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Dynaserv Direct-Drive Servo

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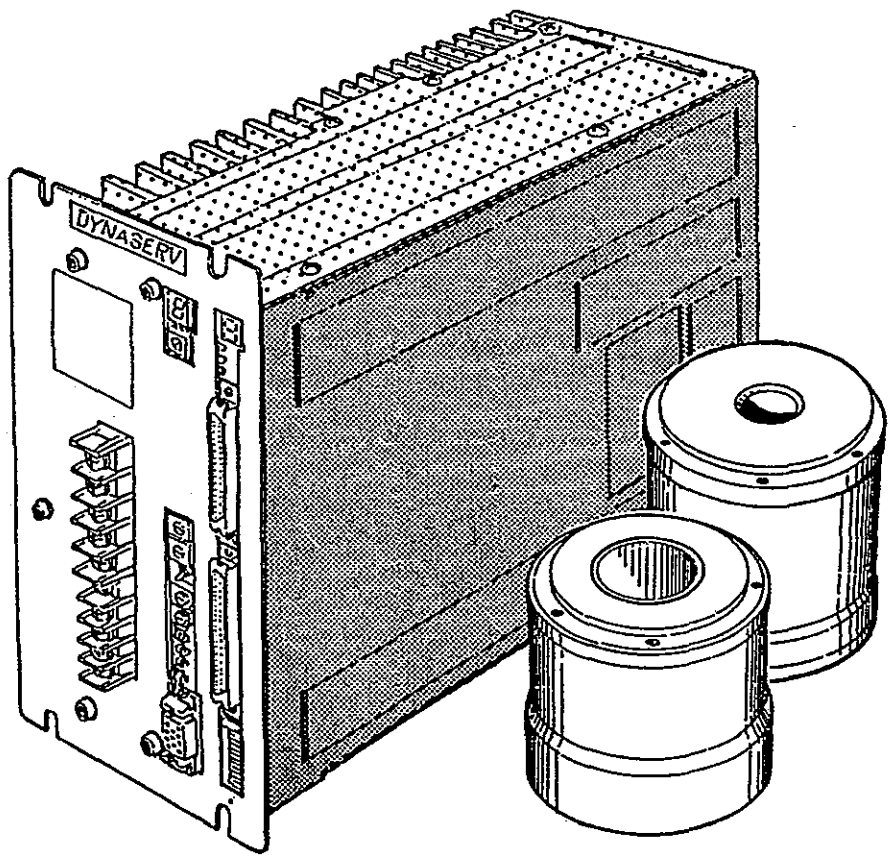
Instruction Manual

DD Servo-Actuator
Logic Control Interface Driver
Suffix <P> Model
Instruction Manual

IM A521-E



YOKOGAWA
Yokogawa MAT Corporation

IM A521-E
Mar. 1, 2000

INTRODUCTION

Thank you very much for purchasing our DYNASERV DD Servo-Actuator. The DYNASERV is a highly accurate, high-torque, high-velocity servo-actuator with an outer rotor. It can be used in a wide range of field applications related to factory automation, including industrial robots, indexes, etc.

This instruction manual covers the model that combines the DM/DR series motor and <P> Model driver. Be sure to read this instruction manual prior to operating the DYNASERV.

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FD No.
1st Edition: May 1995 (YG)

Warning on Installation and Operation

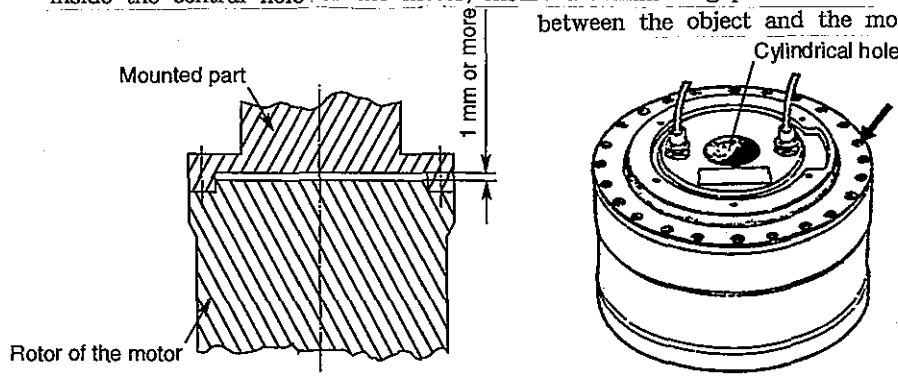
1. Never install the motor with the rotor fixed and the stator set free for rotation.

2. Ensure that the power is switched off when removing the side panel of the driver for jumper setting, etc. Dangerously high voltage is present inside the unit.

3. The motor rotates at high speed with a high torque. Beware of the rotating radius of the load when operating the motor with the load installed.

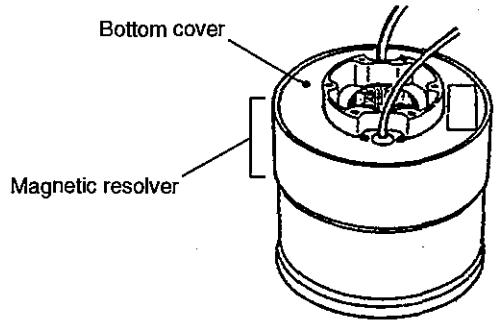
4. Ensure adequate grounding at the ground terminal.

5. When installing a load to the rotor of the motor, allow a space of 1 mm or more between the top surface of the motor and the surface of the load in order to maintain the proper alignment of the surfaces. Never apply any force or press any materials into the cylindrical hole. (See the figure shown below.) When an object is to be introduced inside the central hole of the motor, ensure a minimum gap of 1mm on either side between the object and the motor walls.



6. Never adjust the bolts that fix the bottom of the rotor of the motor (indicated by the arrow in the figure shown above). Loosening or tightening the bolts may cause the commutation angle to be inaccurate, resulting in incorrect motor rotation (only for the DM series).

7. Because a magnetic resolver is incorporated in the motor part shown in the figure on the right, avoid mechanical shock, pressure, or strong magnetic fields (only for the DR series).



8. Use only such screws that do not exceed the effective screw depth of the motor in order to fix the load. The use of a screw longer than the effective screw depth may damage the motor (only for the DR series).

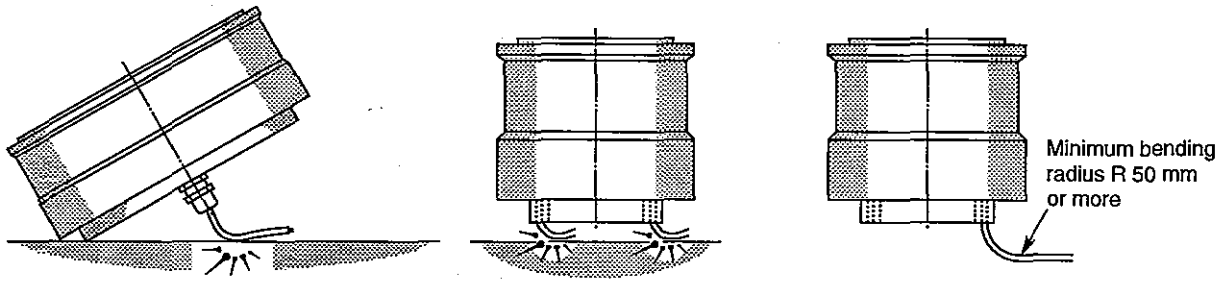
9. Because the surface of the motor is magnetic, materials easily affected by magnetism must keep away from or must not be close to the motor. Install the motor in an appropriate location as the motor is not dust-proof, watertight or oil-proof.

10. If the motor is used with oscillating rotation movements with a small angle (50° or less), then carry out a running-in operation with a back-and-forth movement about 10 times, each move exceeding an angle of 90°. The running-in operation must be carried out after every 10,000 oscillations in order to ensure proper lubrication of the bearings.

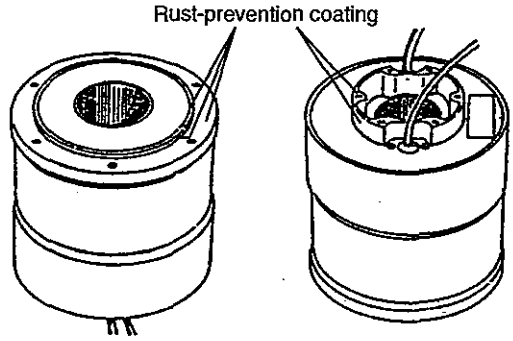
11. Compatibility of the motor with the driver or vice versa when they are of the same model is possible only when they are of the same type. (i.e., if the motor code is DM1□□□□ *1, and the driver code is SD1□□□□ 02, the □□□□ of the motor and the driver must be the same.)

12. Never disassemble or modify the motor or the driver. 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 disassembled or modified motor and driver without permission.

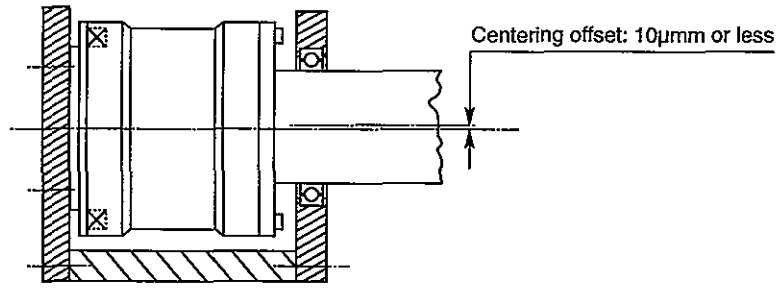
13. If the motor is placed on the floor or the like as shown below when carrying or installing the DYNASERV, the cable is bent by the weight of the motor and this bending may cut the conductor wire. When setting the motor in place, be sure to use a support base which protects the cable from being bent. The minimum bending radius shall be 50 mm or more when installing the motor with the cable bent. Do not apply repeatedly bend the cable when it is used. The cable specifications do not include application with a robot.



14. On the motors of the DYNASERV DR series, a rust-prevention coating has been applied to the load-mount part at the top and also to the fixed part at the bottom of the motor. Before assembling the motor, completely remove this coating using a cloth or paper dipped in a petroleum or chlorine solvent. The presence of the coating may lead to severe mechanical inaccuracies of the assembled system.



15. Appropriate centering and alignment must be carried out when connecting the motor to a load. The shaft of the motor may become damaged if centering is offset 10 µm or more.



16. Never carry out a withstanding voltage test. Carrying out this test even accidentally may damage the circuits. When such withstanding voltage tests are required, consult Yokogawa Precision Corporation or its authorized agency.

