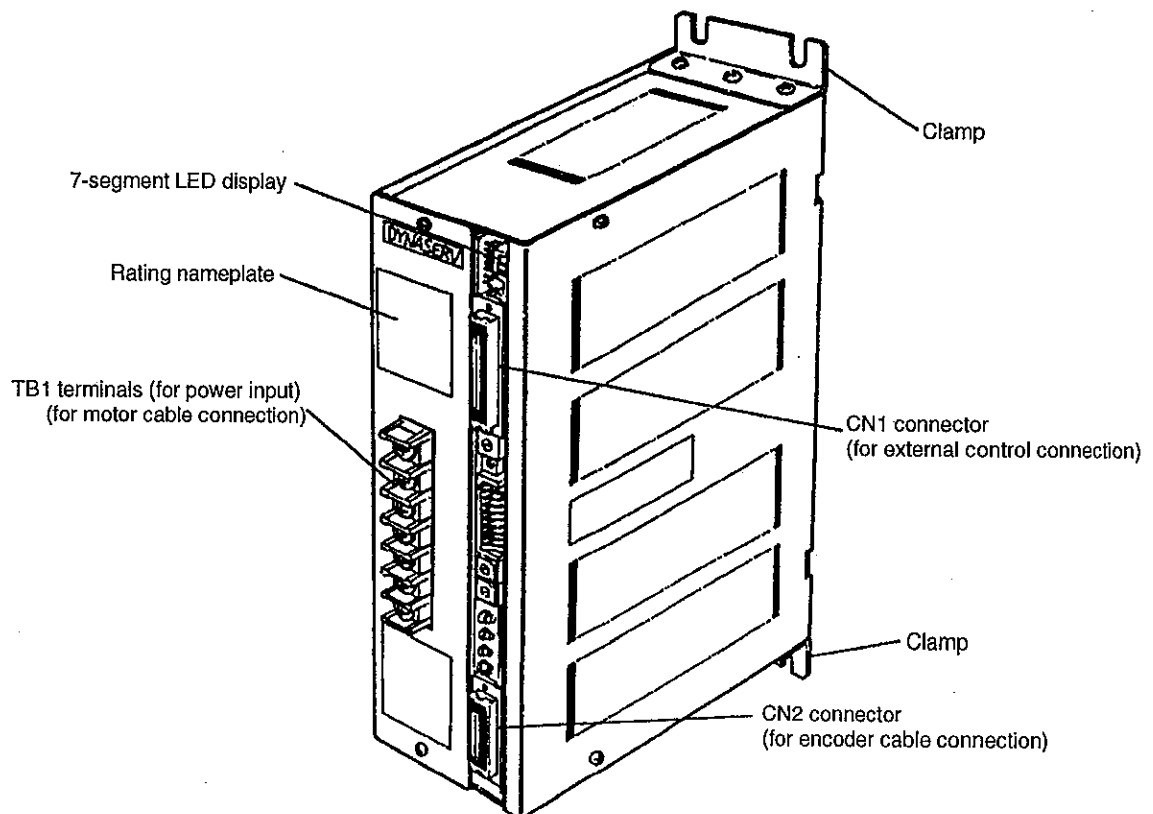


## 2. FUNCTIONAL DESCRIPTION

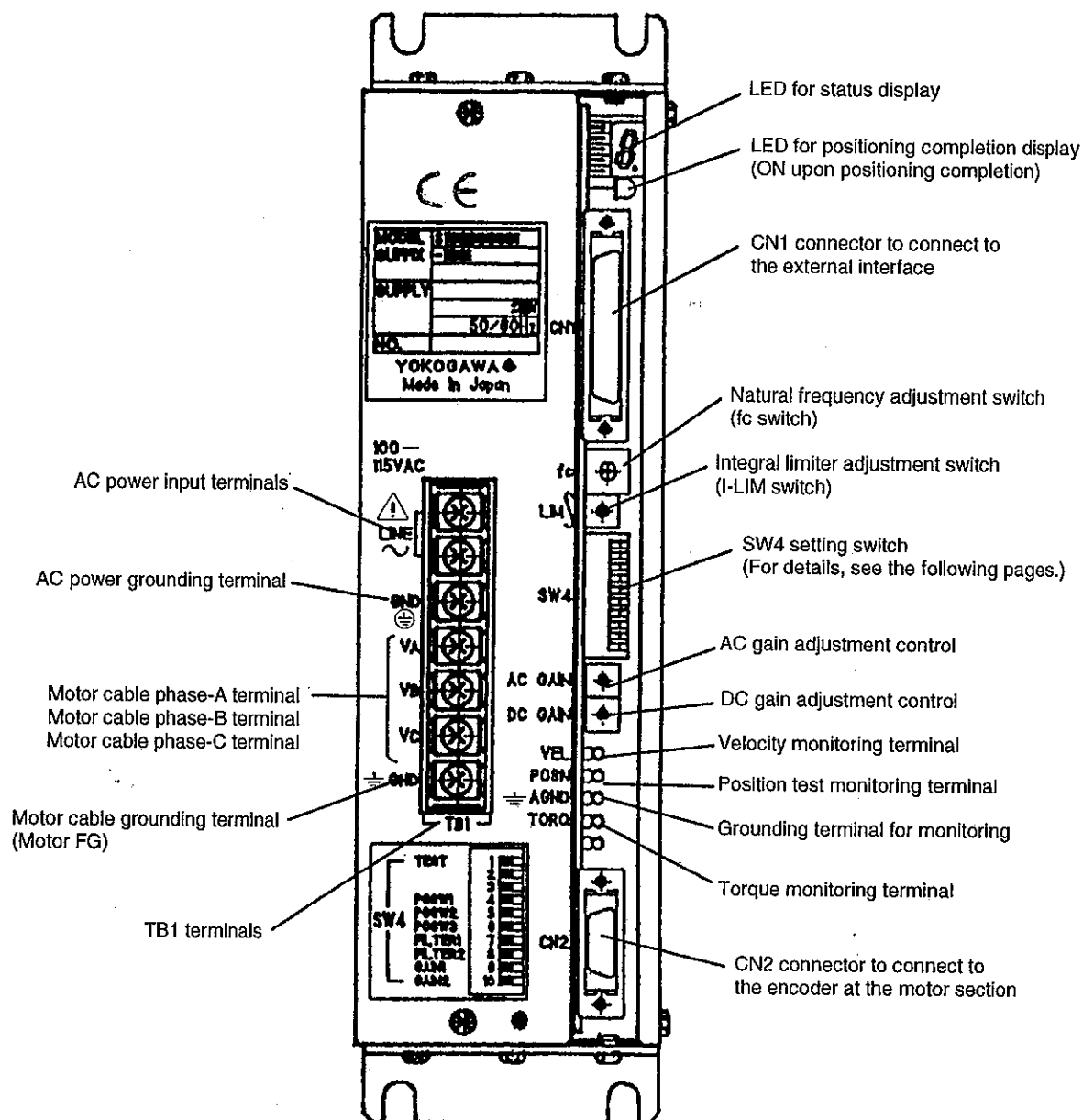
### 2.1 Motor



### 2.2 Driver



## 2.3 Driver (Front Panel)

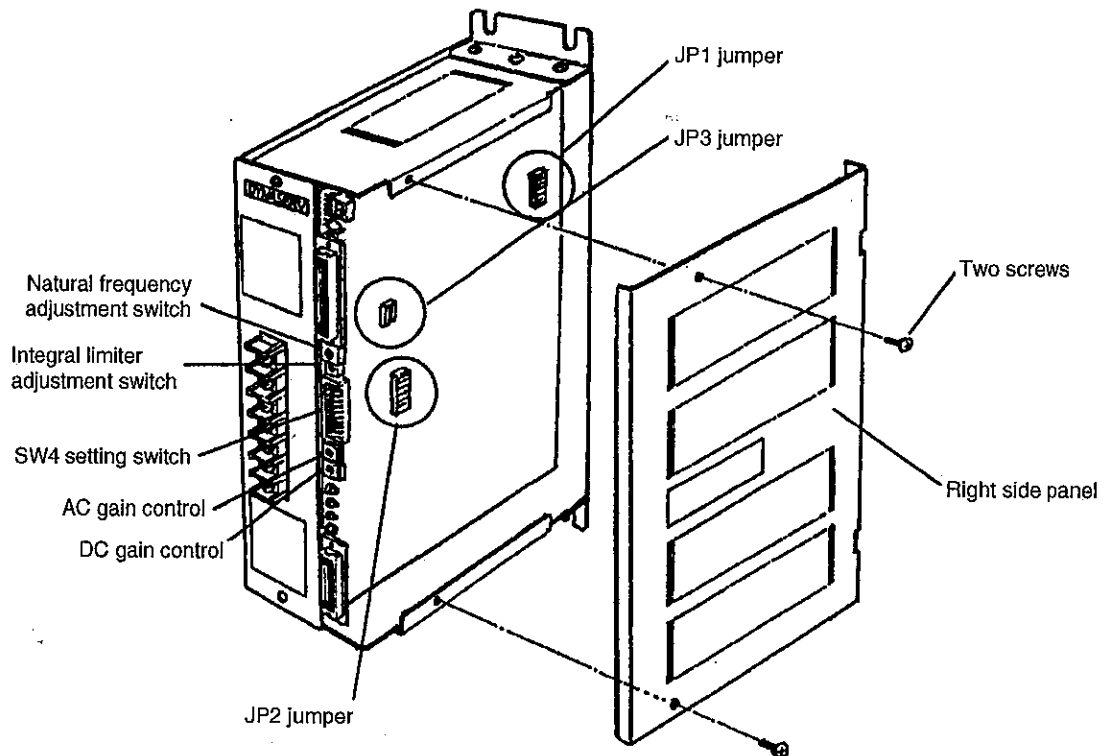


\* Both GND terminals are connected

## 3. PREPARATION FOR OPERATION

### 3.1 Initial Setting

#### (1) Setting of the Jumper Switches in the Driver Box



Some jumpers, switches, and controls within the driver box may need to be set by the customer. However, prior to shipment, they are set as shown below. See the figure above for their locations. To remove the side plate from the driver box, remove the two screws shown in the figure above.



#### WARNING

In order to commence this operation, the power must be turned off because of danger. Further, never touch a section generating high-voltages, even with the power turned off.

For the setting and adjustment procedures, see the following pages. Never touch the switches and variable resistors other than those specified.

#### (2) Jumper Settings Done Prior to Shipment

The statuses for jumpers, switches, and variable resistors in LINEARSERV upon shipment are set as follows as standard. The tuning mode is set to the I-PD position control mode upon shipment.

### JP1 jumper

Name	Setting status
MODE	■—■
CALIB	<input type="checkbox"/> <input type="checkbox"/>
RATE #1	■—■
RATE #2	■—■
UD/AB	■—■

■—■ : Shorted

☐ ☐ : Open

### JP2 jumper

Name	Setting status
I	<input type="checkbox"/> <input type="checkbox"/>
P	■—■
100	<input type="checkbox"/> <input type="checkbox"/>
200	<input type="checkbox"/> <input type="checkbox"/>
PV	■—■

■—■ : Shorted

☐ ☐ : Open

### JP3 jumper

Name	Setting status
VEL	<input type="checkbox"/> <input type="checkbox"/>
TORQ	<input type="checkbox"/> <input type="checkbox"/>

☐ ☐ : Open

### SW4 switch

Name	Setting status
DC GAIN	Minimum position
AC GAIN	Minimum position
fc	Set to "0"
I-LIM	Set to "0"

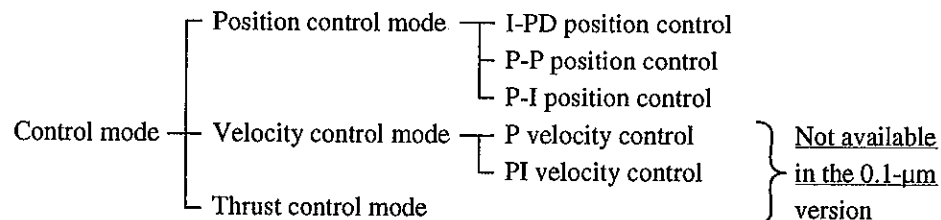
### Variable resistors, switches

NO.	Name	Setting status
1	TEST	OFF
2	——	OFF
3	——	OFF
4	POSW 1	OFF
5	POSW 2	OFF
6	POSW 3	OFF
7	FILTER 1	OFF
8	FILTER 2	ON
9	GAIN 1	OFF
10	GAIN 2	OFF

## 3.2 Control Mode Setting

### (1) Control Mode Types

The following six control modes are available for the LINEARSERV LM/LT series  
(However, only the position control mode can be used in the <0.1- $\mu$ m version>):



The following table shows the validity or nonvalidity of the switches and variable resistors related to the control mode and the jumper settings for each control mode.

**List of Control Modes and Jumper Pin Switch Settings**

Section	Jumper name Switch name	Position control mode			Velocity control mode		Thrust control mode
		I-PD	P-P	P-I	P	PI	
Control board	JP1	MODE	■-■	■-■	■-■	□ □	□ □
		CALIB	□ □	□ □	□ □	□ □	■-■
		RATE #1 *	○	○	○	○	○
		RATE #2 *	○	○	○	○	○
		UD/AB	○	○	○	○	○
	JP2	I	□ □	□ □	■-■	■-■	□ □
		P	■-■	■-■	□ □	□ □	□ □
		100	○	○	○	○	○
		200	○	○	○	○	○
		PV	■-■	■-■	■-■	■-■	□ □
	JP3	VEL	□ □	□ □	□ □	■-■	□ □
		TORQ	□ □	□ □	□ □	□ □	■-■
Front panel	SW4	TEST	○	○	○	○	×
		POSW 1~3	○	○	○	×	×
		FILTER 1,2	○	○	○	○	○
		GAIN 1,2	○	○	○	○	×
		DC GAIN	○	○	○	○	×
		AC GAIN	×	×	○	○	×
	fc	I-LIM	○	○	○	×	×
			○	×	×	×	×

■-■: Jumper shorted

□ □: Jumper open

○: Valid. When the setpoint exerts influence on motor operation.

×: Invalid. When the setpoint does not exert influence on motor operation.

\*: Invalid in 0.1- $\mu$ m version

## (2) Functions and Details on Jumpers and Switches

The servo driver receives a signal from the encoder built into the motor, then outputs an A/B phase or UP/DOWN pulse signal to a higher-level controller. Jumpers related to the feedback pulse signal are [RATE#1 to 2] and [UD/AB]. In addition, the position command pulse signal multiplying factor is determined by the setting of [RATE#1 to 2].