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4. CAUTION ON OPERATION

5. OPERATION

6. MAINTENANCE AND INSPECTION

7. TROUBLESHOOTING AND MEASURES

8. REFERENCE

1. PRODUCT OUTLINE

1.1 Overview

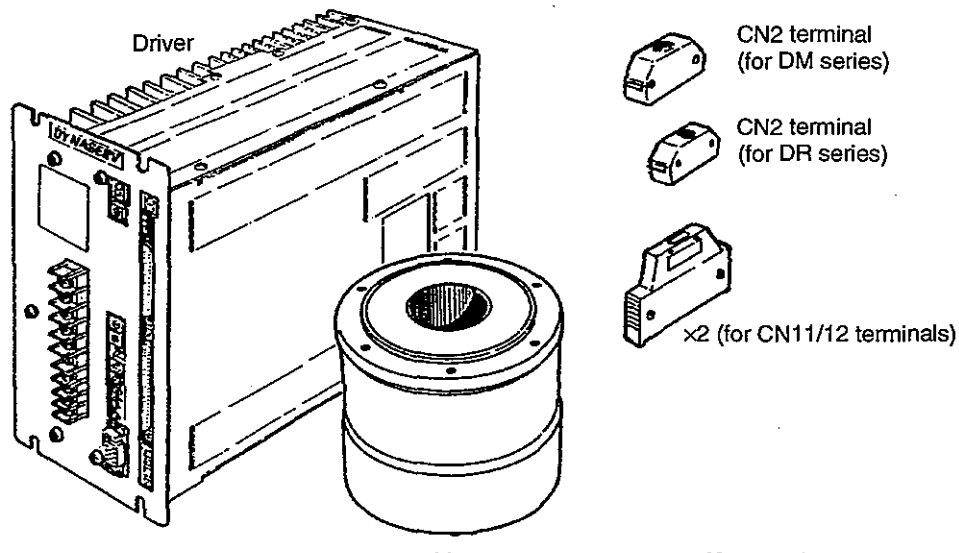
The P driver series, with a highly accurate, built-in positioning controller, has joined up with the popular DYNASERV direct drive (DD) servo actuator (with an outer rotor motor), which features high speed, high torque and high accuracy, in a new series. Operation of this driver is easy. The user has only to connect the sequencer, switches, etc., to the driver, set up the data for the position, speed, and acceleration in binary-coded decimal format (BCD), and then turn on the start signal. The driver then performs fine positioning by smoothly controlling the rotation speed. The operator need not follow complicated protocols since data can be set by merely inserting latch signals on a basis of two BCD digits.

Recognized and highly accurate I-PD control is applied to positioning control, and there is a newly incorporated automatic tuning function; therefore, tuning work has become simplified. This driver can be used in combination with a motor from the conventional DYNASERV DM and DR series (except for the DM8015 and DR5000A series).

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 Name	Q'ty	Remarks
Motor section	1	
Driver section	1	
Connector (for CN2 terminal)/ for DM series	1	Manufactured by Honda Tsushin Kogyo: MR-16LM
Connector (for CN2 terminal)/ for DR series	1	Manufactured by Honda Tsushin Kogyo: MR-8LM
Connector (for CN11 terminal)	1	Manufactured by Fuji Tsushinki Connector: FCN-361J040-AU Cover: FCN-360C040-B
Connector (for CN12 terminal)	1	



[Standard products]

1.3 Model and Suffix Codes

The model and suffix codes of the DYNASERV, DM/DR Series motor and driver are as follows:

(1) Motor

□ □ □ □ □ □ □ □ □ – □ * 1

- Motor series name (DM or DR)
- Design version (1: standard; 5: high speed)
- Maximum output torque (N·m with 3 digits)
- Motor model/outer diameter (A series: dia. 10"; B series: dia. 6"; E series: dia. 8")
- Destination (0: domestic; 5: overseas)
- Special motor part arrangement (0: standard; B: lightweight; C: with flange; D: with mechanical brake)
- Mechanical accuracy: only for the models requiring mechanical accuracy; this is omitted if not required. (-1: mechanical accuracy of 5 µm or less; -2: mechanical accuracy of 10 µm or less; -3: mechanical accuracy of 20 µm or less)
- With compatibility function

(2) Driver

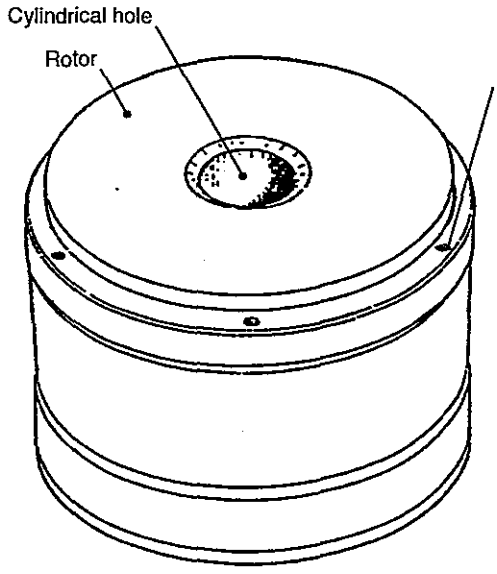
□ □ □ □ □ □ □ □ 2 – □ P □

- Driver series name (SD or SR)
- Design version (1: standard; 5: high speed)
- Maximum output torque (N·m with 3 digits)
- Motor model/outer diameter (A series: dia. 10"; B series: dia. 6"; E series: dia. 8")
- Destination (0: domestic; 5: overseas)
- Compatibility function
- Power voltage (1: 100-115 V power requirements; 2: 200-230 power requirements)
- Built-in interface board type (P: P driver series)
- Mechanical resonance filter (I: with equalizer filter; N: with notch filter; 0: without filter)

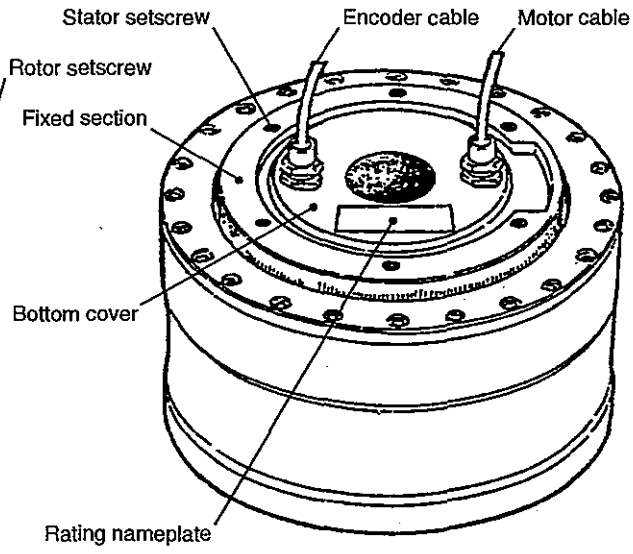
Note: The motor and the driver are compatible within the same model type. For compatibility, the first five digits of the motor code (DM □□□□□ 02) and the driver code (SD □□□□□ 02) must be the same. However, the combination of DM1075B (motor) and SD1075B (driver) may not be able to maintain compatibility during use. In this case, consult Yokogawa Precision Corporation or its authorized agency.

2. FUNCTIONAL DESCRIPTION

2.1 Motor Section (DM Series)

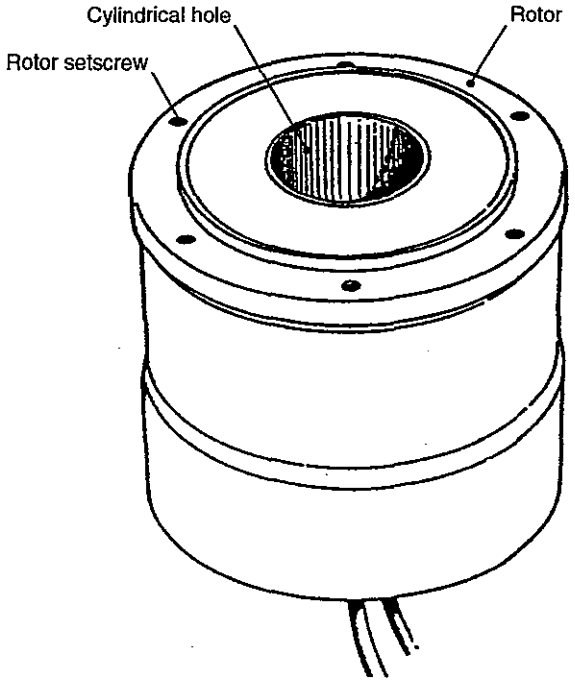


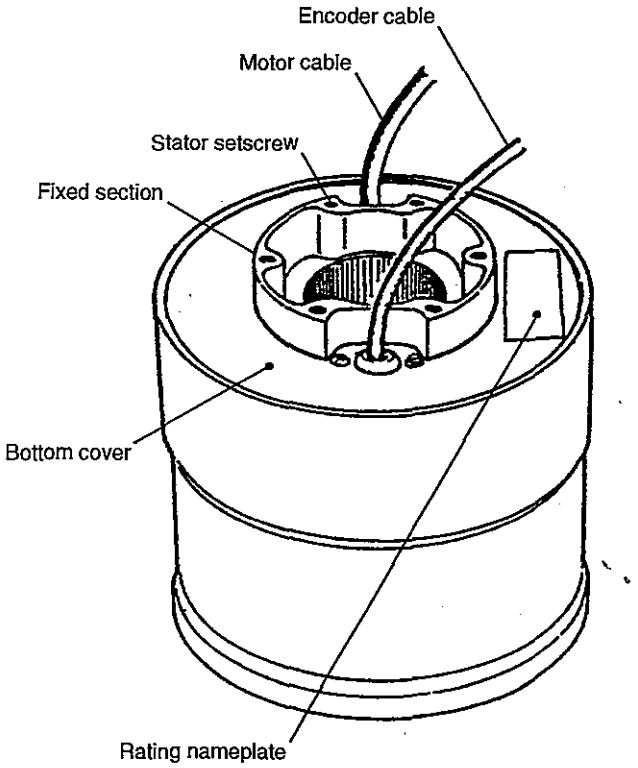
Top View



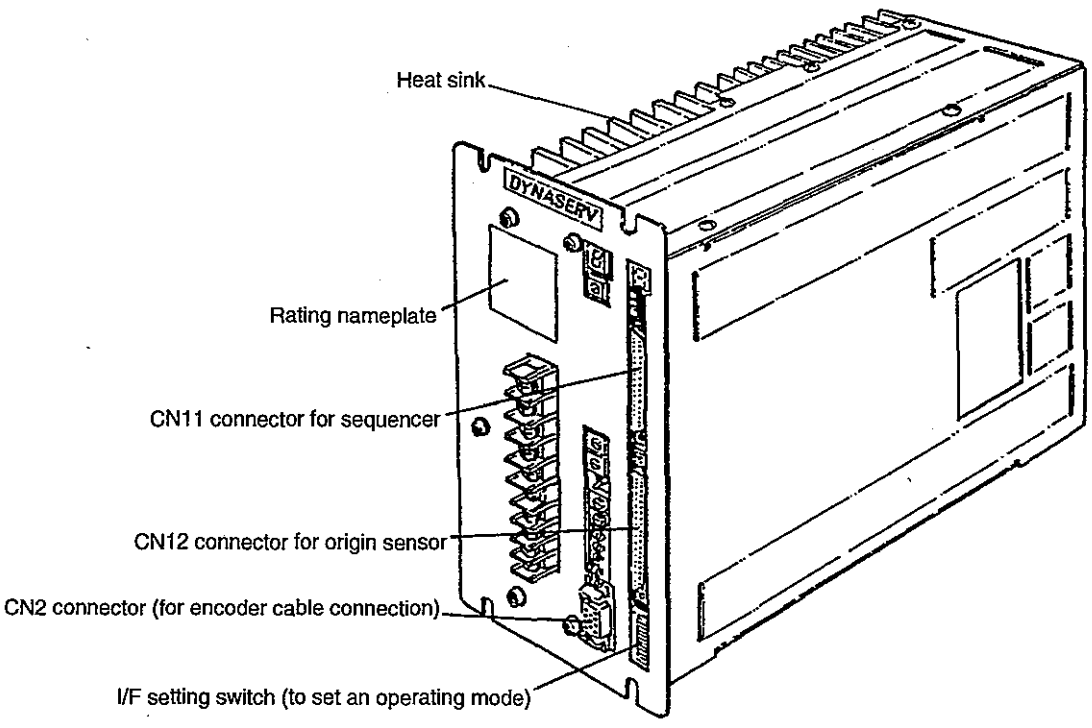
Bottom View

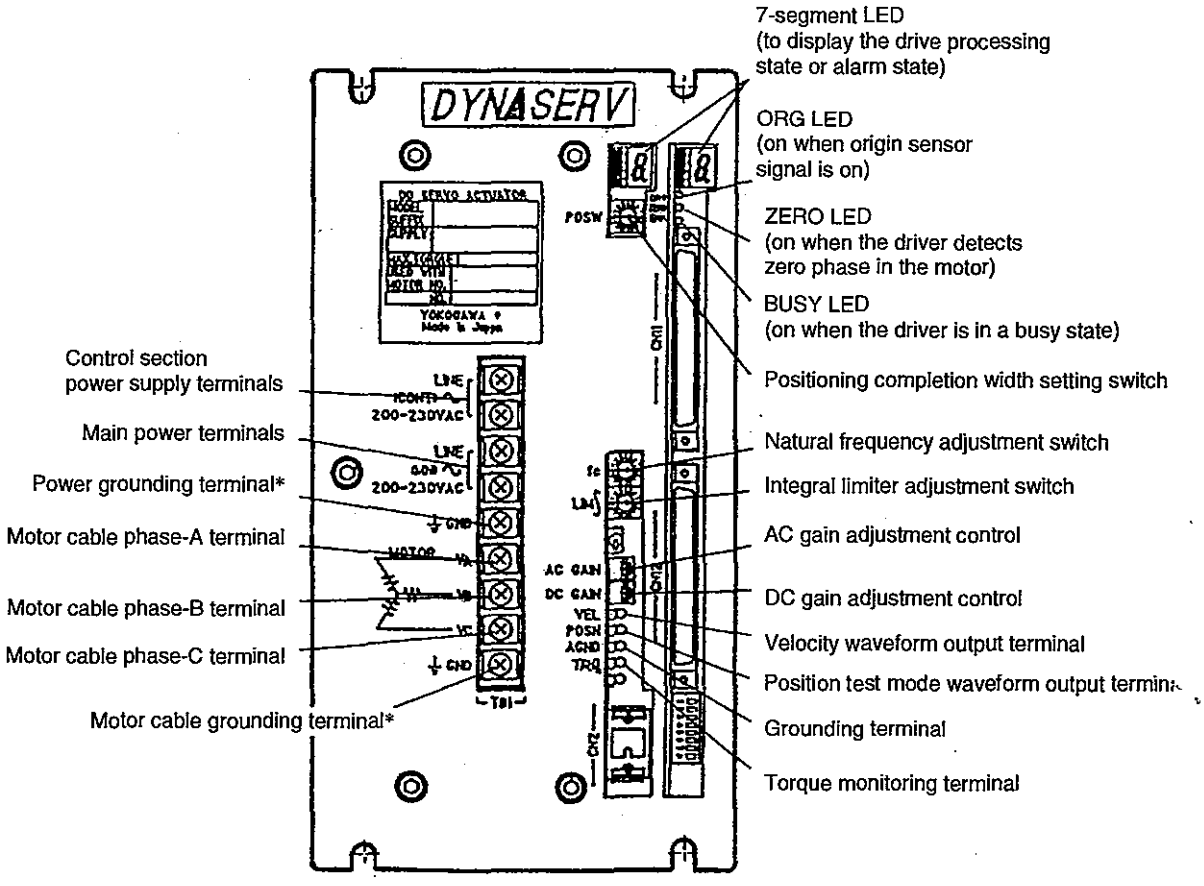
2.2 Motor Section (DR Series)





2.3 Driver Section (Panel Surface)





*: Both GND terminals are connected to the driver case.

3. INSTALLATION AND WIRING

3.1 Flowchart of Preparation for Operation

<1> Check motor and driver models.

Items to Be Checked	Page Numbers for Reference
♦ Motor (rating nameplate) ♦ Driver (rating nameplate)	1-2, 2-1, 2-2

<2> Conduct wiring of connection cable and power cable between motor and driver.
Caution: The power cable must not be connected to a power outlet at this time.

Items Needed	Page Numbers for Reference
♦ CN2 connector (standard accessory) ♦ Encoder cable (fixed to motor section) ♦ Motor cable (fixed to motor section) ♦ Power cable (optional) ♦ Grounding cable (prepared separately) ♦ Two jumper wires (prepared separately)	3-9, 3-15

In addition to the above items, crimp terminal power filter or the like may be necessary.

<3> Prepare origin sensor and overtravel sensor.

Items to Be Provided	Page Numbers for Reference
Provide an origin sensor and overtravel sensors (OTU and OTD) separately. Example: E2C-X1A, E2C-GE4A (amplifier) from Omron Corp.	3-9 - 3-12, 3-17, 5-2 - 5-4

<4> Prepare sequencer or switch circuit.

Items to Be Provided	Page Numbers for Reference
Provide a sequencer or switch circuit separately. Also, provide the power supply and other products having the same specifications.	3-9 - 3-12, 3-15

<5> Connect sequencer or switch circuit and sensors to the driver.

Items to Be Connected	Page Numbers for Reference
♦ Motor-connecting driver ♦ Sequencer or switch circuit (including power supply) ♦ Origin switch, two overtravel sensors (including power supply) ♦ CN11/CN12 connectors (standard accessory)	3-9 - 3-12

<6> Do settings for jumper, filter, and switches provided on the driver.

Items to Be Provided	Page Numbers for Reference
◇ Driver for clock setting ◇ Tweezers	3-3 - 3-8

<7> Operate sequencer or switch circuit in accordance with the operation patterns.

Item to Be Provided	Page Number for Reference
Turn on the power.	

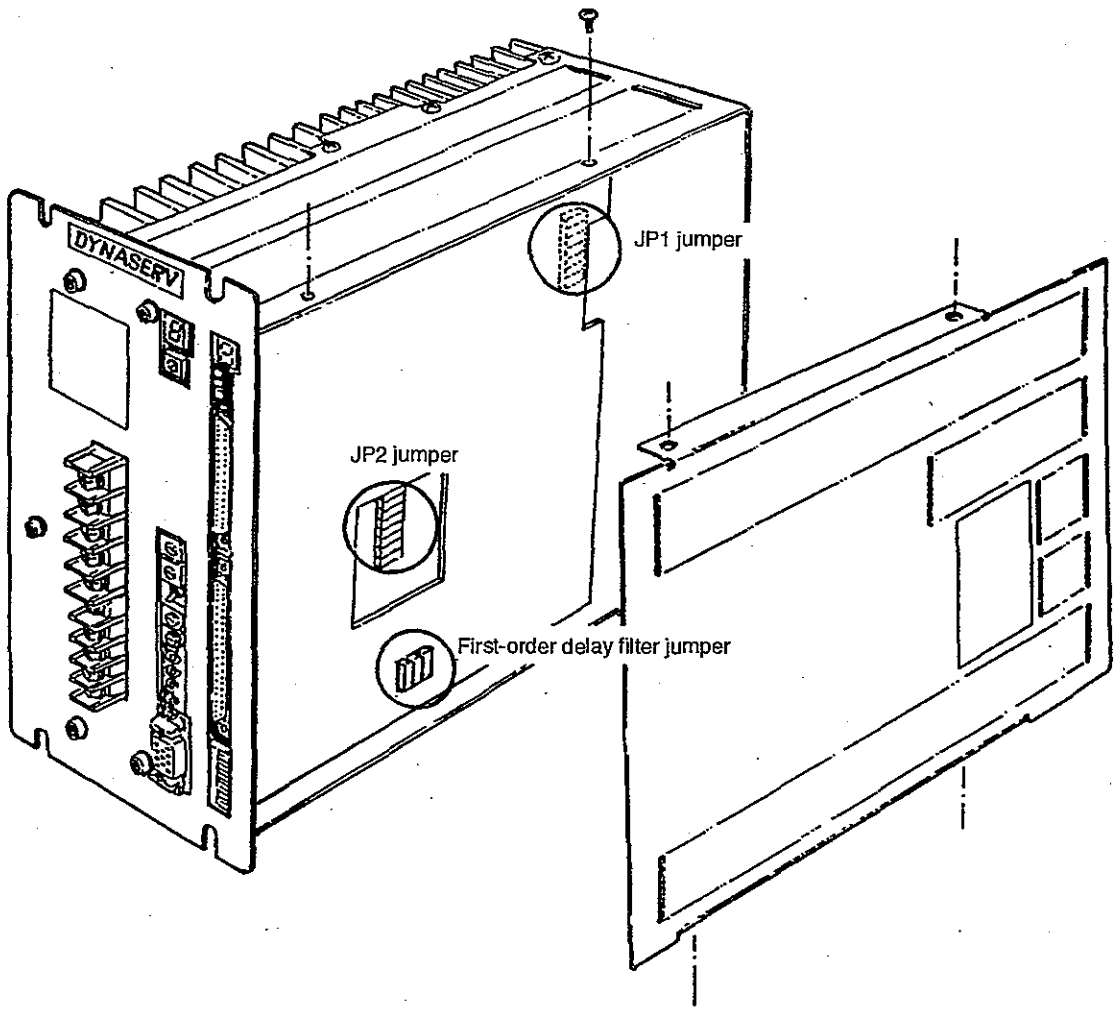
<8> Do tuning to confirm actions.

Item to Be Prepared	Page Numbers for Reference
◊ Oscilloscope	5-11 - 5-18

<9> End

3.2 Initial Setting

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



Certain jumpers, switches, and variable resistors within the driver box may need to be set by the customer. However, prior to shipment, they are set as shown on the next page. See the figure above for their locations.

To remove the side plate from the driver box, remove the four screws shown in the figure above. In order to commence this operation, the power must be turned off because of danger. *Further, never touch the high-voltage generation section, even with the power turned off.* For 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 (Note: ▒▒ indicates a jumper setting upon shipment)**

JP1 jumper

▒▒ MODE: See the next page. (Never change the setting.)
[ ] CALIB: See the next page. (Never change the setting.)
▒▒ RATE#1: Position command pulse multiplying factor setting (Never change the setting.)
▒▒ RATE#2: Position command pulse multiplying factor setting (Never change the setting.)
▒▒ UD/AB: With jumper: A/B-phase; without jumper: up/down pulse (Never change the setting.)
▒▒ VFFH: Velocity feedforward amount setting (Note 1)
▒▒ VFFM: Velocity feedforward amount setting (Note 1)
▒▒ VFFL: Velocity feedforward amount setting (Note 1)
▒▒ GAIN H: DC gain magnification setting (With jumper: DC gain x 13; without jumper: DC gain x 1)

JP2 jumper

[ ] I: Velocity I type control
▒▒ P: Velocity P type control
[ ] 100: Velocity detection filter (Hz) selection (Normally open)
[ ] 200: Velocity detection filter (Hz) selection (Normally open)
▒▒ PV: Mode selection (Never change the setting.)
[ ] VEL: Velocity input (Never change the setting.)
[ ] TORQ: Torque input (Never change the setting.)
[ ] ALM: Open (Never change the setting.)
[ ] TLIM: Open (Never change the setting.)