### a) [RATE#1 to 2] jumpers [JP1]

The adjustment of these jumpers can change the position command pulse signal by 1 to 8 times (see the table below). Note, however, that resolution also varies in accordance with the variation of the multiplying factor.

Setpoint		Multiplying factor	Resolution ( $\mu\text{m}$ )		
RATE # 1	RATE # 2		1.0 $\mu\text{m}$ version	0.5 $\mu\text{m}$ version	0.1 $\mu\text{m}$ version
■-■	■-■	1	1	0.5	0.1
□ □	■-■	2	2	1.0	-
■-■	□ □	4	4	2.0	-
□ □	□ □	8	8	4.0	-

### b) [UD/AB] jumpers (JP1)

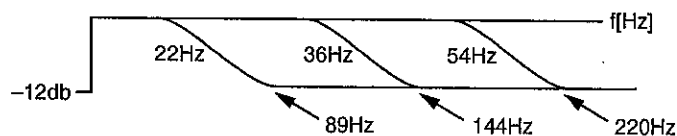
The selection of these jumpers enables the selection of the A/B phase or the UP/DOWN phase. The shorted jumper results in the A/B phase, and the open jumper, the UP/DOWN phase.

### c) [100] [200] jumpers (JP2)

These jumpers are used to select the velocity signal filter cut-off frequency. The cut-off frequency is set to 100 Hz with [100] shorted; likewise, it is set to 200 Hz with [200] shorted. These jumpers must be opened if either one of the [#7, 8/FILTER 1, 2] subswitches in the SW4 switch is set to on.

### d) [FILTER 1, 2] subswitches (SW4 switch)

These subswitches are used to set the first-order delay filter to regulate mechanical resonance. Setting the two subswitches can select the filter frequencies as shown in the table below. Select one of the frequencies in accordance with the load status.



FILTER 1	FILTER 2	Frequency
OFF	OFF	No function
ON	OFF	54/220Hz
OFF	ON	36/144Hz
ON	ON	22/89Hz

**e) [POSW 1 to 3] subswitches (SW4 switch)**

When the position deviation reaches the positioning completion width (number of pulses) in the position control mode, the COIN signal becomes on and the positioning is completed. The number of pulses of the positioning completion width can be set or selected as shown in the table below by using the POSW 1 to 3 subswitches. Note that it may take so much time to complete positioning if the positioning completion width is small, resulting in insufficient adjustment.

POSW 1	POSW 2	POSW 3	Positioning completion width
OFF	OFF	OFF	1 pulse
ON	OFF	OFF	2 pulses
OFF	ON	OFF	4 pulses
ON	ON	OFF	8 pulses
OFF	OFF	ON	16 pulses
ON	OFF	ON	32 pulses
OFF	ON	ON	64 pulses
ON	ON	ON	128 pulses

**f) [GAIN 1, 2] subswitches (SW4 switch)**

These are subswitches to set the loop gain magnification when the loop gain is variably adjusted using the DC GAIN adjustment control provided at the front panel of the driver. Setting the two subswitches can select the magnification as shown in the table below. The function to vary the gain magnification by the GAIN 2 subswitch is the same as that of GAIN 2 signal of the CN1 connector. To use GAIN 2 signal, the GAIN 2 subswitch must be set to off. Refer to page 5-1 to do other settings for use with the GAIN 2 signal.

GAIN 1	GAIN 2	Gain magnification
OFF	OFF	×1
OFF	ON	×6.6
ON	OFF	×14
ON	ON	×20

**g) For  $f_c$ , I-LIM, DC GAIN, and AC GAIN, refer to Chapter 5, "CONTROL MODE AND ADJUSTMENT."**

### 3.3 Connection (Refer to installation manual)

### 3.4 I/O Signals

(1) **Input** (Note: Number in parentheses indicates the Vcc signal input's terminal (COM+).)

Signal name	Pin No.	Meaning	Details
COM +	1	Signal power	Usually a voltage of 5 V is entered (allowed to enter a voltage of 5 to 24 V). However, if you enter a voltage of 24 V, insert a resistance of 1.2 k $\Omega$ . (See the circuit diagram on page 3-11.)
SIGN+ SIGN-	13 37	Motor-rotating direction command	The motor rotates in the UP direction with this signal set to H and in the DOWN direction with the same signal set to L.
IRST	28 (1)	Integral capacitor reset	The integral capacitor in the velocity loop is shorted.
SRVON	5 (1)	Servo ON	The motor is set to the servo ON status 0.2 sec. after this signal is set to L to set the driver to the command wait status.
IACT/PACT	27 (1)	Integral/proportional action selection	Integral action is selected when this signal is set to H and proportional action is selected when this signal is set to L in the position control mode.
TLIM	47 48	Current limit input	The maximum current is limited according to the input signal (analog) thus entered. The voltage between -8 and +8 V must be entered. When a voltage of -8 V is entered, it becomes the maximum thrust. If this signal is not used, always keep it open.
GAIN 2	3 (1)	Gain selection	This selects the DC gain variable range. This has the same function as GAIN 2 in the SW4 switch. To use this signal, the GAIN 2 subswitch must be set to off. (see Note 1)
RST	29 (1) (Non connection)	CPU reset	The driver control section is initialized with this signal set to L for more than 1 msec (the same status as power on status). It takes about 3 seconds to be in the operable [RDY] status.
PULS+ PULS-	15 39	Position command pulse	Driver position command pulse signal. A pulse width of 150 nsec or more is required.
VELIN	25 24	Velocity command input	This is an analog signal to enter a velocity command to the motor when this actuator is in the velocity control mode. Set to the maximum number of rotations at $\pm 6$ V input. The input sensitivity is 2.5 V/rps.
TRQIN	23 22	Current command input	The maximum thrust is generated at $\pm 8$ V.

(2) **Output** (Note: Number in parentheses indicates signal GND (COM-) output.)

Signal name	Pin N	Meaning	Details
COM -	26	Signal GND	
A+/U+	17	Position feedback pulse signal	Pulse signal to indicate the motor rotating position. Either A/B phase or UP/DOWN phase pulse can be selected by the jumper on the board. These are differential output signals because the velocity of frequency is very high.
A-/U-	41		
B+/D+	19		
B-/D-	43		
RDY	31 (26)	Servo ready	The motor is ready to operate with this signal set to L. This signal is set to the H level about 3 seconds after driver power on.
VELMON	49 50	Velocity monitoring	Signal for monitoring the number of motor rotations to output positive voltage for the UP direction and negative voltage for the DOWN direction. (Refer to Note 2.)
COIN	7 (26)	Positioning completion signal	This signal shows that the position deviation is within the positioning completion width. This signal is set to L when positioning is completed.
ERR 0 ERR 1 ERR 2 ERR 3	11 (26) 35 (26) 9 (26) 33 (26)	Error status output	These signals output error statuses. Generally, the RDY signal turns off as an error occurs. However, RDY signal remains as is depending on error contents.
Z+ Z-	21 45	Origin pulse	Signal for detecting the position for every pitch of glass scale (2.048 mm).

(Note 1)

GAIN 2 signal	GAIN 1 subswitch (SW4)	Gain magnification
H	OFF	×1
L	OFF	×6.6
H	ON	×14
L	ON	×20

(Note 2)

	Velocity/input voltage [m/sec/V]
0.5 $\mu$ m version	0.8356/6
0.1 $\mu$ m version	0.1671/6
High speed model	2/5

## 3.5 Installation (Refer to installation manual)

## 3.6 Service Life

The service life of the motor of the LINEARSERV is determined by that of the four linear guides provided at the driver. The following shows the rated loads of the linear guides:

Lord	LM205/210 LM305/310	LM105/110 LM505/510	LM130/530	LM230/330
Basic dynamic rated load : C	2000N	4700N	8330N	20500N
Basic static rated load : C <sub>0</sub>	3000N	8530N	13500N	30400N

The attracting force of the magnetic circuit applies to the motor as follows:

LM105 series: 400N; LM110 series: 800N LM130 series: 2400N

Therefore, one-fourth of the attracting force applies to each linear guide. According to the above, the service life of the motor can be obtained according to the following equations assuming that L is the distance:

<Example>

LM105 series:  $L = 50(1600/(100+P))^3$  [km]

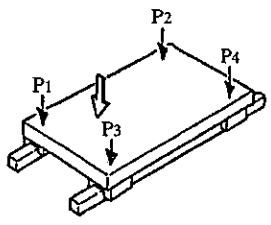
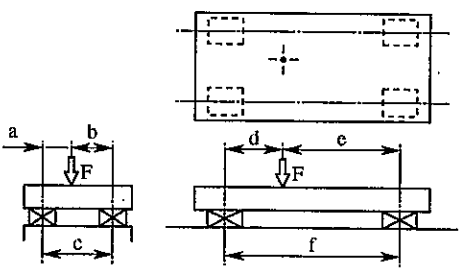
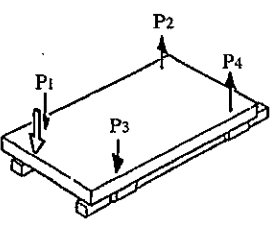
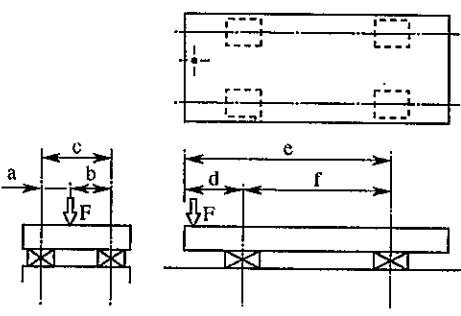
LM110 series:  $L = 50(1600/(225+P))^3$  [km]

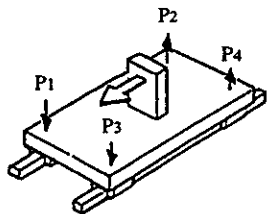
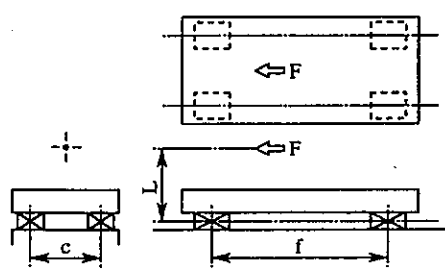
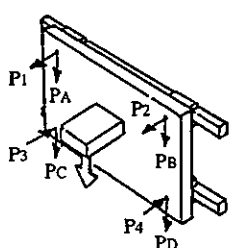
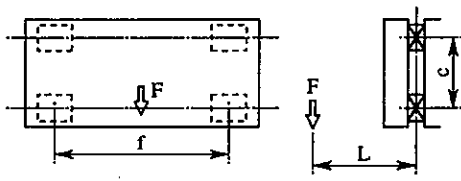
However,  $P$  [N] = Load quality [kg] x 9.8 [m/s<sup>2</sup>]

If the load applies to the center of the slider, assume that one-fourth of the load applies to each guide. Adding the four loads makes the value of  $P$ . If the load is not in the center of the slider, see the diagrams on the right. In this case, dimensions  $f$  and  $c$  between guides should conform to the table below.

Model	f (mm)	C (mm)
LM105/505	76	55
LM110/510	76	76
LM130/530	125	125
LM205/305	91	72
LM210/310	91	93
LM230/330	147	140

### Equations to Obtain Loads Depending on Load Position

Example of load position	Guide position	Equation
(1) Two horizontal-axis vertical loads 		$P_1 = b/c \cdot e/f \cdot F$ $P_2 = b/c \cdot d/f \cdot F$ $P_3 = a/c \cdot e/f \cdot F$ $P_4 = a/c \cdot d/f \cdot F$
(2) Two horizontal-axis vertical overhung loads 		$P_1 = b/c \cdot e/f \cdot F$ $P_2 = -b/c \cdot d/f \cdot F$ $P_3 = a/c \cdot e/f \cdot F$ $P_4 = -a/c \cdot d/f \cdot F$

Example of load position	Guide position	Equation
<p>(3) Two horizontal-axis horizontal loads</p> 		$P_1 = 1/2 \cdot L / f \cdot F$ $P_2 = -1/2 \cdot L / f \cdot F$ $P_3 = P_1$ $P_4 = P_2$
<p>(4) Two axes on the vertical guide plane vertical load</p> 		$P_1 = -1/2 \cdot L / c \cdot F$ $P_2 = P_1$ $P_3 = 1/2 \cdot L / c \cdot F$ $P_4 = P_3$ $P_A = P_B = P_C = P_D = F/4$

Note: F: Load [N]  
a, b, c, d, e, f, L: Distance [mm]  
P1, P2, P3, P4: Vertical load on bearing [N]  
PA, PB, PC, PD: Lateral load on bearing [N]

### Static safety factor

Generally, we consider the basic static load as the permissible limit of the static load. However, its limit is determined depending on the operating conditions of and required conditions to the bearing. The static safety factor  $f_s$  in this case is obtained according to the following equation:

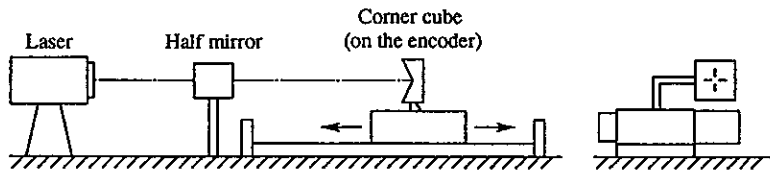
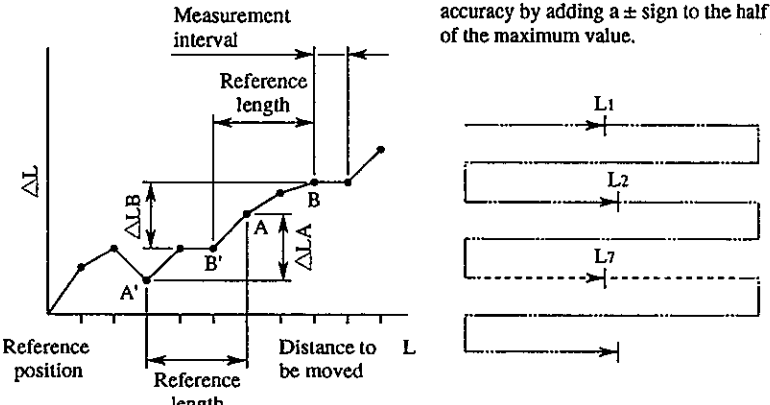
$$f_s = C_0 / P_0 \quad (C_0: \text{Basic static rated load [N]}; P_0: \text{Static load [N]})$$

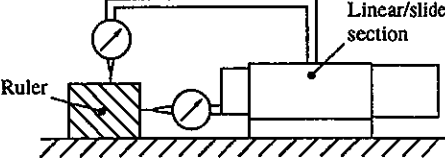
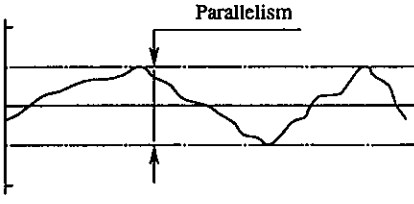
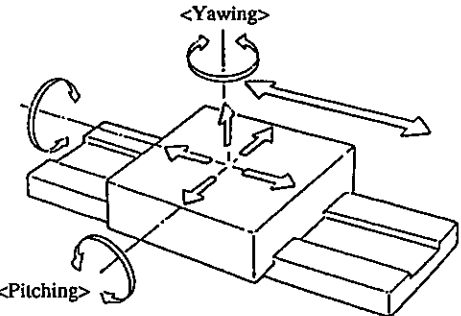
Set the  $f_s$  value to 5 or greater in this LINEARSERV.