First-order delay filter jumper

[ ] 20/80 Hz
[ ] 30/120 Hz
▒▒ 40/160 Hz

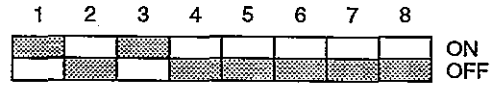
(Note 1)

VFFH	VFFM	VFFL	Velocity Feedforward Amount (%)
Shorted	Shorted	Shorted	100
Shorted	Shorted	Open	95
Shorted	Open	Shorted	90
Shorted	Open	Open	85
Open	Shorted	Shorted	80
Open	Shorted	Open	75
Open	Open	Shorted	70
Open	Open	Open	65

(3) Settings of Switches and Variable Resistors Prior to Shipment

Switch/Variable Resistor	Setting Status
DC GAIN	Minimum position
AC GAIN	Minimum position
POSW	Set to "8"
fc	Set to "0"
I-LIM	Set to "0"

I/F setting switch



: Factory setting

3.3 Jumper and Filter Settings

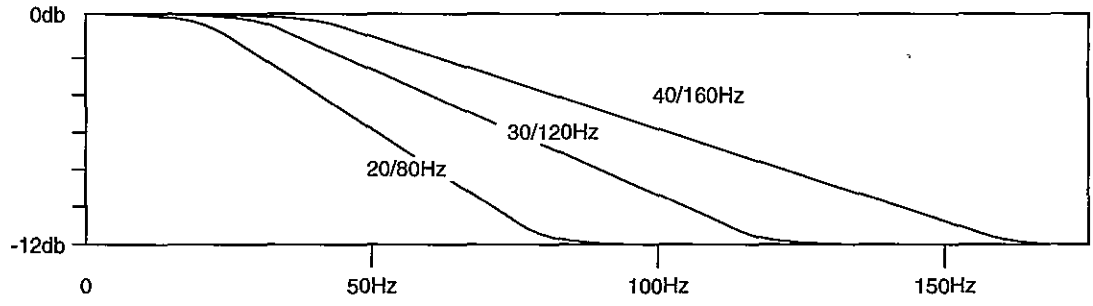
(1) Velocity Detection Filter and Jumper Settings <JP2/100, 200>

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. Usually these jumpers must be kept open.

(2) First-order Delay Filter and Jumper Settings

(Note: Effective only when no mechanical resonance filter (optional) is provided)

These jumpers are used to select the first-order delay filter cut-off frequency. The selection of this frequency can regulate most of the oscillation when the motor oscillates 100 Hz or more due to mechanical resonance.

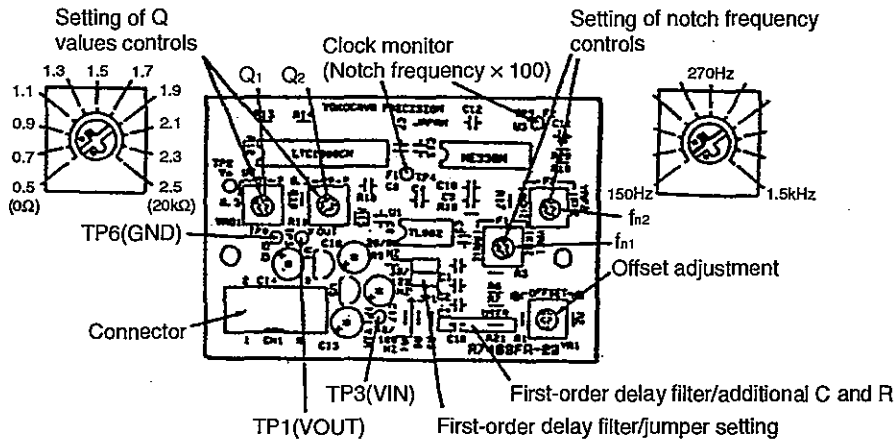


(3) Mechanical Resonance Notch Filter Adjustment

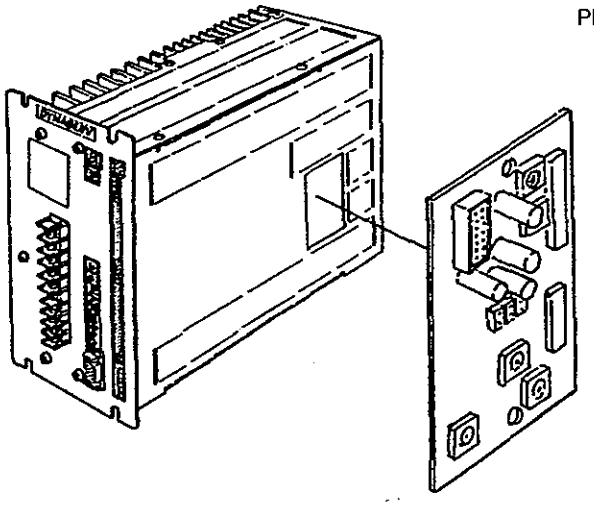
The following explains the adjustment procedure when a mechanical resonance notch filter is installed as an option. The board of the filter is located as shown in the figure on page 3-7 just inside the square cut-out on the side panel. Controls fn_1 and fn_2 on the board are used to set the notch frequencies 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).

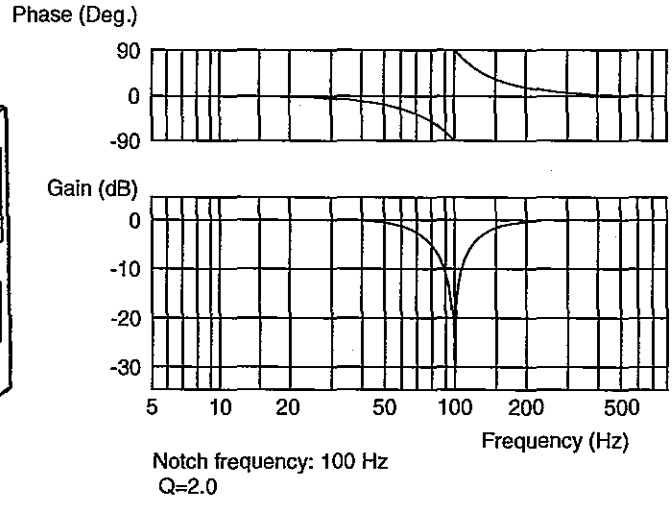
Use controls Q_1 and Q_2 to change the setting of the Q values. The Q values can be set within a range from 0.5 to 2.5 (0 to 20 kΩ) (the Q values are factory-set to 2.5 at the time of shipping). The offset voltage shall be readjusted when the Q value has been changed. This voltage is to be adjusted using adjustment controls so that the voltage difference between TP1 and TP3 becomes ±50 mV or less.

The first-order delay filter is also located on this board. The frequencies can be selected from 20/80 Hz, 30/120 Hz and 40/160 Hz, using a jumper. In addition, using the appropriate pair of C and R, the desired filter frequency can be set.



Notch Filter Board Layout





(4) fc Natural Frequency Adjustment Switch

This is a switch to set or adjust the positioning frequency. The greater the switch number, the higher the frequency bandwidth and the higher the servo stiffness.

fc Switch Position	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
fc (Hz)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

(5) POSW Positioning Completion Width Setting

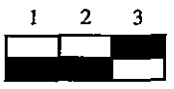
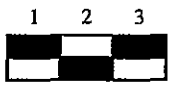
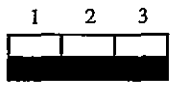
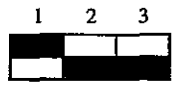
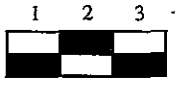
This is a switch to set the positioning completion width. When the POSW switch is set to 1, the COIN signal in the CN11 connector becomes L if the difference between the instruction value and the POSW signal is within ±5 pulses.

POSW Switch Setting	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Number of pulses	1	5	20	100	2	10	40	200	4	20	80	400	8	40	160	800

(6) I/F Setting Switch

The I/F setting switch is used to set the interface mode. For its setting procedure, refer to the operation description given later. This section describes the meanings of the switch settings.

1 Nos. 1, 2, and 3 setting sub-switches /command input (Never make settings other than those below.)

			
Feed pulse input	Feed angle input	Pulse position input	Angle position input
Incremental input		Absolute input	
		Note: These settings are effective only upon driver resetting. Never change the settings while in operation.	
Tuning mode	Maintenance mode		

2 No. 4 setting sub-switch/data storage

	When you turn on the sub-switch in the positioning mode, the motor position at that time is saved as the electrical origin.		When you turn on the sub-switch after automatic tuning, the control parameter at that time is displayed.

Note: Always turn the switch off. Always reset the switch to off when the setting is completed.

3 No. 5 setting sub-switch/automatic tuning effective or parameter clearing

	In the positioning mode and automatic tuning mode, automatic tuning is executed when you turn on this sub-switch.		When you turn this sub-switch on in the maintenance mode, the parameter is cleared, and the parameter setting that is saved in the driver is initialized.

Note: Always reset the sub-switch to off when the setting is completed.

4 No. 6 setting sub-switch/gain selection

	fc, I-LIM, and DC GAIN on the front panel can be adjusted in the switch off status.		When you turn on the sub-switch, a parameter value for automatic tuning you select in the tuning mode is selected. Connection check is possible in the maintenance mode.

5 No. 7 setting sub-switch/overtravel detection

	When you turn on the switch, the overtravel detection function stops the motor automatically when OTU and OTD signals become H. In this status, all motor operation commands except for jog mode are prohibited. In the tuning mode, a test operation (round-trip operation) is made by turning this switch on. A connection check is possible in the maintenance mode.

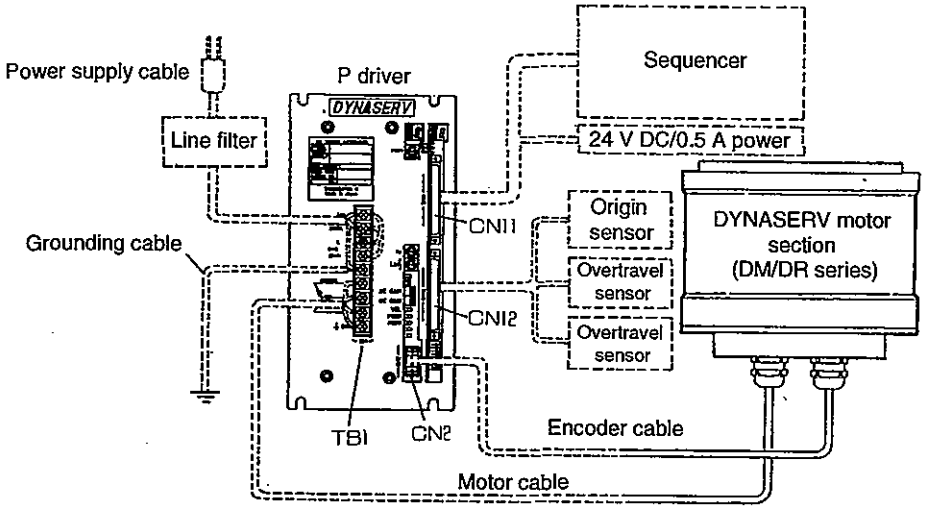
6 No. 8 setting sub-switch/setting of 1 to 5 digits of data

					
Correspondence between position data input and strobe signal	STP0 STP1 STP2 STP3	First and second digits of data Third and fourth digits of data Fifth and sixth digits of data Seventh and eighth digits of data	Correspondence between position data input and strobe signal	STP0 STP1 STP2 STP3	First and fifth digits of data Second and sixth digits of data Third and seventh digits of data Fourth and eighth digits of data
Correspondence between encoder data input and strobe signal	STE0 STE1 STE2 STE3	First and second digits of data Third and fourth digits of data Fifth and sixth digits of data Seventh and eighth digits of data	Correspondence between encoder data input and strobe signal	STE0 STE1 STE2 STE3	First and fifth digits of data Second and sixth digits of data Third and seventh digits of data Fourth and eighth digits of data

Note: These settings are effective only upon driver resetting. Never change the settings while in operation.