Therefore, the maximum static load (F) of the motor is:

$$F < 4C_0 / f_s - F_M \quad (F_M: \text{Attracting force})$$

### 3.7 Definitions and Measurement Methods of Specification Accuracies

Item	Specification value	Definition and measurement method
Positioning accuracy	Positioning accuracy $10\mu\text{m(P-P)}$	<p>■ Measurement by laser interferometer</p>  <p>&lt;Positioning accuracy&gt; Positioning should be made sequentially from a reference position in a direction, and then measure the difference between the actually moved distance and the one to be moved at each position to obtain the maximum difference within each reference length. This measurement should be done in the total moving distance with a specified interval. These maximum values thus obtained are taken as measured values.</p> <p>&lt;Repeatability&gt; Determine an arbitrary point for positioning and repeat positioning seven times with the same direction in order to measure stop positions, and then obtain a half of the maximum difference of the reading. As a rule, this measurement should be done at the center of the distance to move or at both side positions. Of these values obtained, the maximum one is taken as the measured value. Represent the accuracy by adding a <math>\pm</math> sign to the half of the maximum value.</p>
	Repeatability $\pm 0.5\mu\text{m}$	 <p><math>\Delta L = (\text{actually moved distance}) - (\text{command value of distance to be moved})</math></p>

Item	Specification value	Definition and measurement method
Mechanical accuracy	Parallelism	<p>■ Measurement by dial gauges</p> <p>&lt;Parallelism&gt; Deflection of the gauges on the vertical and horizontal directions on table moving axis</p>  <p>(Measured values are indicated by two direct lines in parallel. Parallelism is the distance between the maximum and minimum measured values (the range indicated by two direct lines in parallel).)</p> 
	Pitching Yawing	<p>■ Measurement by autocollimator (indicated by the maximum difference of measurement reading)</p> <p>&lt;Pitching&gt; Angle change in the vertical direction on table moving shaft</p> <p>&lt;Yawing&gt; Angle change in the horizontal direction on table moving shaft</p> 



## 4. CAUTION ON OPERATION

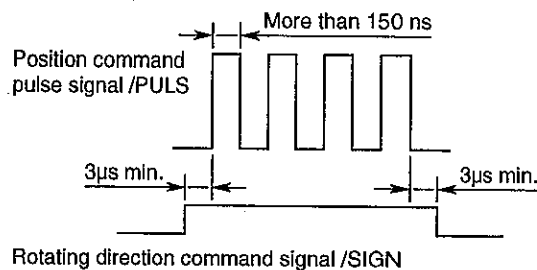
### 4.1 Cautions on I/O Signals

#### (1) Position Command Pulse Input Signal (PULS±)

This is the driver position command pulse signal. The pulse signal uses positive switching logic with a minimum pulse width of 150 ns. This signal should be connected upon the position control mode.

#### (2) Motor Rotating Direction Command Input Signal (SIGN±)

This is the signal that indicates the motor rotation. The motor rotates clockwise when this signal is set to H and counterclockwise when this signal is set to L. The timing of this signal with respect to the position command pulse signal at the output is as shown below:



Note: The pulse should be set to active H. This means that there is no current flowing through the driver photocoupler if a pulse is not output.

#### (3) Velocity Command Input (VELIN)

This is connected when the signal is in the velocity control mode. An analog input signal is used as the motor rotating velocity command value. The motor rotates clockwise when a positive voltage is supplied and counterclockwise when a negative voltage is supplied. (Input range: -10 to +10V; input impedance: 100 kΩ)

#### (4) Current Command Input (TRQIN)

This is connected when the signal is in the thrust mode. An analog input signal is used as the motor current command value. The motor rotates to the UP direction when a positive voltage is supplied and to the DOWN direction when a negative voltage is supplied. Upon the position control mode, this command can be used as a thrust feedforward signal.

#### (5) Current Limit Input (TLIM)

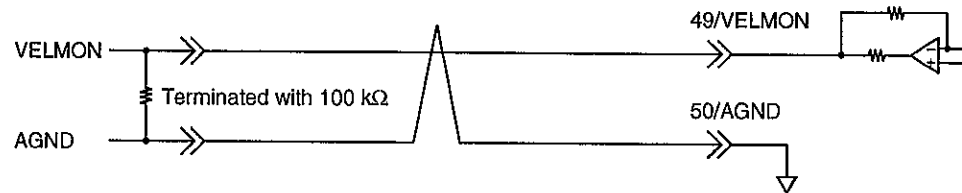
This is an analog signal to limit (regulate) the motor current.

## (6) Velocity Monitoring Output (VELMON)

Motor analog velocity monitoring output.

Output voltage: At maximum velocity +10V(UP direction)

At maximum velocity -10V(DOWN direction)



## (7) A/B Phase, UP/DOWN Pulse Output Signals (A/U±, B/D±)

Pulse signals to indicate the motor position. The following two pulse output statuses can be selected by jumpers on the controller board.



### NOTE

As the 0.1-μm version outputs signals after averaging, a delay occurs to the actual motor position.

#### a) A/B Phase Output Pulse

The following pulse signal is output with the jumper [UD/AB] on the controller board shorted.

	DOWN direction	UP direction
A-phase pulse	750kHz max.	750kHz max.
B-phase pulse	90°	90°

#### b) UP/DOWN Output Pulse

The following pulse signal is output with the jumper [UD/AB] on the controller board opened.

	DOWN direction	UP direction
UP-pulse signal		3MHz max.
DOWN-pulse signal	3MHz max.	

**(8) Origin Pulse Output Signal (Z±)**

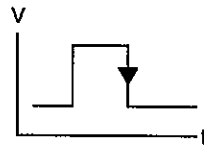
This is the signal for detecting the original position provided on each stroke (2.048 mm)\* of the motor. When the original position is detected, the next pulse signal is output. The point at which H changes to L when the motor rotates to the UP direction, or L changes to H when the motor rotates to the DOWN direction, corresponds to the original position. The accuracy of origin pulse depends on that of the motor. The characteristics of the origin pulse signal are as shown in the diagrams on the below.

The origin repeatability upon positioning control is influenced by the following items:

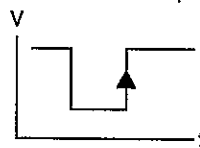
- Origin return algorithm
- Position control system
- External vibration
- Control gain

※(High speed model : 4.096mm)

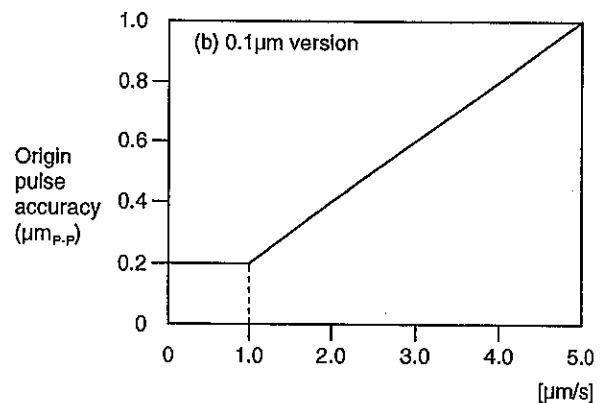
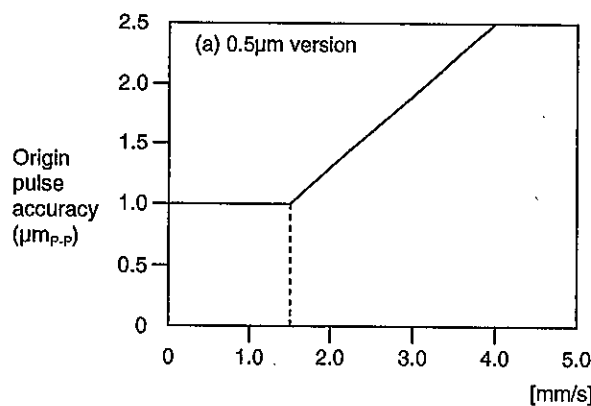
When the motor rotates to UP direction: 200 $\mu$ s or more



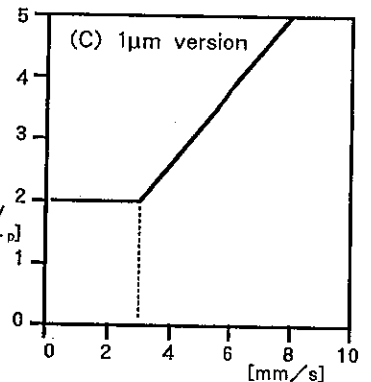
When the motor rotates to DOWN direction: 200 $\mu$ s or more



<Origin pulse signal and zero position>

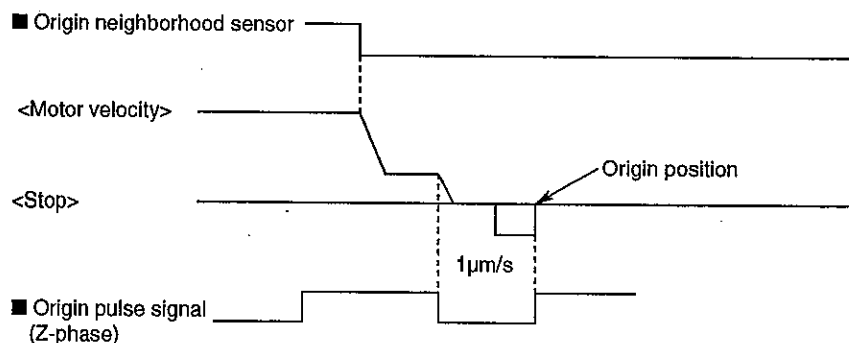


<Relationship between motor velocity and pulse accuracy>



In the 0.1- $\mu$ m version, since the feedback pulse signal that is equalized in the servo driver is output, it is not synchronized with the origin pulse signal. Thus, if the controller does an origin return, select the method which does not use feedback pulse. If feedback pulse is used, the origin return accuracy may be insufficient.

<Example of origin return>



### (9) ERR Output Signal

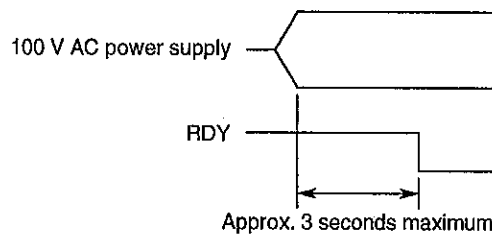
ERR 0 to 3 show the driver statuses. For details, see Section 7.2, "LED Displays."

Since these signals are updated every 20 msec, take proper actions to prevent misreading if the signals are read by the controller (double reading, etc.)

## 4.2 Power On/Off

Pay special attention to the following when the power is turned on.

- (1) The inrush current in both the main and control power circuits is about 20 A (100 V AC source) peak.
- (2) The motor is set to the servo status about 200 ms after the SRVON signal is set to L. At this time, serial pulse input becomes effective.
- (3) After the power supply is turned on, the RDY=H condition is maintained up to 3 seconds.



## 5. CONTROL MODE AND ADJUSTMENT

### 5.1 Position Control Mode Adjustment

In the position control mode, motor positioning control is performed according to the command position sent from the higher-level controller. Two control methods are available in the velocity control mode: the I-PD control system is selected with the CN1 connector [IACT/PACT] signal set to H, and the P control system, with the same signal set to L. Usually, the I-PD control system is selected in the positioning mode of operation.

#### (1) I-PD Position Control

This method uses position integral feedback and is suitable for highly accurate positioning. A stable control characteristic is also achieved even under load variations. In this mode, adjustment of the fc switch, I-LIM switch, and DC gain adjustment control becomes necessary.

##### a) fc switch (Natural frequency adjustment switch)

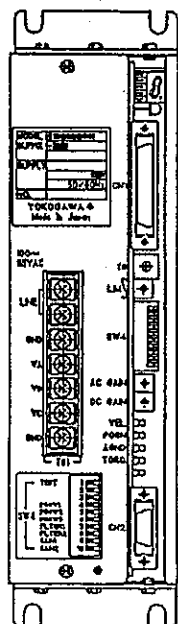
The 1 to 16 Hz position control system band is selected from a scale of 0 to F.

##### b) I-LIM switch (Integral limiter adjustment switch)

This prevents the wind-up phenomenon by limiting the output of the digital integrator during software servo computation. The larger the switch number, the larger the limited value. The smaller the limited value, the smaller the wind-up and the shorter the settling time. However, if the limited value becomes too small, the motor output torque is also limited. Therefore, it is better to make the switch value large within no wind-up range. Fine adjustment is performed during the acceleration/deceleration operation. If this value is inappropriate, an overcount alarm may occur.

##### c) DC gain adjustment control

The combination of the GAIN 1 and 2 subswitches with DC GAIN adjustment control in the SW4 setting switch provided at the front panel results in an adjustment range from 0.5 to 110 times. The DC gain should be as large as possible. If there is a change in inertia, adjust the gain so that it reaches the optimum at the maximum load.



## (2) P Position Control

Positioning accuracy is not high because proportional control is used for positioning feedback. The velocity controls which can be set for simultaneous selection are P and I controls, and they can be set with a jumper.

With P velocity control (P-P type), torque which is proportional to the positioning error is obtained, and compliance control is possible. In this control mode, only the fc switch and DC gain control are to be adjusted.

With I velocity control (P-I type), high tact positioning can be achieved. In this control mode, the fc switch, DC gain control, and AC gain control are to be adjusted.

## (3) Position Control System Adjustment Procedure (see the following figure)

The position control system can be adjusted in the test mode. Turning on the test switch at the front of the driver generates a 2.5Hz square-wave position command signal inside the driver to output the motor position to the POSN signal terminal. At this time, ensure that the motor exhibits reciprocal action at very small rotating angles.