3.4 External Wiring

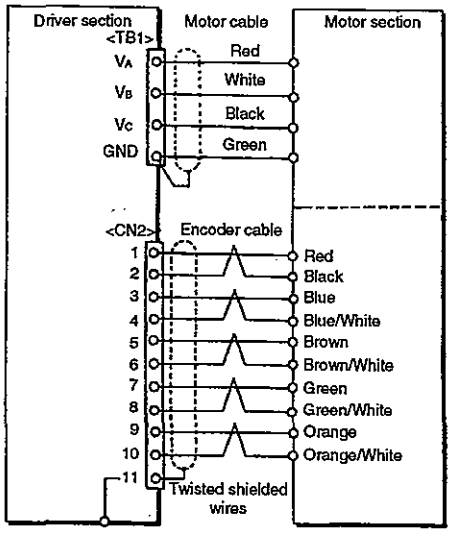
(1) External Connection Diagram



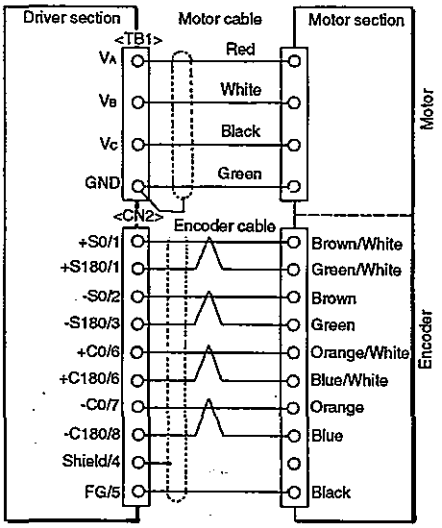
(The items bounded by the dotted lines must be provided by the customer.)

(2) Connection Between the Motor and the Driver

1) DM/SD series



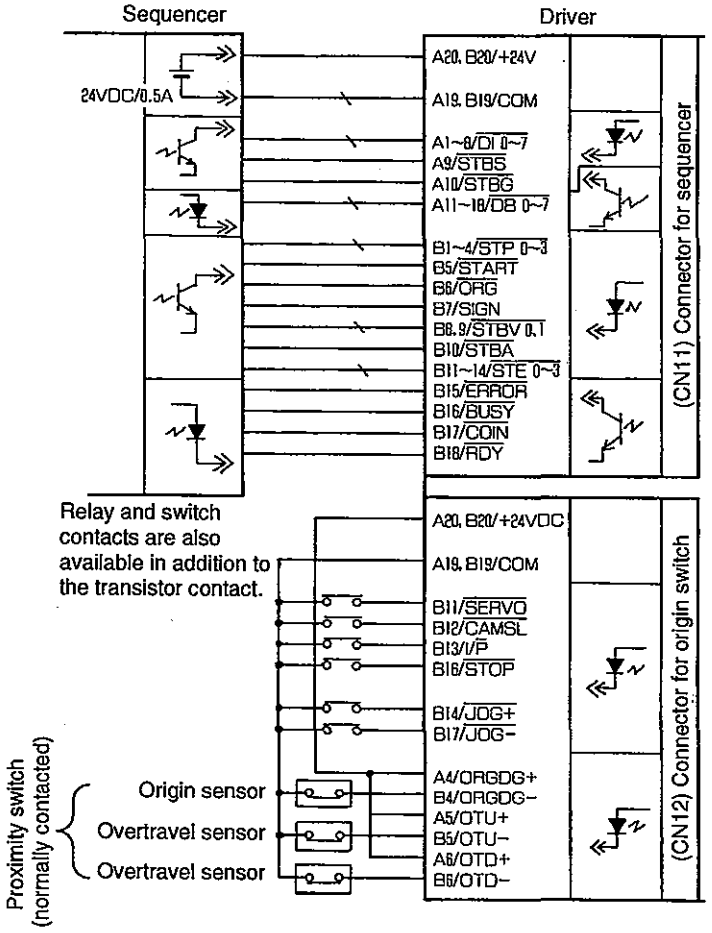
2) DR/SR series



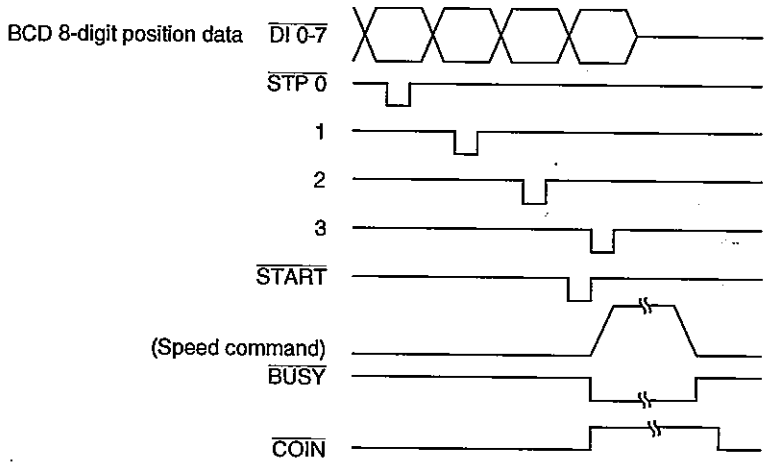
(3) Signals for Sequencer (CN11)

Terminal No.	Signal	Input/ Output	Description
A20 B20	+24 V +24 V	I	24 V power supply input
A19 B19	COM COM	I	Power supply ground (GND) input
B 5	$\overline{\text{START}}$	I	Starts when the signal rises from L to H
B 6	$\overline{\text{ORG}}$	I	Returns to origin (initializes) when H falls to L
B15	$\overline{\text{ERROR}}$	O	L is in an error state
B16	$\overline{\text{BUSY}}$	O	L is in a busy state
B18	$\overline{\text{RDY}}$	O	L is in the driver-ready state
B17	$\overline{\text{COIN}}$	O	L is independent of the BUSY signal state when the position deviation is the POSW switch setpoint or less.
B 7	$\overline{\text{SIGN}}$	I	Rotation direction or the sign of position data: clockwise L; counterclockwise H
A 1 A 2 A 3 A 4 A 5 A 6 A 7 A 8	$\overline{\text{DI 0}}$ $\overline{\text{DI 1}}$ $\overline{\text{DI 2}}$ $\overline{\text{DI 3}}$ $\overline{\text{DI 4}}$ $\overline{\text{DI 5}}$ $\overline{\text{DI 6}}$ $\overline{\text{DI 7}}$	I	BCD data (2 digits). Combining this signal with latch signals enables positioning, speed, and acceleration data and gain to be set.
B 1 B 2 B 3 B 4	$\overline{\text{STP 0}}$ $\overline{\text{STP 1}}$ $\overline{\text{STP 2}}$ $\overline{\text{STP 3}}$	I	Latch signals for positioning data
B 8 B 9	$\overline{\text{STBV 0}}$ $\overline{\text{STBV 1}}$	I	Latch signals for speed data
B10	$\overline{\text{STBA}}$	I	Latch signals for acceleration data. Valid only when a trapezoid is selected in cam curve selection.
A10	$\overline{\text{STBG}}$	I	Latch signals in selection of DC gain. Turning off No. 6 I/F setting sub-switch makes the selected DC gain effective.
A11 A12 A13 A14 A15 A16 A17 A18	$\overline{\text{DB 0}}$ $\overline{\text{DB 1}}$ $\overline{\text{DB 2}}$ $\overline{\text{DB 3}}$ $\overline{\text{DB 4}}$ $\overline{\text{DB 5}}$ $\overline{\text{DB 6}}$ $\overline{\text{DB 7}}$	O	BCD codes for encoder/status data
B11 B12 B13 B14	$\overline{\text{STE 0}}$ $\overline{\text{STE 1}}$ $\overline{\text{STE 2}}$ $\overline{\text{STE 3}}$	I	Strobe signal for encoder data. The eighth digit is for the sign; when DB7 is in the L state, the digit displays (-).
A 9	$\overline{\text{STBS}}$	I	Serves as strobe signal for status data as well as latch signals for encoder data. The status data are used to identify the details of alarms and errors.

(4) Example of Sequencer (CN11/12) Connection



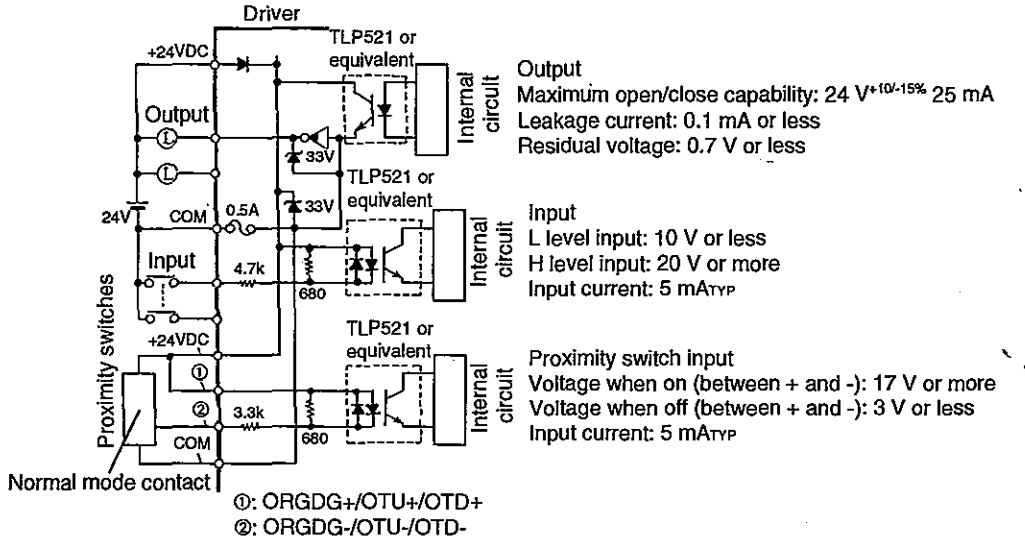
Example of sequence



(5) Signals for Origin Switch (CN12)

Terminal No.	Signal	Input/ Output	Description
A20 B20	+24 V +24 V	O	The +24 V signal entered from the connector for the sequencer is output to this terminal.
A19 B19	COM COM	O	The COM signal entered from the connector for the sequencer is output to this terminal.
A 4 B 4	ORGDG+ ORGDG-	I	Origin proximity signal. Signals from the normally-closed switches are connected.
A 5 B 5	OTU+ OTU-	I	CW (clockwise-from-load-mounting-surface) hard limit signal. Signals from the normally-closed switches are connected.
A 6 B 6	OTD+ OTD-	I	CCW (counterclockwise-from-load-mounting-surface) hard limit signal. Signals from the normally-closed switches are connected.
B11	$\overline{\text{SERVO}}$	I	Servo on/off. Servo on in the L state.
B16	$\overline{\text{STOP}}$	I	Uses this signal in the H state usually. Setting the state to L upon activation of the motor can stop the system in an emergency. Set the startup command signals such as START, ORG, and JOG to H and then set this signal to H.
B14 B17	$\overline{\text{JOG+}}$ $\overline{\text{JOG-}}$	I	Setting this signal to L enters the jog mode. To rotate the motor in a CW direction, set the JOG+ signal to L, and to rotate it in a CCW direction, set the JOG- signal to L. Usually run the motor in the H state.
A 11 A 12 A 13 A 14 A 15 A 16 A 17 A 18	DA 0 DA 1 DA 2 DA 3 DA 4 DA 5 DA 6 DA 7	I	Uses this signal in the H state. Already reserved.
B 12	CAMSL	I	Cam curve selection signal. H: trapezoid; L: cam curve (trapecloid)
B 13	$\overline{\text{I/P}}$	I	Selection of the positioning control mode. H: integral control; L: derivative control. Use this signal in the H status.

(6) Electrical Specifications for CN11/12



3.5 Installation

When the product is delivered, first check the product type and model as well as the inclusion or absence of accessories and for the exact combination of the motor and driver.

(1) Motor Mounting

The motor can be mounted either vertically or horizontally. However, incorrect mounting and an unsuitable mounting location may shorten the motor's service life and cause problems. Therefore, always observe the following.

a) Installation Location

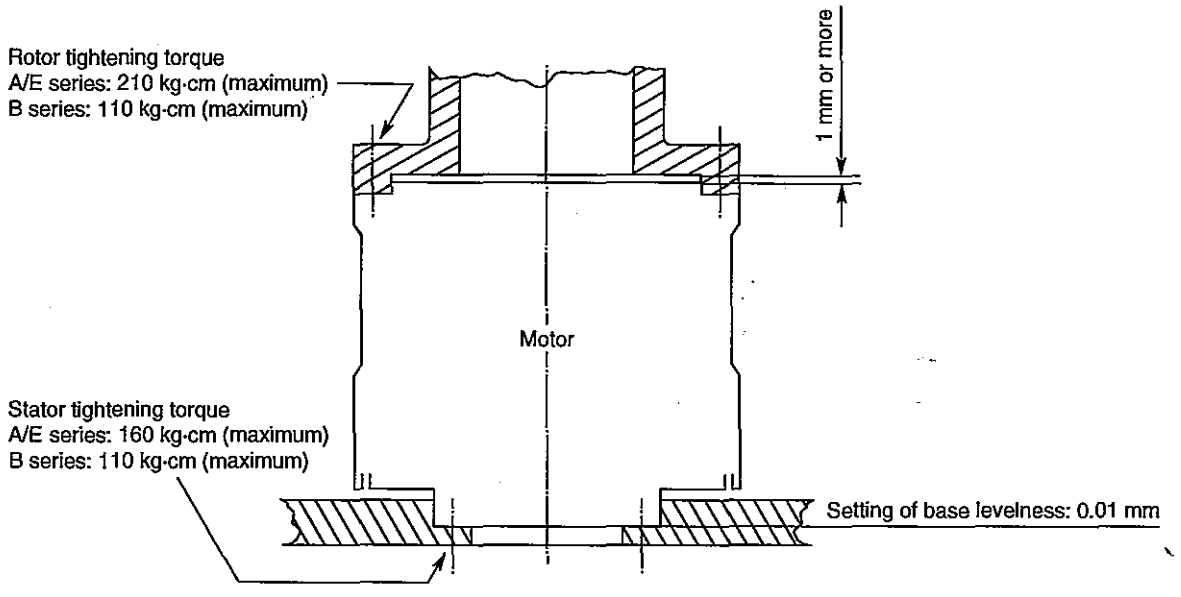
The motor section is designed for indoor use. Therefore, the installation location must be such that:

- There are no corrosive and explosive gases.
- The ambient temperature is between 0° and 45°C.
- Dust concentration is low, with adequate air ventilation and low humidity.

Note: The DYNASERV is not moisture-proof or oil-proof, so it should be covered by a suitable moisture-proof or oil-proof cover.

b) Mechanical Coupling

- When coupling a load with the motor rotor section, make sure there is a clearance of more than 1 mm between the motor upper surface and the load.
- Secure the motor rotor and stator by tightening the setscrew with torques of less than the following values given below.
- The motor base's deviation from a level plane must be maintained at less than 0.01 mm.



Note: When tightening the screws, always apply LOCTITE 601 or the equivalent to these screws to lock them.

(2) Driver Mounting

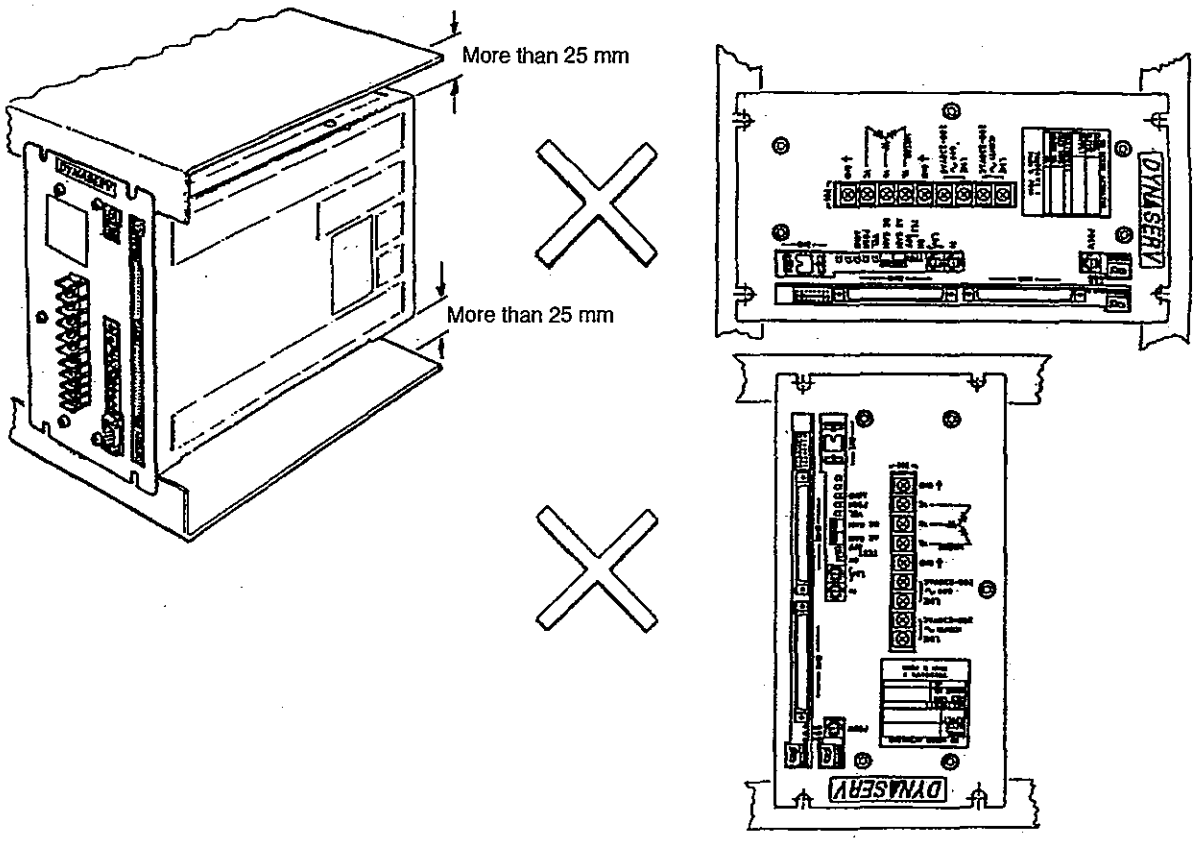
The standard driver is designed for rack mounting.

a) Installation Location

- If there is a heat generating source near the installation location, ensure that temperature does not exceed 50°C in the proximity of the driver by providing an appropriate heat shield or cover, etc.
- If there is a vibration generating source near the driver, then mount the driver on the rack with appropriate vibration insulators.
- Further, installation must be at a location where the humidity is low, and where the surrounding environment is free from high temperatures, dust, metal powders and corrosive gases.

b) Mounting Procedure

- Normally, the driver is rack-mounted (L-shaped angle brackets) on a level plane with its driver panel facing forward. However, it may be mounted with its driver panel facing upward. Always avoid mounting it with the panel turned on its side or upside down. (See the figure below.)
- The driver box adopts a natural air-cooling system. To mount it, make sure there is a clearance of more than 25 mm above and below the box for ventilation.
- Mount the driver using the 4-screw holes at the top and bottom of the driver panel.

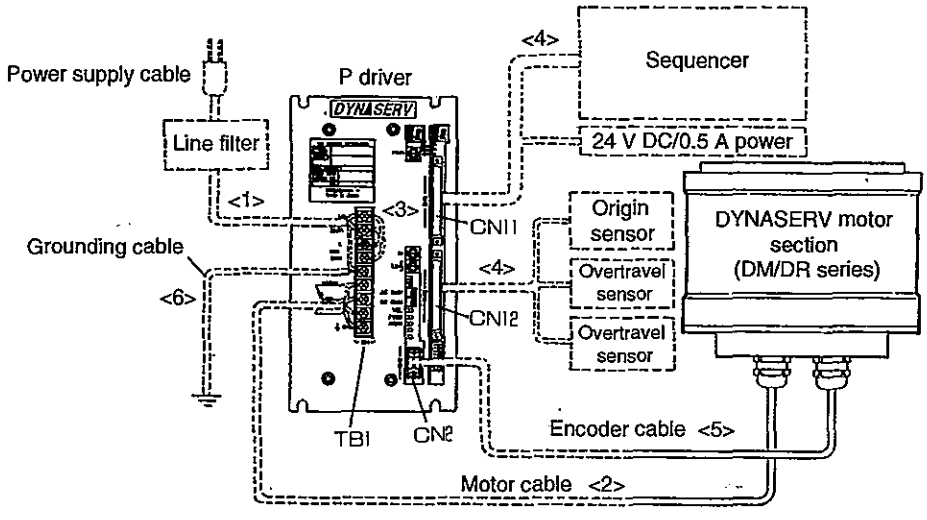


3.6 Wiring Cables

(1) Cable Sizes and Rated Currents

			A/E Series	B Series
Input	<1> AC power supply cable	Current (A)	20	15
		Cable size	HIV: More than 2.0; Length: within 30 m	
	<2> Motor cable	Current (A)	20	15
		Cable size	HIV: More than 2.0; Length: within 30 m	
	<3> Jumper wire	Current (A)	20	15
		Cable size	HIV: More than 2.0	
Output	<4> Interface cable	Current (A)	100 mA DC maximum	
		Cable size	More than 0.2 mm²; Length: Within 5 m	
	<5> Encoder cable	Current (A)	150 mA DC maximum	
		Cable size	*Twisted-pair collectively shielded wire; Length: Within 30 m	
	<6> Grounding	Cable size	HIV: More than 2.0	

Notes: 1. Current values: r.m.s. of rated currents
2. Cable size: cross-sectional area in mm²
3. Cross-sectional area of conductor marked with an *: more than 0.2 mm² of tin-plated twisted wire
4. Outside diameters of the cables used for CN2: less than dia. 9 mm, respectively
5. Cable size is obtained under the condition that the ambient temperature is 40°C and the rated current flows through 3 bundled leadwires.
6. HIV: Heat-resistant polyvinyl chloride insulated wire maintains insulation resistance up to an operation temperature of 75°C



(The items bounded by the dotted lines must be provided by the customer.)

(2) Wiring Cautions

- Use the specified multi-core twisted-pair cables with collective shielding for the interface and the encoder cables. Ensure proper end shield connections.
- Use thick conductors as grounding cables as much as possible. Ground the DYNASERV through a resistance of 100W or less.
- Since high voltage and large current flow through the motor and the AC power cables, ensure proper wiring connections.