① The adjustment procedure for I-PD position control in the test mode is as follows:

**Step 1:** Connect an oscilloscope to the POSN signal terminal.

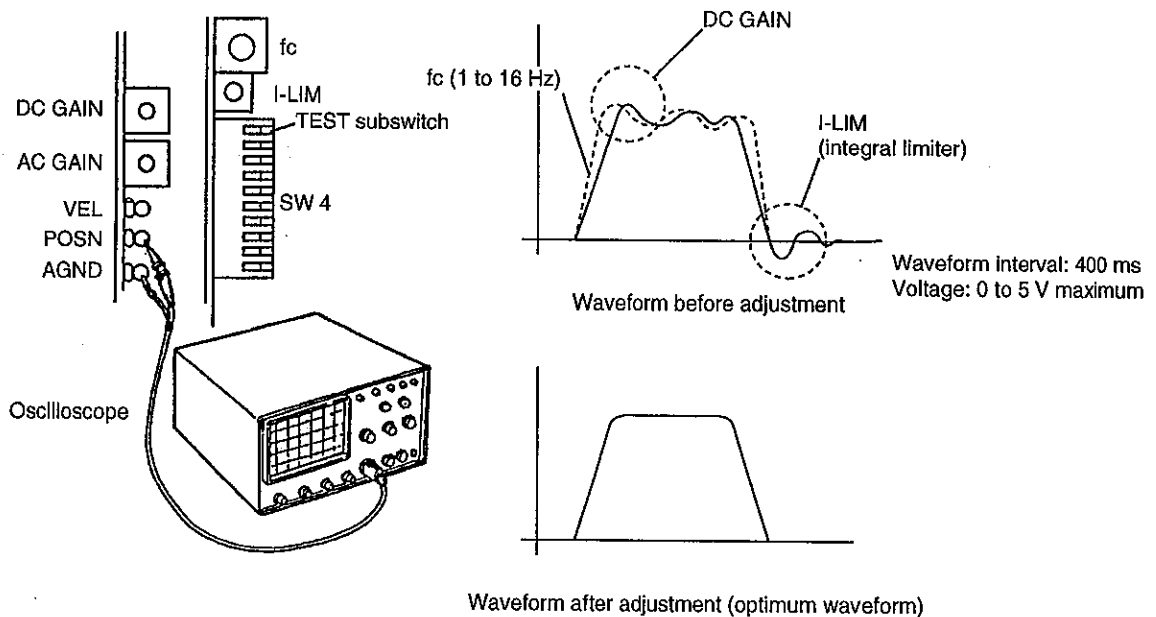
**Step 2:** Set the CN1 connector SRVON signal to L. At that time, set the TEST subswitch to off.

**Step 3:** Set the TEST subswitch at the front of the driver to on.

**Step 4:** Adjust the fc switch. Its variable range is from 1 to 16 Hz and should be set to about 10 Hz (scale graduation: 9) under normal load conditions. Set the I-LIM switch to a large value within the range in which there is no hunting. Select the GAIN 1 or 2 subswitch in accordance with the load condition. Fine adjustment is made by DC gain control. Perform the above adjustments so that the POSN signal becomes a square wave.

**Step 5:** Set the TEST subswitch at the front of the driver to off.

**Step 6:** Set the CN1 connector SRVON signal to H.



② The adjustment procedure for P-I type position control in the test mode is as follows:

**Step 1:** Connect an oscilloscope to the POSN signal terminal.

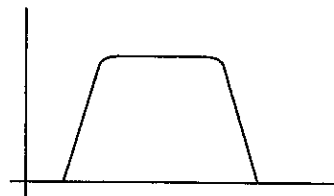
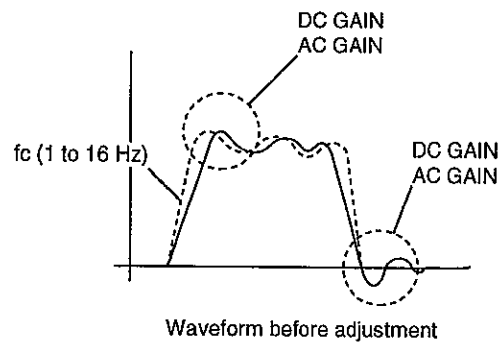
**Step 2:** Set the CN1 connector SRVON signal to L. At that time, set the TEST subswitch to off.

**Step 3:** Set the TEST subswitch at the front of the driver to on.

**Step 4:** Adjust the  $f_c$  switch. Its variable range is from 1 to 16 Hz. Set AC gain control to a large value within the range in which there is no hunting. Fine adjustment is made by DC gain control. Perform the above adjustments so that the POSN signal becomes a square wave.

**Step 5:** Set the TEST subswitch at the front of the driver to off.

**Step 6:** Set the CN1 connector SRVON signal to H.



#### (4) Procedure for Adjustment Without Measuring Instruments

The preceding demonstrated procedures for making adjustments while monitoring the waveform; this section demonstrates an adjustment procedure that does not use any measuring instruments. These adjustment methods are valid only in the case of the position control mode (I-PD type, the setting upon shipment). Make the adjustment according to the following order:

- 1) Calculate the load  $\langle W \rangle$  [kg].
- 2) Set the  $f_c$  switch on the driver front panel to ON.  
Position band frequency  $\langle f_p \rangle$  is  $(f_c + 1)$  [Hz]. Usually, set the switch to near "9."
- 3) Calculate the value of DC gain.

	0.5- $\mu$ m version		0.1- $\mu$ m version	
	TM105 series	TM110 series	TM105 series	TM110 series
DC GAIN	$f_p/4 \cdot (1.2+W)$	$f_p/8 \cdot (1.4+W)$	$f_p/20 \cdot (1.2+W)$	$f_p/40 \cdot (1.4+W)$

	0.5- $\mu$ m version		0.1- $\mu$ m version	
	TM130 Series		TM130 Series	
DC GAIN	$f_p/24 \cdot (5+W)$		$f_p/120 \cdot (5+W)$	

	High speed model		
	TM505	TM510	TM530
DC GAIN	$3f_p/4 \cdot (1.2+W)$	$3f_p/8 \cdot (1.4+W)$	$3f_p/24 \cdot (5+W)$

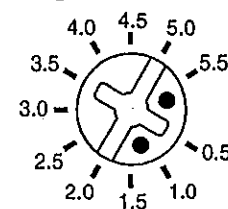
Example: When  $\langle W \rangle = 10$  [kg] and  $f_c = 10$  [Hz] in TM105 series;  
DC GAIN =  $11/4 \cdot (1.2+10) = 30$

- 4) Set the value of DC GAIN calculated in 3) above using the SW4 switch and the DC gain control.

##### SW4 switch

GAIN 1	GAIN 2	Gain magnification
OFF	OFF	$\times 1$
OFF	ON	$\times 6.6$
ON	OFF	$\times 14$
ON	ON	$\times 20$

##### DC gain control



Example: To set GAIN magnification to  $\times 30$ , set the SW4 switch to "x20" and then the DC gain control to "1.5." This results in  $20 \times 1.5 = 30$ .

Generally, a satisfactory result can be obtained by setting the setpoint a little greater than the calculated value.

- 5)  $\langle \text{LIM} \rangle$  switch setting

Usually set the  $\langle \text{LIM} \rangle$  switch to "3 to 4." If you make the setpoint smaller, the settling time decreases. However, setting it too small may cause the limiter to apply to the thrust, resulting in an insufficient thrust generation.

## 5.2 Velocity Control Mode Adjustment

In the velocity control mode, the motor rotating angle is controlled so as to correspond to the velocity command voltage (-6 to +6 V) from the higher-level controller. The two control methods can be selected in the velocity control mode. The following table shows the relationship between the velocity command voltage and motor velocity.

	Velocity/input voltage [m/sec/V]
0.5 $\mu$ m version	0.8356/6
0.1 $\mu$ m version	0.1671/6
High speed model	2/5

### (1) PI Velocity Control

The use of integral/proportional action in velocity control achieves smooth and disturbance-resistant control. This is the same control mode used in a conventional DC/AC servo motor control. In this control mode, only the DC gain and AC gain adjustment controls are adjusted.

#### a) DC gain

The combination of the driver's GAIN 1 and 2 subswitches in the SW4 switch results in an adjustment range of from 0.5 to 110 times.

#### b) AC gain

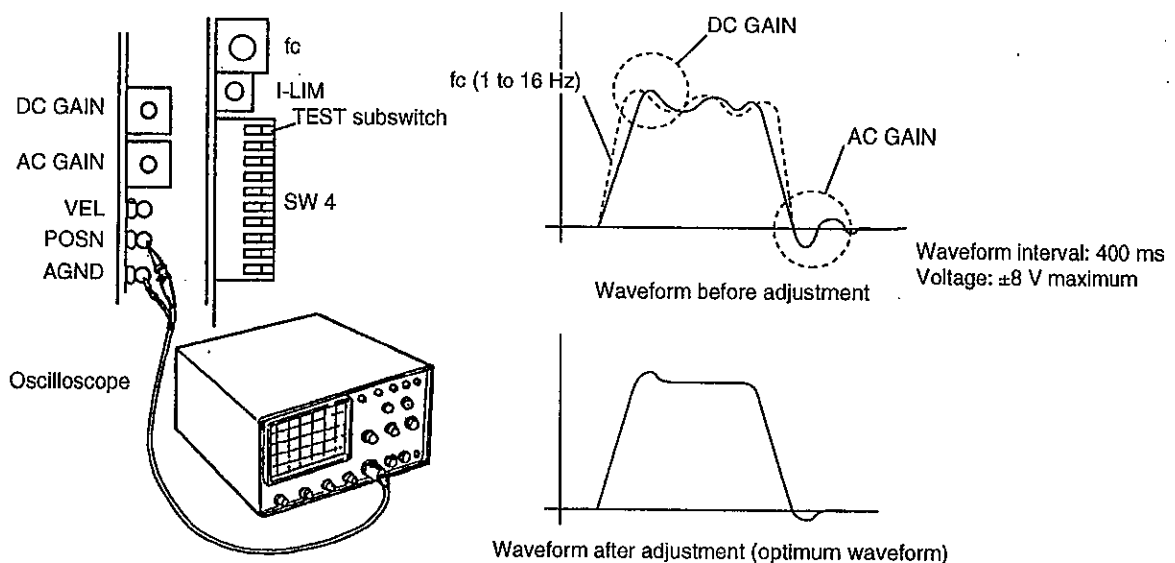
Velocity loop band damping is adjusted.

### (2) P Velocity Control

Since velocity control is effective only in proportional action, response is fast but is strongly influenced by disturbances in the controlled motor. In this control mode, DC gain control at the front of the driver and the GAIN 1 and 2 subswitches in the SW4 are adjusted.

### (3) Adjustment of Velocity Control System

Adjustment of the velocity control system can be carried out in the test mode. By turning on the TEST subswitch at the front of the driver, a 2.5Hz square waveform signal is applied to the velocity input in the driver, and the motor starts moving back and forth, repeatedly, at a small rotating angle. Under this condition, observe the VEL signal on the front panel on an oscilloscope, and adjust the DC gain and AC gain so that the VEL signal becomes an optimum waveform as shown in the figure below.



## 5.3 Thrust Control Mode Adjustment

In the thrust control mode, current flows through the motor corresponding to the current command voltage (-8 to +8 V) from the higher-level controller. Motor output thrust depends on the current. Therefore, thrust is 0 at 0 V of command voltage, and the maximum thrust is produced at 8 V.



### NOTE

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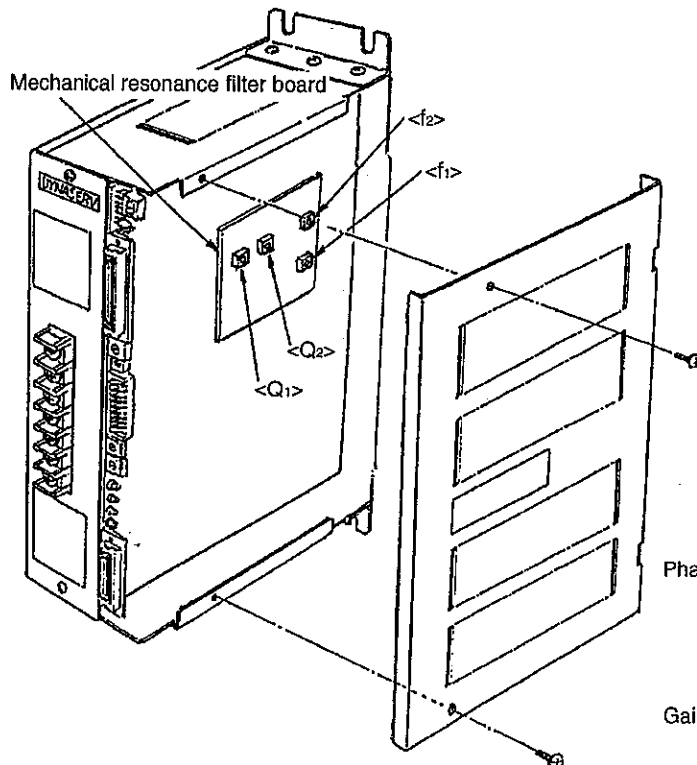
When desirous of using the thrust control mode, carefully plan and design the velocity and position control loops and a proper interlocking system so that the final control system meets the exact specifications of the application.

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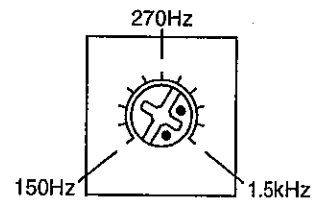
## 5.4 Mechanical Resonance Notch Filter Adjustment

The following explains the adjustment procedure when a mechanical resonance notch filter is installed as an option. The board of the filter is located as shown in the figure below just inside the square cut-out on the side of the driver. Controls  $f_1$  and  $f_2$  on the board are used to set the notch frequencies at the first and second stages, respectively. The frequencies can be set within the range from 150 Hz to 1.5 kHz (the frequencies are factory-set to 1.5 kHz when shipped).

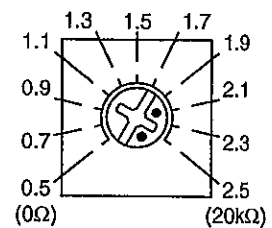
Use controls  $Q_1$  and  $Q_2$  to change the setting of the Q values. The Q values can be set within a range from 0.5 to 2.5 (0 to 20 k $\Omega$ ) (the Q values are factory-set to 2.5 when shipped).



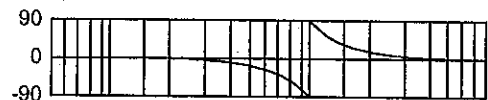
$f_1$  and  $f_2$  adjustment controls



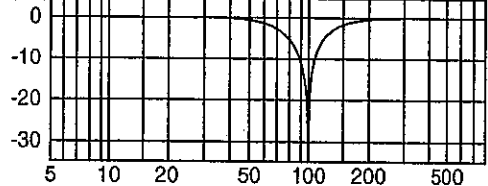
$Q_1$  and  $Q_2$  adjustment controls



Phase (Deg.)



Gain (dB)



Notch frequency: 100 Hz  
Q=2.0



## 6. MAINTENANCE AND INSPECTION

### 6.1 Motor

Only simple daily checks need be carried out on the motor. Check for noise or excessive vibration which is not normal. Never disassemble the motor. If the condition of the motor is not normal after 20,000 hours of use or five years after installation, replace the motor together with the servo driver, if necessary. This time period may vary depending on the environmental and operating conditions where the motor is used.

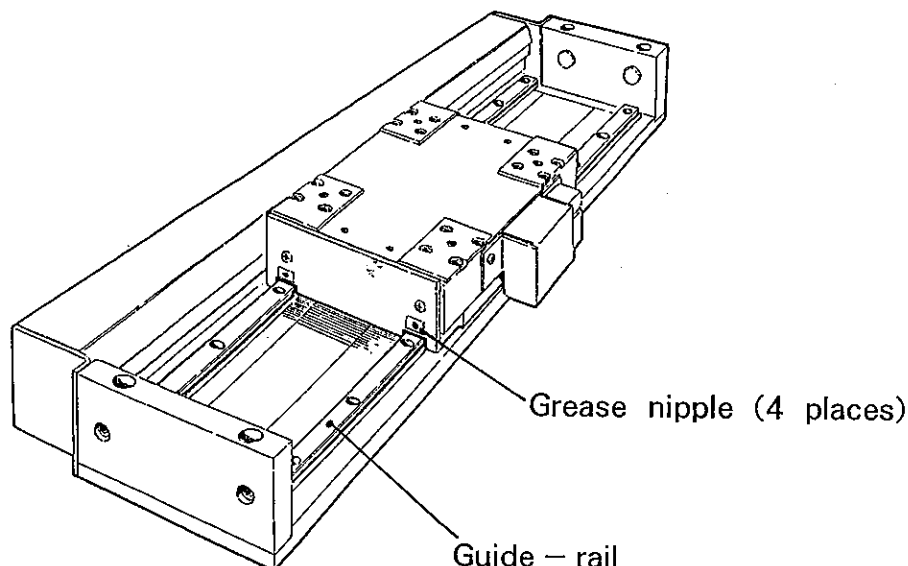


#### CAUTION

It is absolutely imperative to lubricate the motor (at specific locations as shown in the figure the below) with the specified lubricating grease only, either after every run of 100km, or after every 3 months of usage, whichever occurs first.

If the lubricating points are inaccessible due to some reason, then use the specified lubricating grease on the guide – rails instead.

As the type of grease lubricant varies with the model of motor, kindly contact the manufacturer or it's authorized distributor for recommended products.



### 6.2 Servo Driver

There is no need for daily maintenance of the servo driver. However, it is recommended that periodic cleaning be undertaken to prevent it from poor insulation caused by accumulated dust.

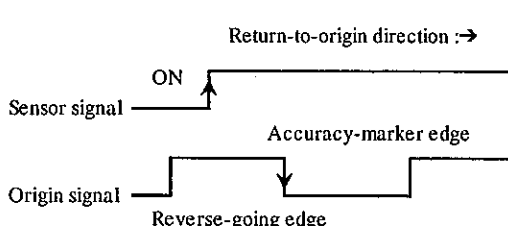


# 7. TROUBLESHOOTING AND MEASURES

## 7.1 Motor Problems and Measures

Whenever any abnormal condition occurs while operating the motor, check the LED display on the front panel of the driver first. If the cause of the abnormal condition is not determinable by the LED indicated on the display, take the appropriate countermeasures shown in the table below. If the motor still does not function normally, even after the following measures have been taken, immediately cease operation and consult Yokogawa Precision Corporation or its authorized agency.

Problem	Estimated Cause	Inspection Item	Measure	Page(s) for Reference
The motor is not servo-locked.	■ No AC power is being fed.	Wiring	Turn on the specified AC power	3-6, 3-7
	■ The servo ON (SRVON) terminal is set to H.	Inspection	Set to L	3-12
	■ The CPU reset (RST) terminal is set to L.	Inspection	Set to H	3-12
	■ The integral capacitor reset (IRST) terminal is set to L.	Inspection	Set to H	3-12
	■ fc, I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4
The motor does not start.	■ Overloaded	Operation of the motor with no load.	When starting the motor, lighten the load or replace the motor with a larger output motor.	
	■ Incorrect external wiring	Inspection of wiring	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
	■ fc, I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4
Motor rotation is unstable.	■ Imperfect connection	Check of connection of each phase of A, B, C and GND.	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
	■ The motor and driver combination is inappropriate.	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-3
The motor overheats.	■ Ambient temperature is high.	Check if ambient temperature is greater than 45°C.	Lower the ambient temperature to below 45°C.	
	■ Overloaded	Operation of the motor with no load.	When starting the motor, lighten the load or replace the motor with a larger output motor.	
Abnormal sound is produced.	■ Incorrect mounting	Looseness of screws	Tighten the screws.	
	■ Problem with linear guide	Check for sound and vibration near the linear guide.	Motor replacement (Contact us.)	
	■ Mounting base vibration	Check the mounting base.	Reinforce the mounting base.	

Problem	Estimated Cause	Inspection Item	Measure	Page(s) for Reference
Abnormally small motor thrust	■ Incorrect motor/driver combination	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-3
	■ Overloaded	Check the OVL signal.	Recheck the operation. Lighten the load.	3-12, 3-13
	■ $f_c$ , I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4
The motor runs out of control.	■ Incorrect motor/driver combination	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-3
	■ Improper jumper setting	Inspection	Perform correct jumper setting.	3-1 - 3-5
	■ Improper connection	Check of motor/encoder connection.	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
Position is out of killer.	■ Incorrect A/B-phase and U/D pulse jumper selection	To be inspected		3-1 - 3-5
	■ Command pulse rate and width are not as specified.	Check the command pulse width.		4-1 - 4-4
	■ Feedback pulse rate and receive circuit response speed are not as specified	Check the feedback pulse rate (3 MHz max.) and receive circuit response speed.		4-1 - 4-4
	■ Neither end of the feedback pulse transmission cable shield is connected to the ground.	To be inspected. If so, connect the driver to AGND and the controller to SG.		
The motor does not return to its origin accurately.	■ Connection with unmatched controller	Check the method for returning the motor to its origin and reconfigure the settings.		
	■ Improper positioning of the "around-the-origin" sensor	Observe the positional relationship of the accuracy-marker edge of the "around-the-origin" sensor signal with the one for the origin signal using an oscilloscope to ensure that these two edges do not overlap.		
	■ Chattering in origin signal	<p>Check for any chattering in the origin signal. Increasing the speed of the return-to-origin signal helps prevent chattering from occurring. If chattering still persists, adjust the position of the "around-the-origin" sensor. (If the reverse-going edge appears first, you may confuse it with the accuracy-marker edge.)</p> 		

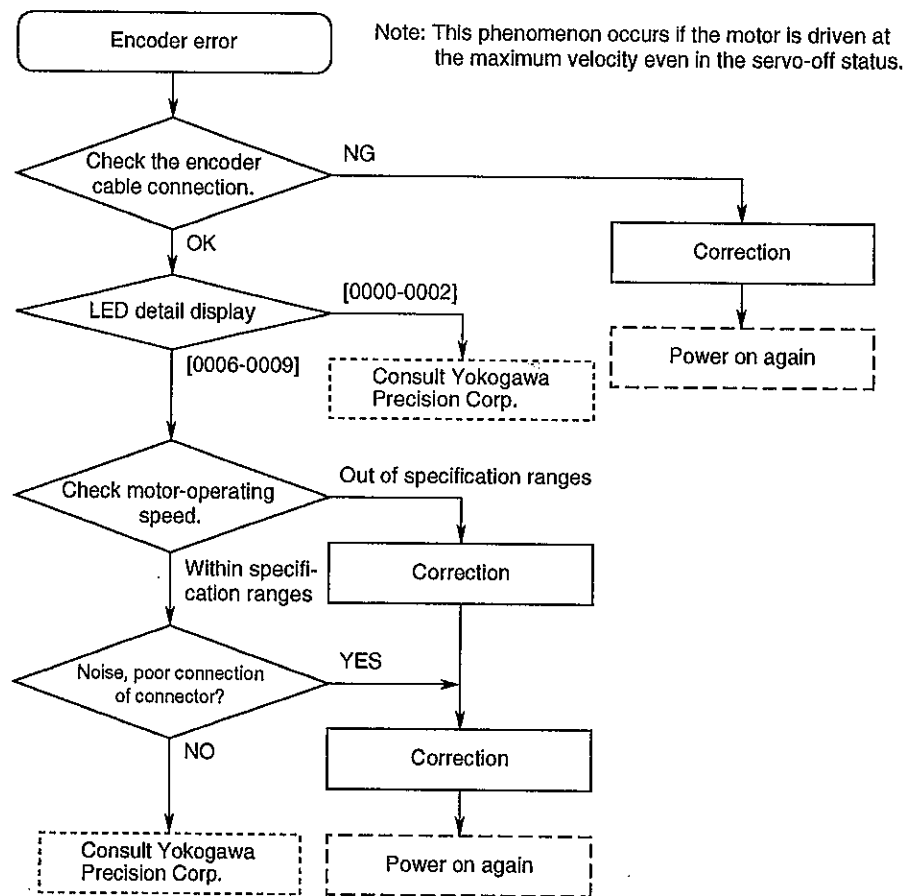
## 7.2 LED Displays

A 7-segment LED is mounted on the front panel of the driver to display the normal/abnormal status of the motor and driver. An error signal is output at the same time. Display details are as shown in the following tables.

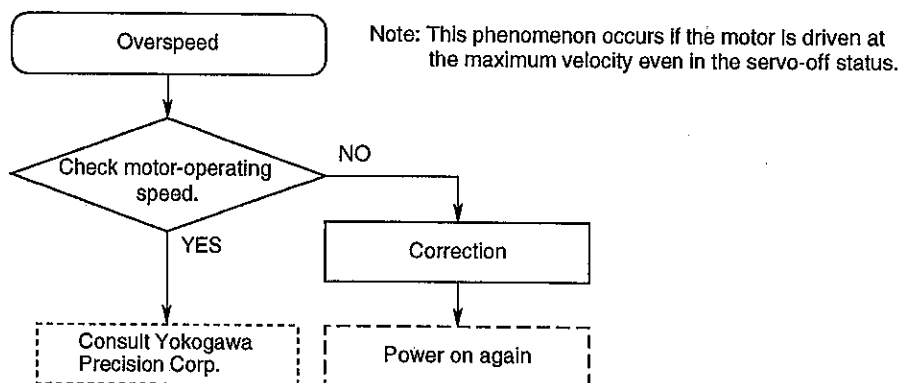
LED display			Output signal					Status	Estimated cause	Possibility of recovery
Servo		Display details with TEST subswitch on	ERR				R D Y			
OFF	ON		3	2	1	0				
0	0.	—	L	L	L	L	L	Normal display		
1	1.	—	L	L	L	H	L	Overspeed	Motor velocity exceeds 125% of its maximum velocity.	Possible
2		—	L	L	L	L	H	RAM error	RAM read/write error	Impossible
3		0000-0002	L	L	H	H	H	Encoder error	Encoder signal level has dropped. See "Procedure for Error Correction."	Impossible
		0006-0009							Encoder signal having abnormal intervals is entered. See "Procedure for Error Correction."	
6		—	L	H	H	L	H	Over count, shut down	Effective only upon option setting	Impossible
	6.						L	Counter overflow	Position deviation is greater than 32,767 pulses in the position control mode.	Possible
7		—	L	H	H	H	H	ROM error	ROM checksum error	Impossible
8		—	H	L	L	L	H	Main power supply dropped	Input AC power supply voltage has dropped.	Possible
8.		—	L	L	L	L	H	Driver reset	Driver reset status	Possible
9		0000	H	L	L	H	H	CPU error	Watchdog timer (WDT) error	Impossible
A		—	H	L	H	L	H	Overcurrent error	Excessive current flows through the motor.	Impossible
C	C.	—	H	H	L	L	L	Overload	Motor input power exceeds the specified value. The motor current becomes 1/2.5 as detection is done.	Possible
E		—	H	H	H	L	H	Overvoltage	Excessive voltage is entered into the driver or excessive load is made to rotate at high speed.	Impossible

Note: Consult Yokogawa Precision Corporation or its authorized agency for cases where recovery is impossible.