3.7 Monitoring Output

(1) Analog Velocity Monitoring Sensitivity

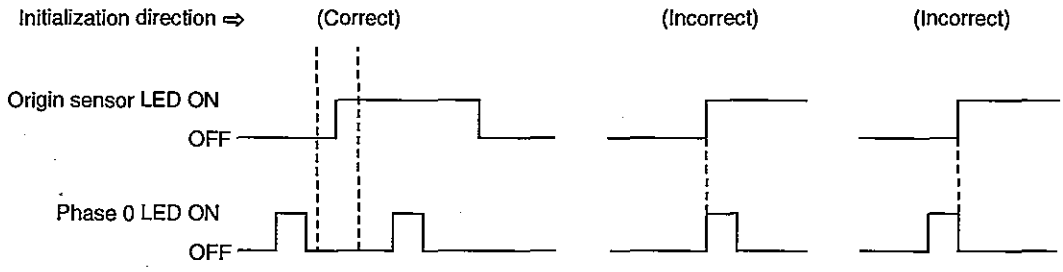
Model		Velocity Detection Sensitivity (V/rps)
DM Series	DM1015B - 1060B	5/2.0
	DM1050A - 1200A	5/1.0
DR Series	DR1008B - 1060B, DR1070E, DR1100E	5/2.0
	DR1050A	5/1.5
	DR1130E - 1250E, DR1100A - 1400A	5/1.0
	DR5030B - 5070B	5/5.0

(2) Torque Monitoring Sensitivity
±8 V DC (maximum torque)

(3) Position Test Monitoring Sensitivity
0 - 5 V DC

3.8 Caution on Mounting Origin Sensor and Overtravel Sensor

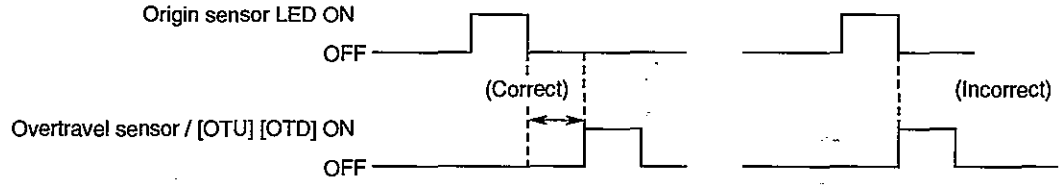
(1) Adjust the origin sensor position so as not to change the statuses of the ORG and ZERO LEDs, when the motor rotates in the initialization direction.



As shown in the incorrect portions of the figure above, if the timing of the LED display overlaps, then shift the sensor position about 1 or 2 mm on the circumference of the motor to shift the timing. The sensor position can be digitally displayed upon initialization. The DYNASERV has the number of zero phases given in the following table in equal circular divisions, depending on the model. Therefore, if the origin-sensor-mounting position is incorrect, then the position is detected with the zero phase shifted to 1, causing the origin position to be inaccurate.

Model		Number of Zero Phases
DM Series	A series	100
	B series	60
DR Series	A series	200
	B series	124
	E series	150
	5000B series	68

(2) When you mount overtravel sensors, make sure that the signal of the sensors does not overlap with that of the origin sensor. Always mount two overtravel sensors (OTU and OTD). If the OTU and OTD signals are entered out of the same sensor, initialization is not correctly made.

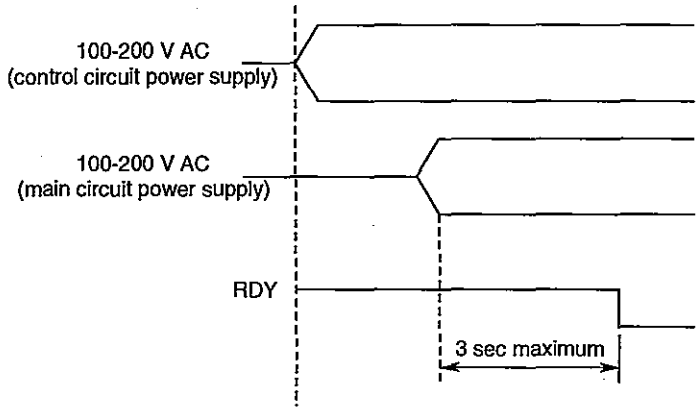


4. CAUTION ON OPERATION

4.1 Power On/off

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

(1) When turning on the main and control circuit power supplies, turn them on simultaneously or turn on the control circuit power first.
(2) When turning them off, turn them off simultaneously (including after an instantaneous power failure), or turn off the main circuit power first.
(3) The inrush current in both the main and control power circuits is about 25 A peak.
(4) The motor is set to the servo status about 200 ms after SERVO is set to L.
(5) When the main power circuit is active, RDY=H indicates a driver problem. However, after the control or main circuit power supply is turned on, the RDY=H condition is maintained up to 3 seconds.



4.2 Restrictions on Cyclic Operating Frequency (DR5000B Series Only)

The maximum operating velocity of the DYNASERV DR5000B Series (DR5030B to DR5070B) is higher than the other DR Series motors. Owing to the special characteristics of this series, certain limiting restrictions apply as to the cyclic stop-start frequency of the move profile. Hence, when desirous of using this motor/driver is such a manner, exercise sufficient caution.

(1) Restrictions on Motor Operation

Motor-operating conditions are set assuming that the motor is operated at an ambient temperature of 45°C with the motor mounted on a metal base. If the motor load conditions and operating intervals are set as shown in Figure 4.7, then under the cyclic motor operations of acceleration, constant velocity, deceleration, and stopping the following equations must be fulfilled. Also, if either the average motor velocity (number of revolutions) or the current duty is known, it is possible to obtain the other in a simplified manner from the graph shown in Figure 4.8. For current I_1, I_2, and I_3, as shown in Figure 4.9, the respective voltage is measured on the monitor terminals (V_{TR}) of the driver's front panel and then is multiplied by 1.875, thereby obtaining the respective current [A].

$$\eta_B = \frac{N_R}{2}(t_1 + 2t_2 + t_3) \times \frac{1}{5t_{CY}} \times 100 \quad \text{Eq. (1)}$$

$$\eta_C = (t_1 I_1^2 + t_2 I_2^2 + t_3 I_3^2) \times \frac{1}{15^2 t_{CY}} \times 100 \quad \text{Eq. (2)}$$

$$\eta_B = +2.6 \cdot \eta_C < 103 \quad \text{Eq. (3)}$$

η_B = velocity
η_B = current duty
I_1, I_2, I_3 = current (A)
N_R = number of revolutions (rps)
t_{CY} = cyclic time (msec)
t_1, t_2, t_3 = time (msec)

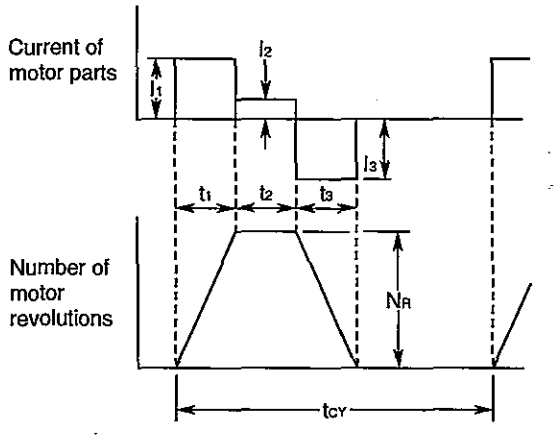


Figure 4.7

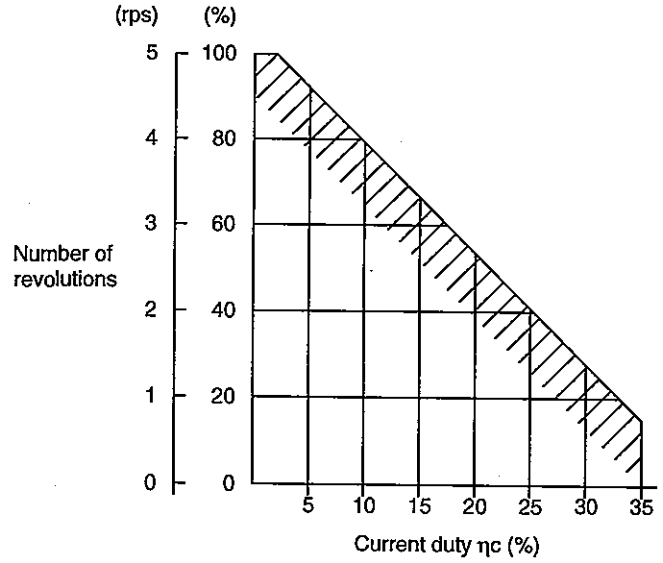


Figure 4.8 Average Velocity/Current Duty Graph

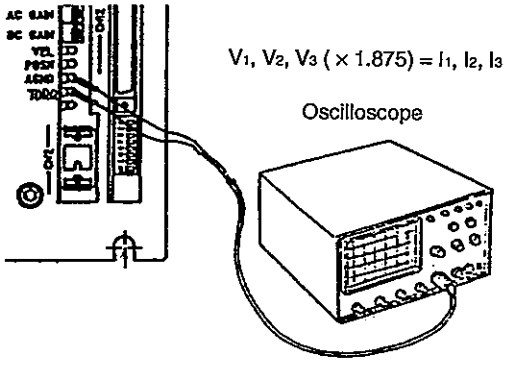


Figure 4.9

<Example>

$N_R = 4(\text{rps})$
$I_1 = I_3 = 9(\text{A})$
$I_2 = 3(\text{A})$
$t_1 = t_2 = t_3 = 1/4\ t_{CY}$

From the above, h_B and h_C are obtained.

$$\eta_B = \frac{4}{2}\left(\frac{1}{4}t_{CY} + \frac{2}{4}t_{CY} + \frac{1}{4}t_{CY}\right) \times \frac{1}{5t_{CY}} \times 100$$

$$= \frac{2}{5} \times 100 = 40$$

$$\eta_C = \left(\frac{81}{4}t_{CY} + \frac{9}{4}t_{CY} + \frac{81}{4}t_{CY}\right) \times \frac{1}{225t_{CY}} \times 100$$

$$= \frac{17100}{900} = 19$$

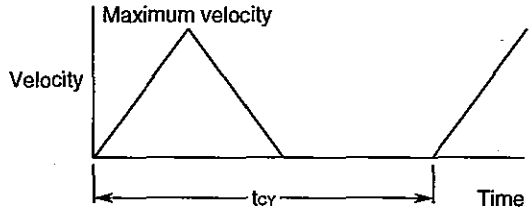
For equation (3),

$40 + 2.6 \times 19 = 98 < 103$

Thus, it is found that the conditions fulfill equation (3), resulting in confirmation of the correct settings.

(2) Restrictions on Driver Operation

The DYNASERV cyclic operating frequency is also restricted to the maximum value of energy generated from the regenerative resistor built in the driver. This means that if the DYNASERV is operated in a repetitive pattern shown in Figure 4.10, the cyclic operating frequency, as shown in Figure 4.11, is restricted by the load inertia with the number of revolutions set as a parameter. If the load inertia exceeds 1 kg•m^2 or if the DYNASERV must be used beyond the rated load inertia, consult Yokogawa Precision Corporation or its authorized agency.