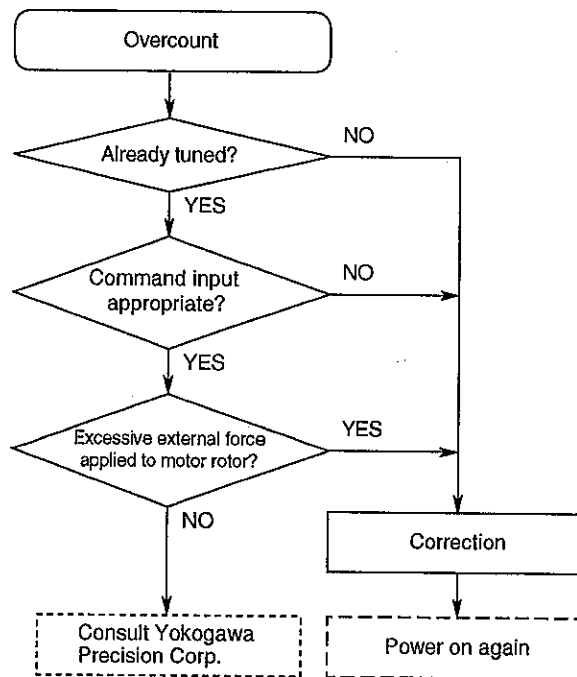
## (1) Encoder error



## (2) Overspeed

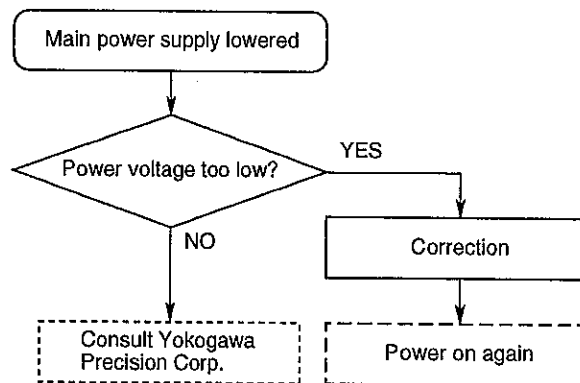


## (3) Overcount

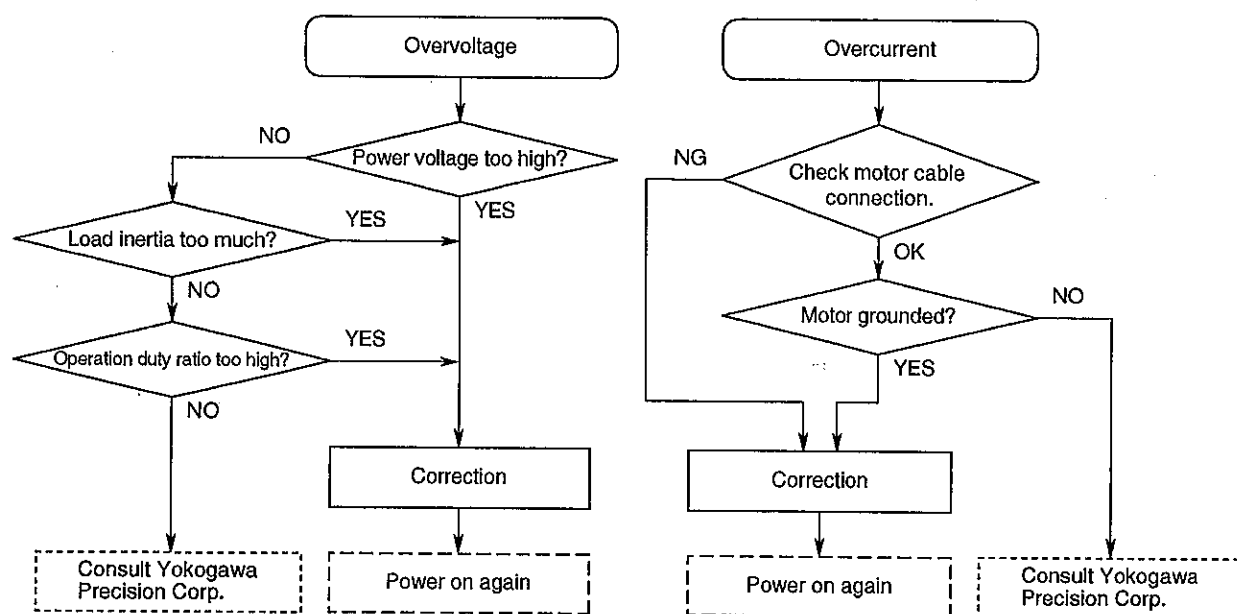


Note: The position deviation exceeds 16.4 mm in the position control mode.  
 This phenomenon tends to occur if the motor is driven at the maximum velocity or if the < LIM > switch is set to too high a value.

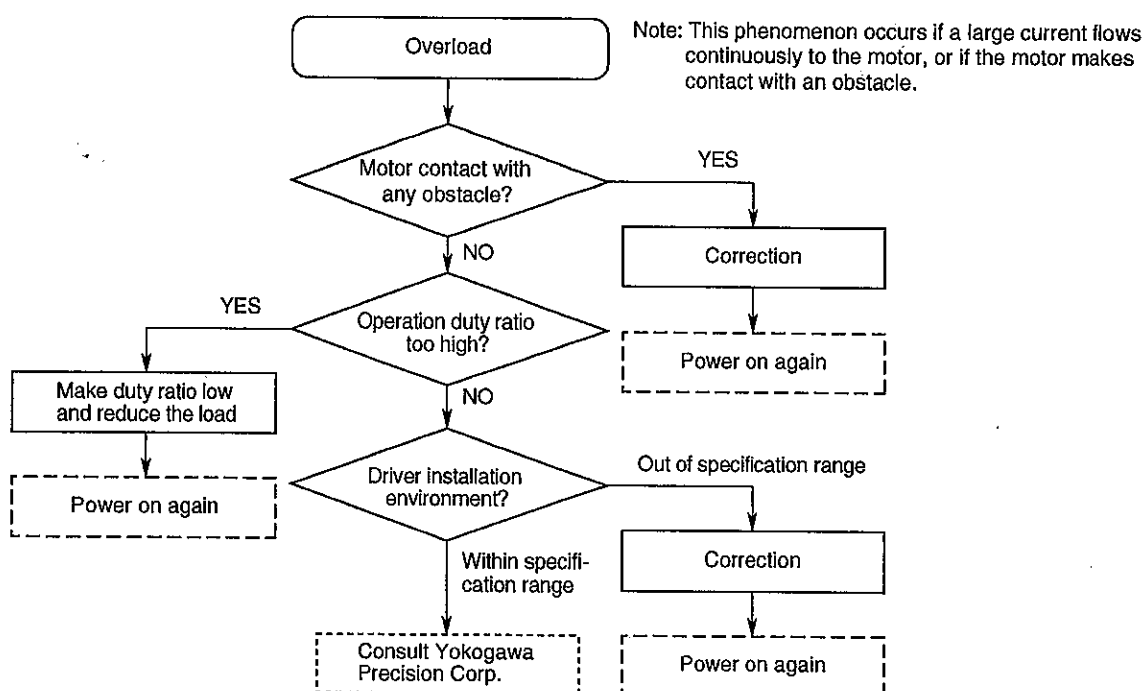
## (4) Main power supply lowered



## (5) . Overvoltage, Overcurrent



## (6) Overload



# 8. REFERENCE

## 8.1 Standard Specification

(1) Motor & Driver (HR : High rigidity model / HS : High speed model /  
R + S : High rigidity + high speed model)

Series		50N series				100N series				300N series					
Model		St'd	HS	HR	R + S	St'd	HS	HR	R + S	St'd	HS	HR	R + S		
Motor & driver coupling	Max. force (N)	50		40		100		90		300		270			
	Max. speed (m/s) <sup>①</sup>	0.83 (0.16)		2.0		0.83 (0.16)		2.0		0.83 (0.16)		2.0			
	Rated output (W)	100 - 115VAC Model		20		21.2		45		30		42.5			
		200 - 230VAC Model		20		21.2		45		63		85			
	Rated force (N)	25		20		50		45		150		135			
	Rated speed (m/s)	100 - 115VAC Model		0.42		1		0.42		1		0.2		0.3	
		200 - 230VAC Model		0.42		1		0.42		1		0.28		0.6	
	Encoder resolution (μm/p) <sup>⑥</sup>	0.5 (0.1)		1.0		0.5 (0.1)		1.0		0.5 (0.1)		1.0		1.0	
	Repeatability (μm)	± 0.5 (± 0.1)		± 1		± 0.5 (± 0.1)		± 1		± 0.5 (± 0.1)		± 1		± 1	
	Position <sup>⑤</sup> accuracy (μm)	Ls = Storork length	Glass scale		5 + 5/1000Ls										
		Metal scale		50 + 50/1000Ls											
Rated power consumption (VA)	100 - 115VAC Model		170		250		212		315		315		315		
	200 - 230VAC Model		170		250		212		355		475		630		
Motor section	Max. load (N)	200	600	200	600	200	600	200	600	1000	2000	1000	2000		
	Slider weight (kg)	1.0	1.4	1.0	1.4	1.4	1.8	1.4	1.8	5.0	8.7	5.0	8.7		
	Rail weight (kg/m)	12	15	12	15	15	18	15	18	25	45	25	45		
	Oregon signal (Pulse/mm)	1/2.048		1/4.096		1/2.048		1/4.096		1/2.048		1/4.096			
	Stroke length/Ls (mm)	50/100/150/200/300/400/500/600/700/800/900/1000/1100/1200/1300/1400/1500/1600/1700/1800													
	Life (km)	①	②	①	②	①	②	①	②	③	④	③	④		
	Common item	Motor insulation : class F / Insulation resistance : 10M Ω Min.(500VDC) Withstanding voltage : 1500VAC, 1min./Excitation : 3 Phase													
① (2000/ (200 + W/4)) <sup>③</sup> × 50    ② (4700/ (200 + W/4)) <sup>③</sup> × 50    ③ (8330/ (600 + W/4)) <sup>③</sup> × 50 ④ (20000/ (600 + W/4)) <sup>③</sup> × 50    W : Load (N) ⑤ Shown the value of the scale at 23℃ (Coefficient of glass of the linear expansion : 8 × 10 <sup>-6</sup> /℃) ⑥ ( ) Shown the spec. of ± 0.1 μm version (option by selected the driver, except HS & R + S model)															
Driver section	Input	Speed signal(Analog voltage/DC)	± 10V Max		± 10V Max		± 10V Max		± 10V Max		± 10V Max		± 10V Max		
		Positioning signal(Serial pulse)	1.6MHz Max		2.0MHz Max		1.6MHz Max		2.0MHz Max		1.6MHz Max		2.0MHz Max		
		Force signal	Analog voltage : DC ± 8V Max												
		Movement signal	H : Up direction/L : Down direction												
	Output	Speed signal ①	+ 10V (Up direction) to - 10V (Down direction)												
		Encoder signal ②	Track A/B (400kHz Max)、Oregon signal												
		Alarm signal	Over current, over voltage, over temperature of heat sink, under voltage CPU abnormal												
		Monitor	2.5Hz Step response output (Test mode)												
	Power source		100 - 115/200 - 230VAC ± 10%、50 - 60Hz												
	Max. power consumption		300VA		450VA		350VA		500VA		500VA		700VA		
	Weight		1.8kg												

(2) Environmental ① Except HS & R + S model (+5V ~ -5V) ② Except HS & R + S model (500kHz max.)

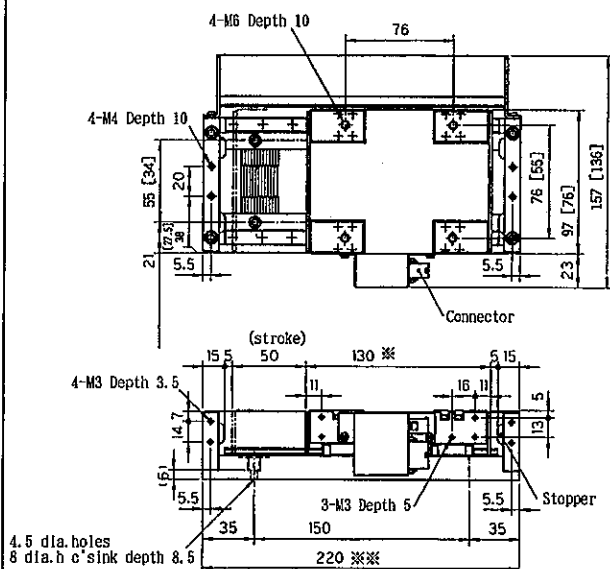
Item		Motor section	Driver section	Note
Operation	Temp.	5 - 40°C	5 - 40°C	
	Humi.	20 - 85% RH	20 - 90% RH	No condensing
Storage	Temp.	- 20 to 85°C	- 20 to 85°C	
	Humi.	20 - 85% RH	20 - 90% RH	No condensing
Environment		No corrosive gases, dust - free atmosphere		
Location		Do not use at locations exceeding 1000m above the sea level		

## 8.2 External Dimensions (unit : mm)

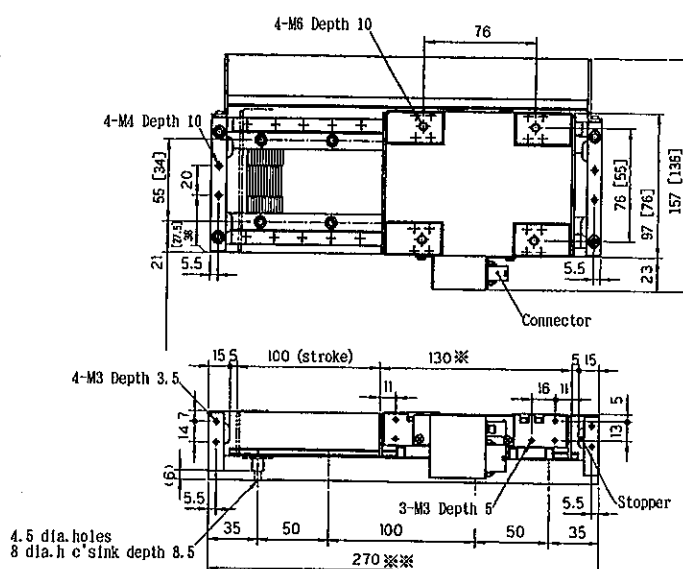
HS models dimensions same as st'd model and R + H models same as HR models

### (1) LM110 Series ([ ] Dimension are shown the LM105 series)

#### ① Stroke length 50mm



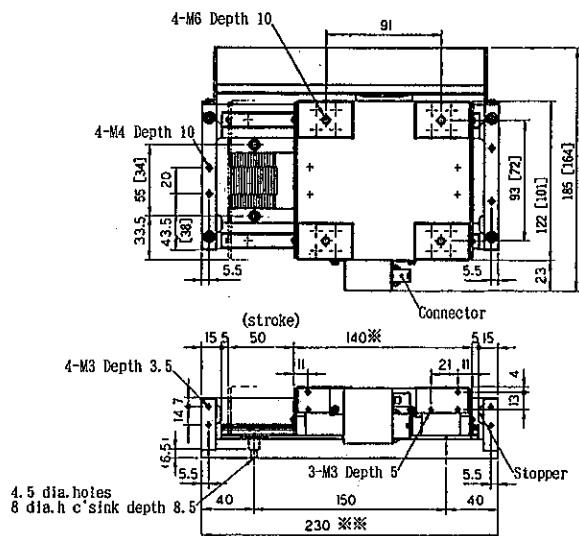
#### ② Stroke length 100mm



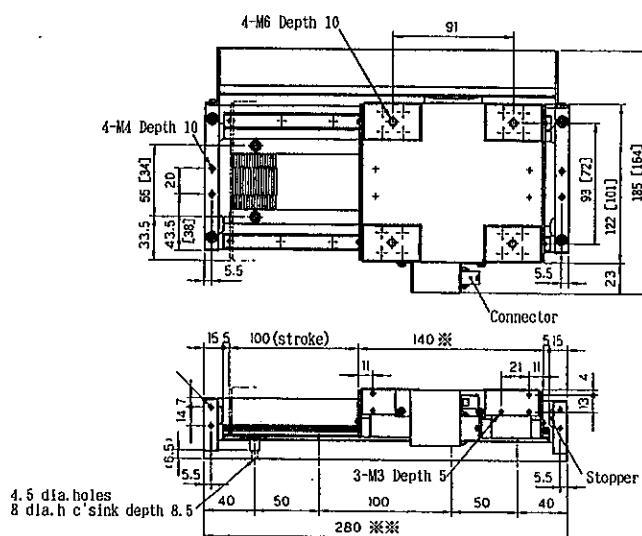
※ (OA length of slider) ※※ (OA length of motor)

### (2) LM210 Series ([ ] Dimension are shown the LM205 series)

#### ① Stroke length 50mm

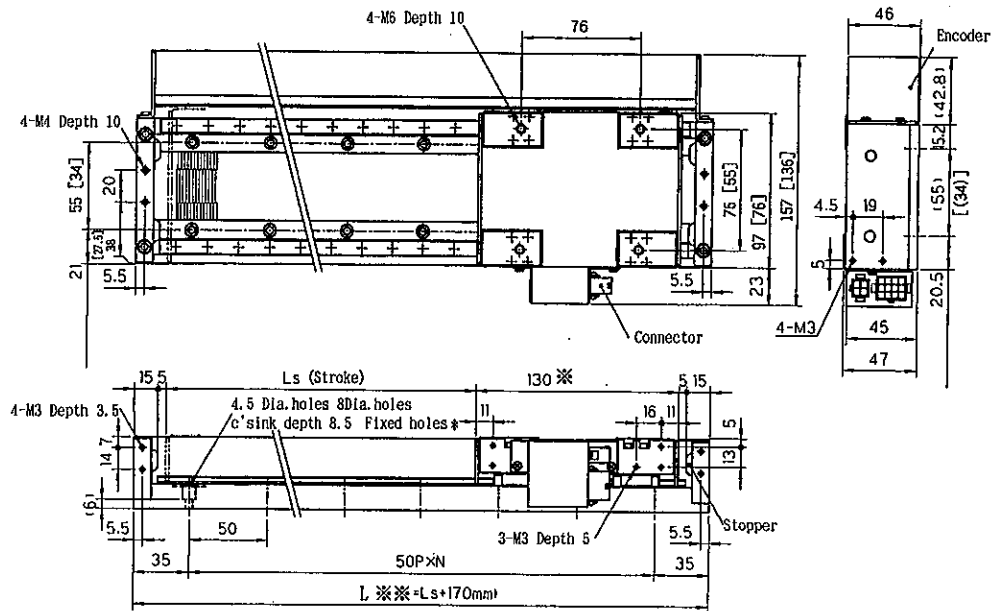


#### ② Stroke length 100mm



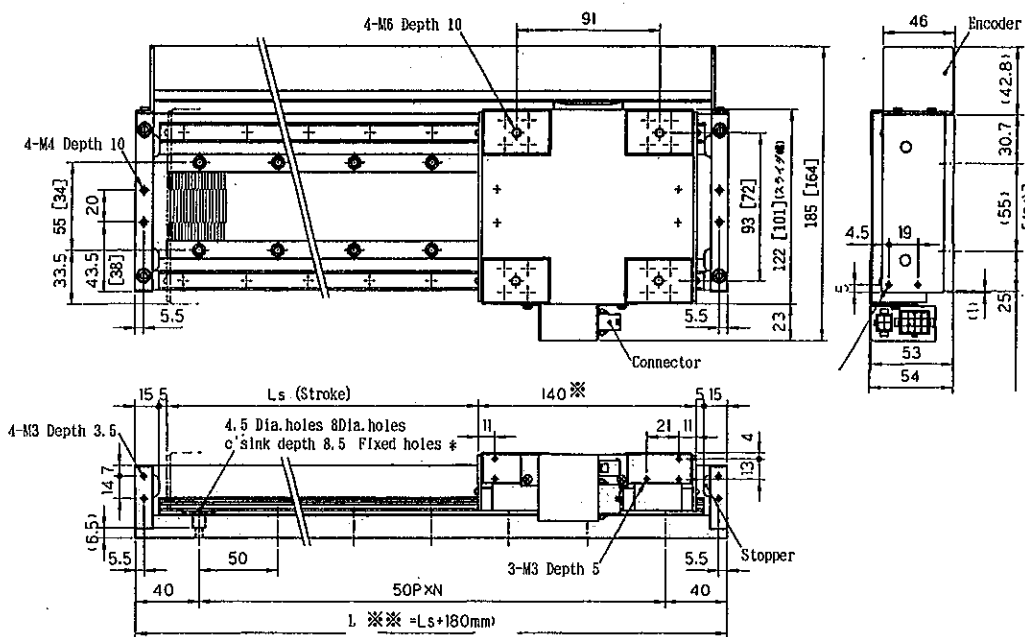
※ (OA length of slider) ※※ (OA length of motor)

### ③ Stroke length 150 – 1800mm



Model letter	L	Ls	N	※
LM10X0F00-0002	320	150	5	2x6
LM10X0G00-0002	370	200	6	2x7
LM10X0H00-0002	470	300	8	2x9
LM10X0J00-0002	570	400	10	2x11
LM10X0K00-0002	670	500	12	2x13
LM10X0L00-0002	770	600	14	2x15
LM10X0M00-0002	870	700	16	2x17
LM10X0N00-0002	970	800	18	2x19
LM10X0P00-0002	1070	900	20	2x21
LM10X0Q00-0002	1170	1000	22	2x23
LM10X0R00-0002	1270	1100	24	2x25
LM10X0S00-0002	1370	1200	26	2x27
LM10X0T00-0002	1470	1300	28	2x29
LM10X0U00-0002	1570	1400	30	2x31
LM10X0V00-0002	1670	1500	32	2x33
LM10X0W00-0002	1770	1600	34	2x35
LM10X0X00-0002	1870	1700	36	2x37
LM10X0Y00-0002	1970	1800	38	2x39

### ③ Stroke length 150 – 1800mm

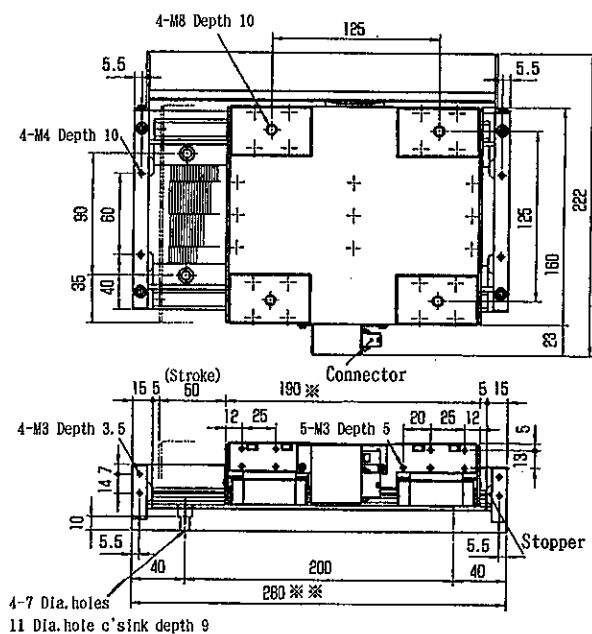


Model letter	L	Ls	N	※
LM210X0F00-0002	330	150	5	2x6
LM210X0G00-0002	380	200	6	2x7
LM210X0H00-0002	480	300	8	2x9
LM210X0J00-0002	580	400	10	2x11
LM210X0K00-0002	680	500	12	2x13
LM210X0L00-0002	780	600	14	2x15
LM210X0M00-0002	880	700	16	2x17
LM210X0N00-0002	980	800	18	2x19
LM210X0P00-0002	1080	900	20	2x21
LM210X0Q00-0002	1180	1000	22	2x23
LM210X0R00-0002	1280	1100	24	2x25
LM210X0S00-0002	1380	1200	26	2x27
LM210X0T00-0002	1480	1300	28	2x29
LM210X0U00-0002	1580	1400	30	2x31
LM210X0V00-0002	1680	1500	32	2x33
LM210X0W00-0002	1780	1600	34	2x35
LM210X0X00-0002	1880	1700	36	2x37
LM210X0Y00-0002	1980	1800	38	2x39

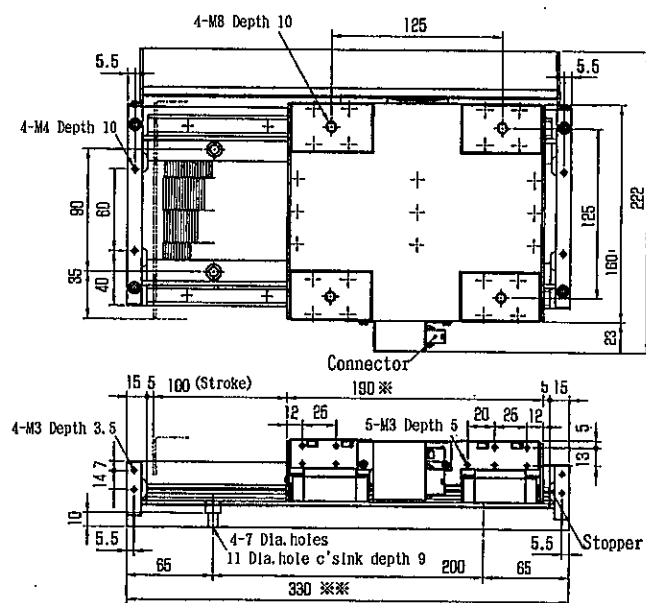
HS models dimensions same as st'd model and R + H models same as HR models

### (3) LM130 Series

#### ① Stroke length 50mm



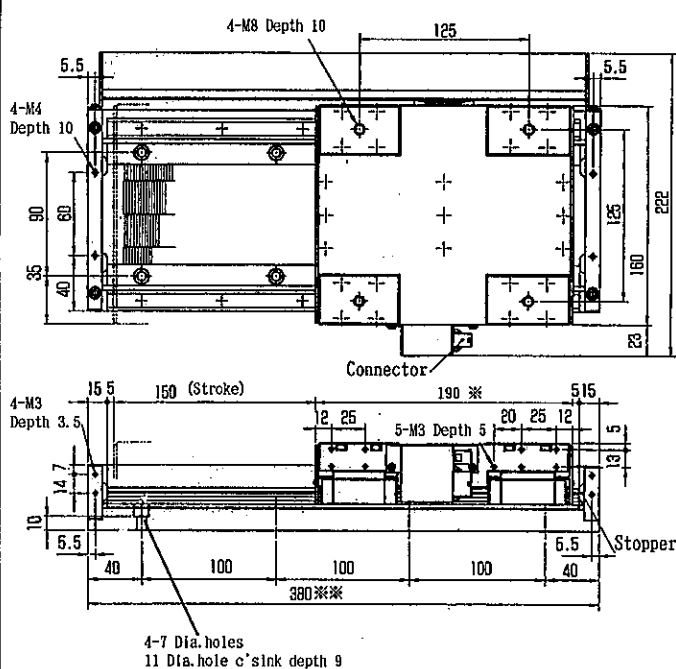
#### ② Stroke length 100mm



※OA length of slider

※※OA length of motor

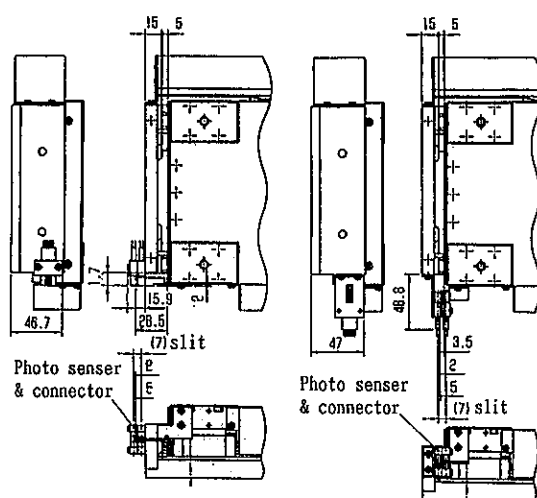
#### ③ Stroke length 150mm



#### Location of the sensor

(1) Outside pos.

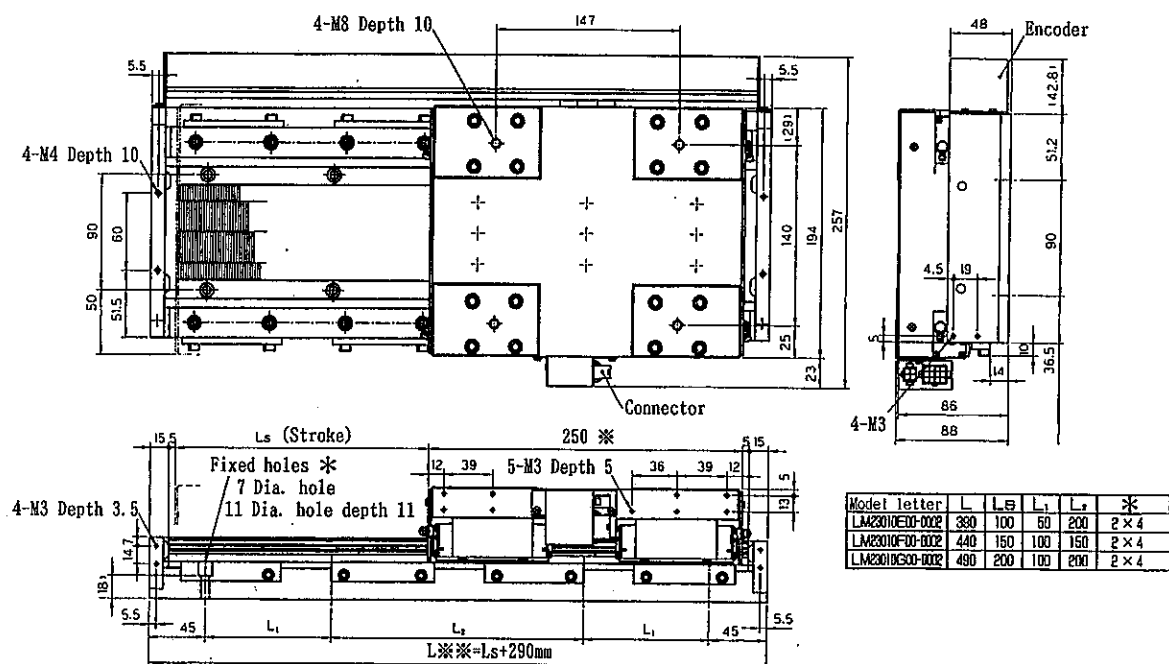
(2) Inside pos.



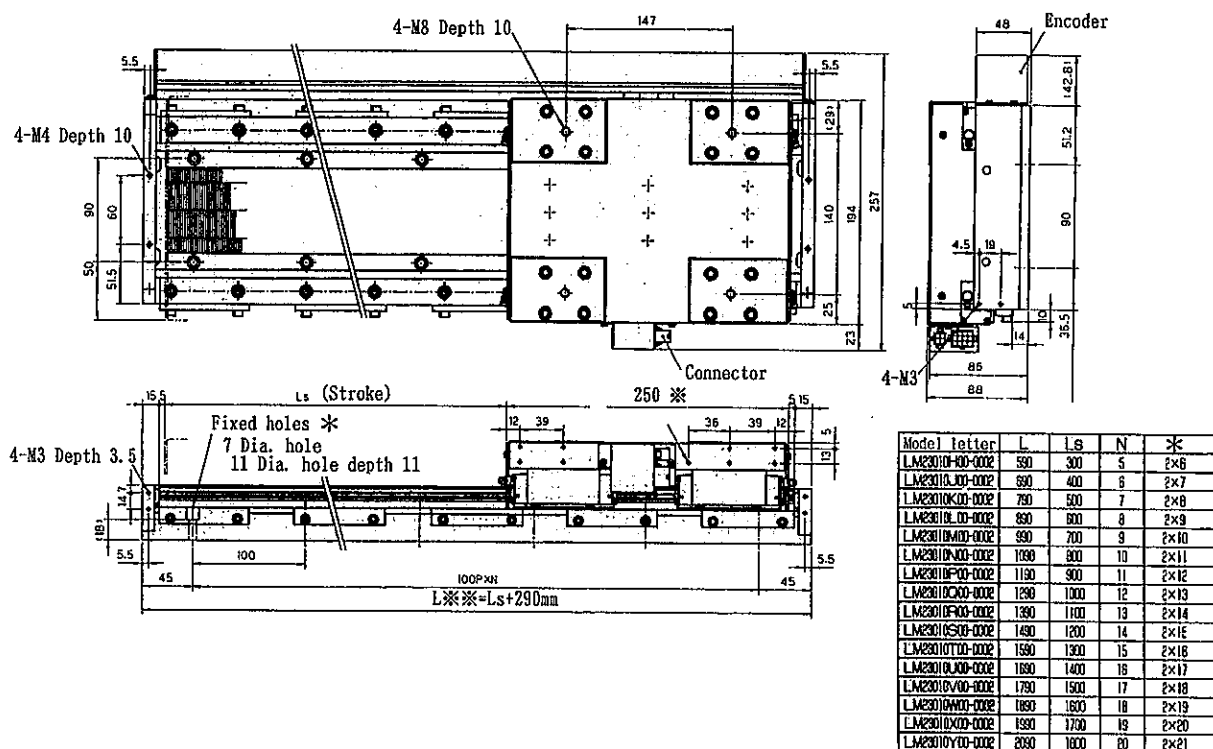
HS models dimensions same as st'd model and R + H models same as HR models

## (4) LM230 Series

### ② Stroke length 100 – 200mm

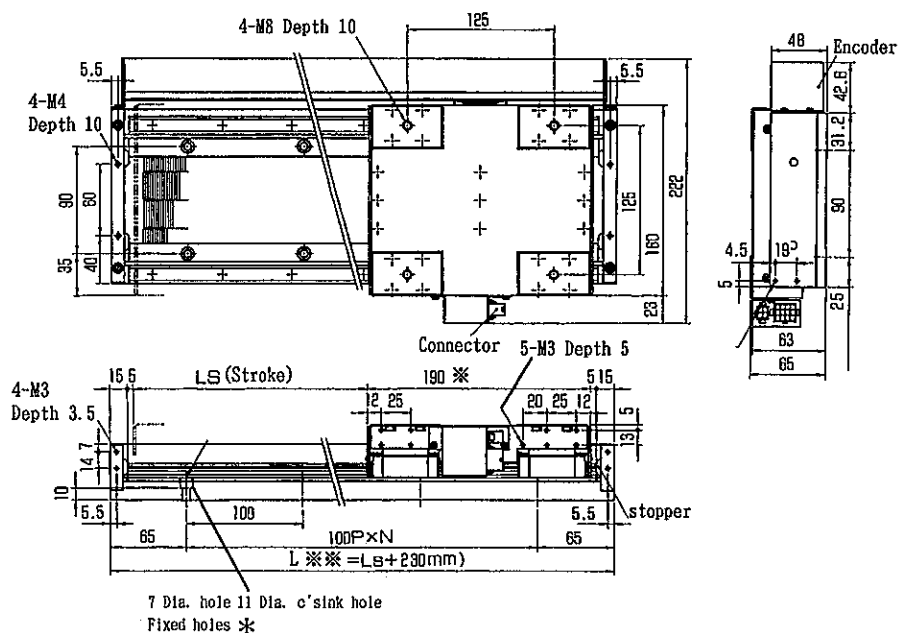


### ③ Stroke length 300 – 1800mm



### (3) LM130 Series

#### ④ Stroke length 150 – 1800mm

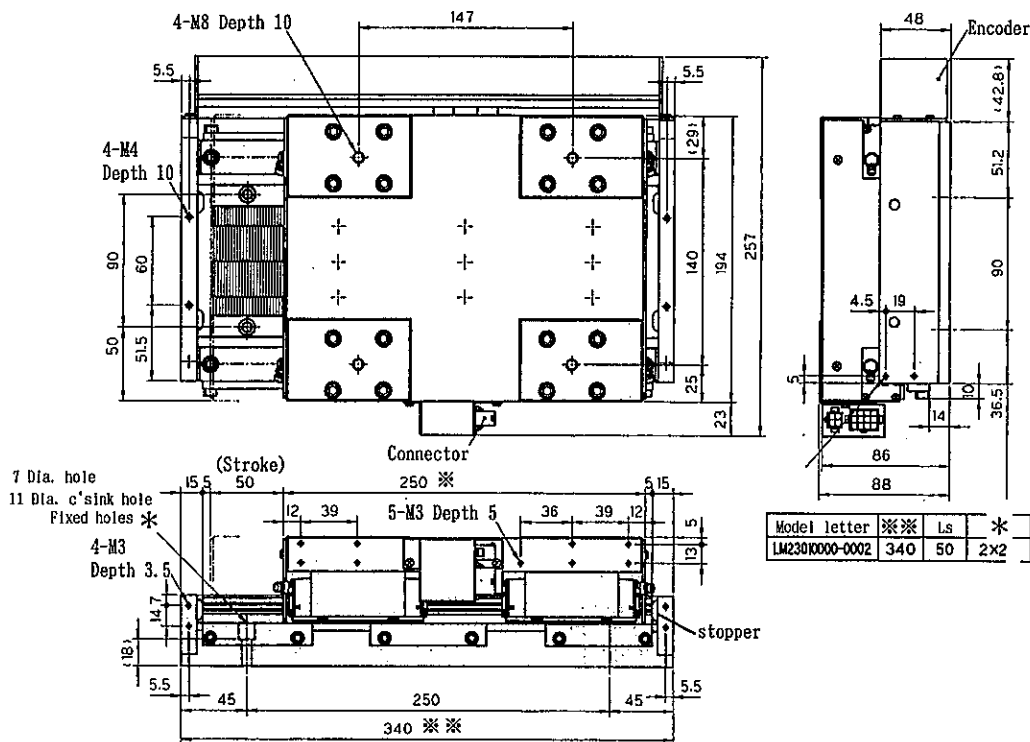


Model letter	L	LS	N	*
LM130 10G00-0002	430	200	3	2 x 4
LM130 10H400-0002	530	300	4	2 x 5
LM130 10J000-0002	630	400	5	2 x 6
LM130 10K000-0002	730	500	6	2 x 7
LM130 10L000-0002	830	600	7	2 x 8
LM130 10M000-0002	930	700	8	2 x 9
LM130 10N000-0002	1030	800	9	2 x 10
LM130 10P000-0002	1130	900	10	2 x 11
LM130 10Q000-0002	1230	1000	11	2 x 12
LM130 10R000-0002	1330	1100	12	2 x 13
LM130 10S000-0002	1430	1200	13	2 x 14
LM130 10T000-0002	1530	1300	14	2 x 15
LM130 10U000-0002	1630	1400	15	2 x 16
LM130 10V000-0002	1730	1500	16	2 x 17
LM130 10W000-0002	1830	1600	17	2 x 18
LM130 10X000-0002	1930	1700	18	2 x 19
LM130 10Y000-0002	2030	1800	19	2 x 20

※ OA length of slider    ※※ OA length of motor

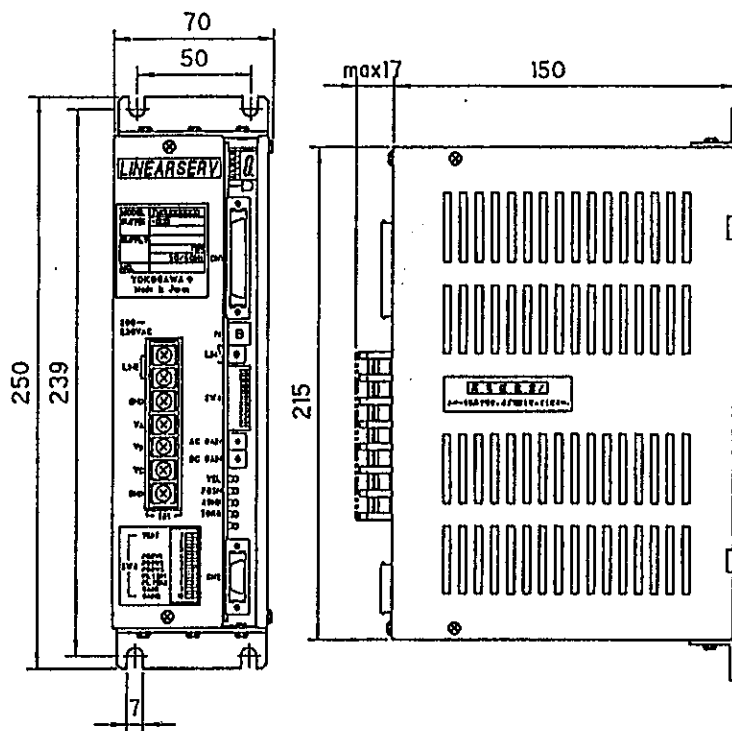
### (4) LM230 Series

#### ① Stroke length 50mm

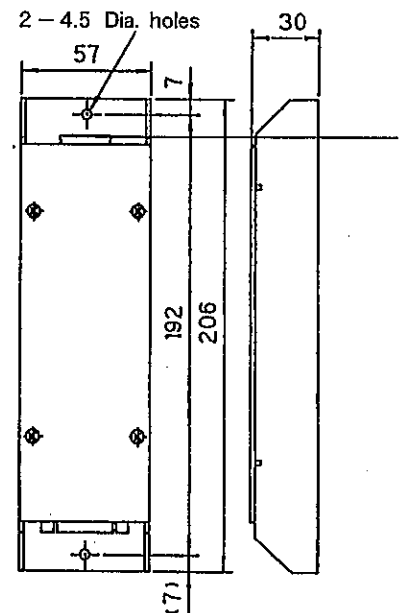


Model letter	※※	LS	*
LM230K000-0002	340	50	2 x 2

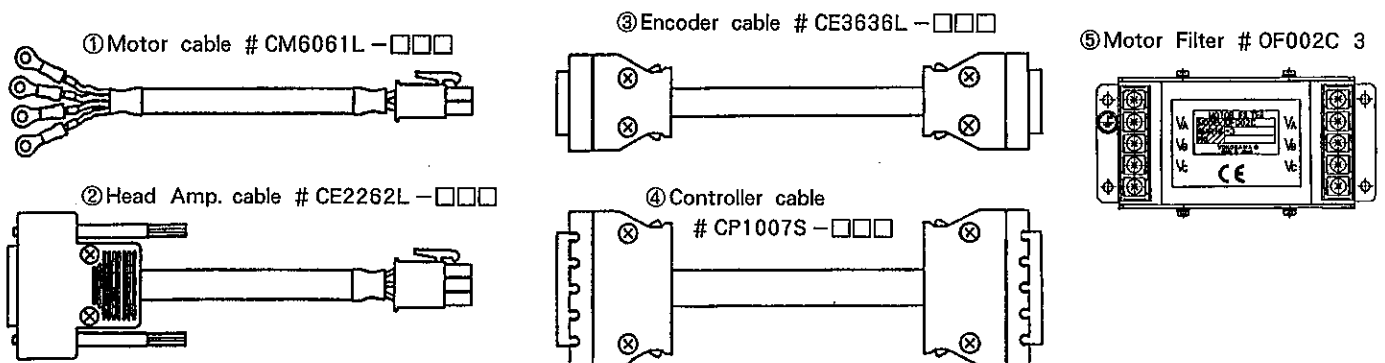
## (5) Driver section



## (6) Head amp. section

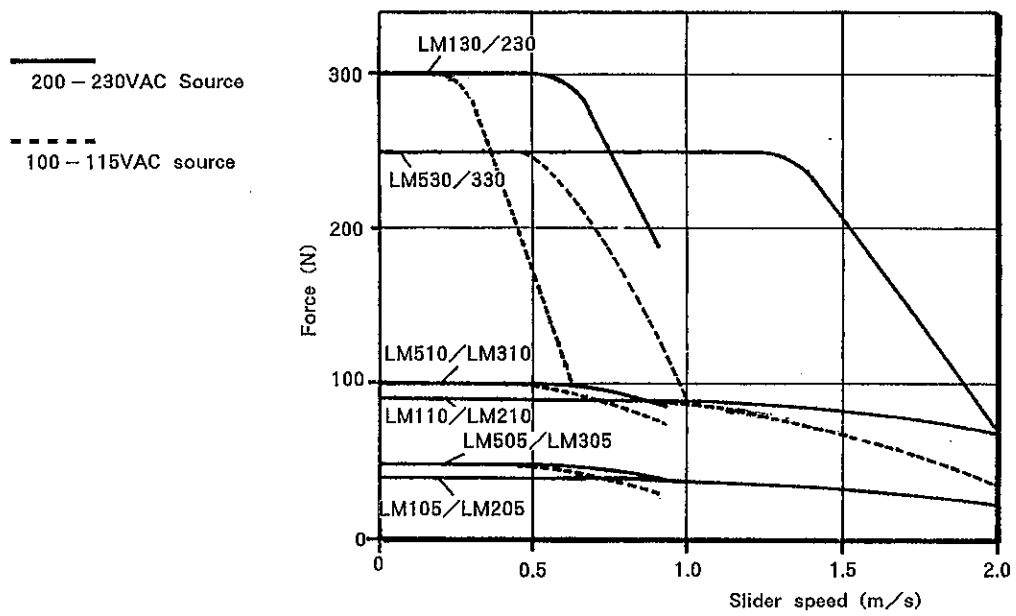


## (7) Option cable



(Note) □□□ : Shown cable length Exsample : 0.1m = 001, 1m = 010, 10m = 100

### 8.3 Velocity vs Thrust Characteristics



## 8.4 Driver Block Diagram