Cyclic operating frequency = $\frac{60}{t_{CY}}$ (times/minute)

Figure 4.10

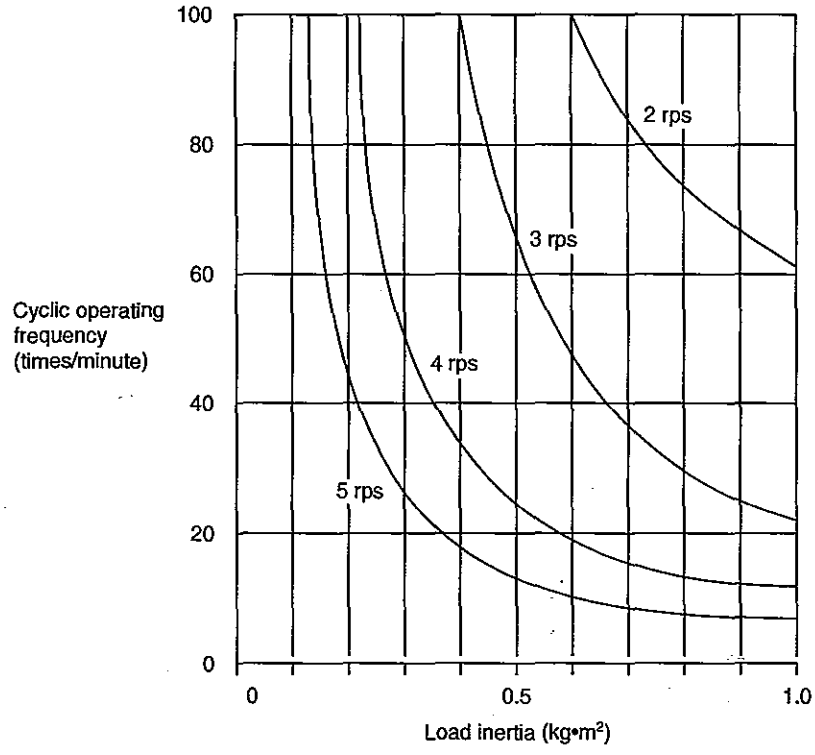


Figure 4.11

5. OPERATION

5.1 Overview

Three operation modes are provided for this driver and they can be selected with the I/F setting switch on the front panel.

(1) Positioning Mode

There are three functions for the positioning modes.

1) Initialization
This function selects the origin signal of the encoder housed in the motor by the external origin sensor activated by an ORG signal to execute initialization.

2) PTP (point to point) positioning
This function executes PTP positioning by the start signal according to the position, speed and acceleration time set using a sequencer or a switch.

3) JOG operation
This function drives the motor in a fine angle by turning the JOG switch on or off, It is used to decide an electrical origin (user-defined origin).

(2) Tuning Mode

The two functions described below are used to set the control parameters for position control.

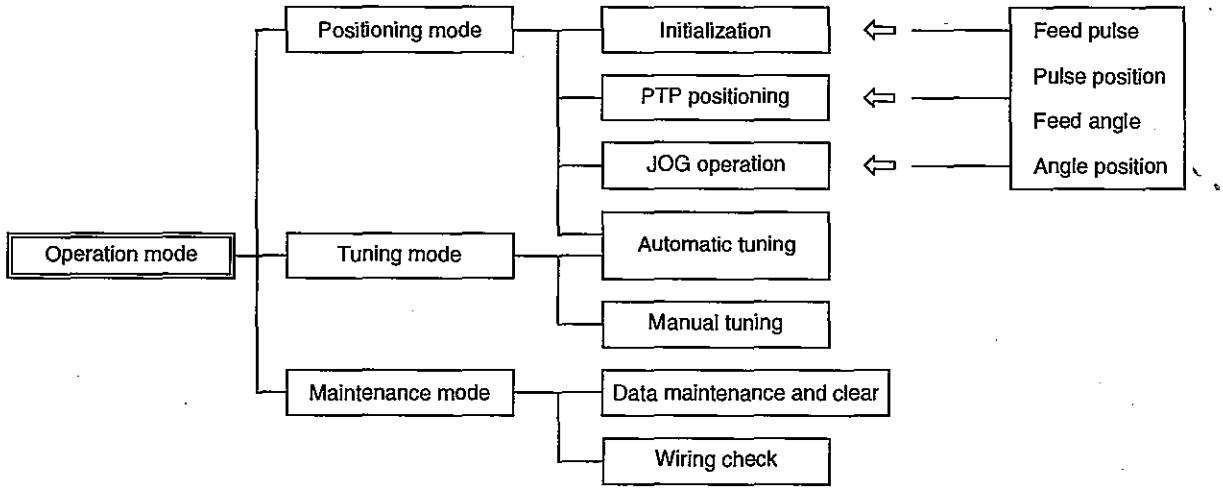
1) Automatic tuning
This function automatically determines the control parameters and saves them in the driver. (A part of this function can also be used in the positioning mode.)

2) Manual tuning
Users adjust fc, I-LIM and DC gain, etc. according to the guideline of the adjustment.

(3) Maintenance Mode

This mode maintains the data saved in the driver and checks the wiring.

The above description is summarized as follows.



5.2 Procedure for Positioning Mode

This section describes signal operations in the positioning mode.

(1) Initialization and Setting of an Electrical Origin

1) Initialization starts when setting the rotational direction by a SIGN signal and changing the ORG signal from H to L.

2) When initialization starts, a BUSY signal transfers to L and remains L until the completion of initialization.

3) After confirming the BUSY signal is set to L, return the ORG signal to H. Otherwise, the BUSY signal holds at L even if initialization has been completed.

4) The electrical origin is in the same place as the mechanical origin at factory shipment. For an electrical fine adjustment of the initialization position, use the No. 4 I/F setting sub-switch.

5) Move the motor to an appropriate position as an electrical origin immediately after initialization, and change the No. 4 I/F sub-switch from off to on. That place is then saved as the electrical origin. At that time, the 7-segment LEDs on the front panel display 02.

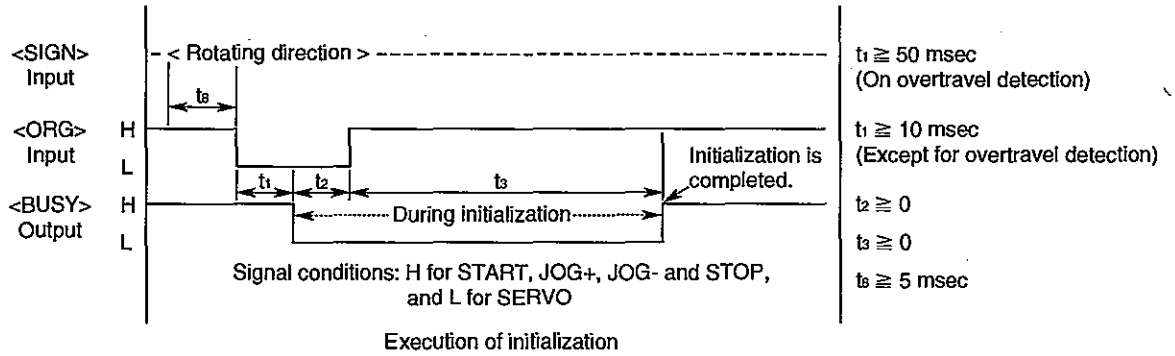
   To move the motor to an appropriate position for setting, either of the two ways below should be used.
   - ♦ To move the motor in JOG mode with the servo-on status
   - ♦ To move the motor manually with the servo-off status

6) The electrical origin can be set within the range of only one revolution of the servo motor. The setting of the electrical origin beyond that range is impossible. Also note that setting is impossible in the following cases:
   1. Before initialization
   2. When initialization is stopped midway
   3. After the automatic tuning function is executed

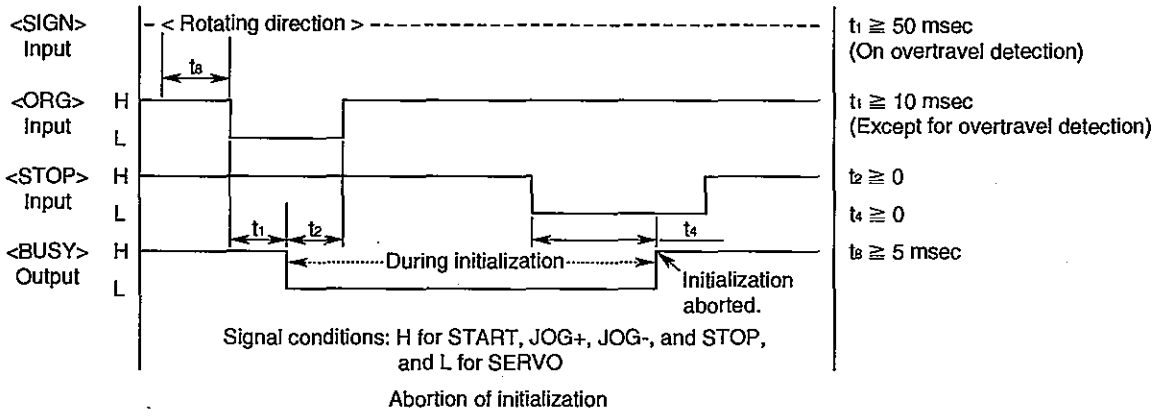
7) If automatic tuning is executed, execute initialization and set the electrical origin again.

8) After checking the LED's for the setting of the electrical origin, turn off the I/F setting switch. Otherwise, operation cannot be carried out in the positioning and JOG modes.

9) After setting is completed, be sure to check that the servo motor rotates in the same direction to the origin as they are set. The direction of initialization must be set to the same rotating direction. If it is different, the position of the origin may deviate.

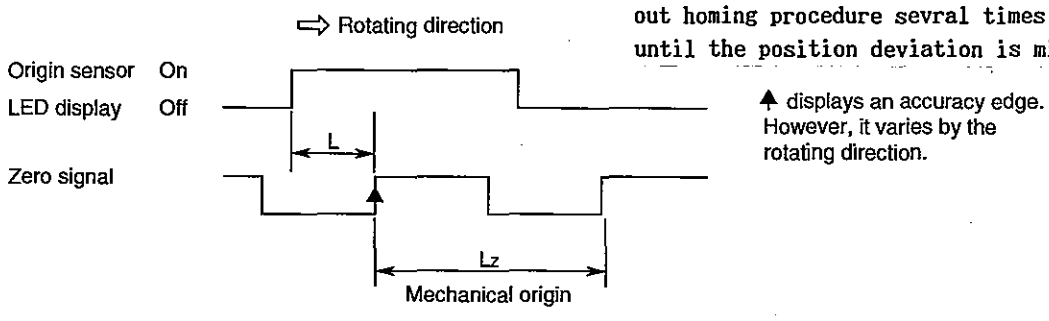


Execution of initialization

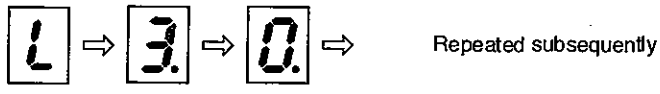


(2) Special Display If the ORG Signal Continuously Holds at L

If the ORG signal continuously holds at L, the distance between the origin sensor signal and "zero" signal accuracy edge can be displayed on the LED after initialization has been completed. The right-side LED of the two 7-segment LEDs in the upper right corner of the front panel displays (L/Lzx100) in a percentage (0 to 99). Have ever when using the <DYNASERV> DR series motor ensure that the origin senser settings are in the range of <10 to 40> in order to reduce noise levels and vibration. After preliminaly adjustment carry out homing procedure sevral times until the position deviation is minimized.



In the case of 30% , the display of the LED is as follows.



NOTE

If initialization has not been completed after a definite time, the following causes are assumed.

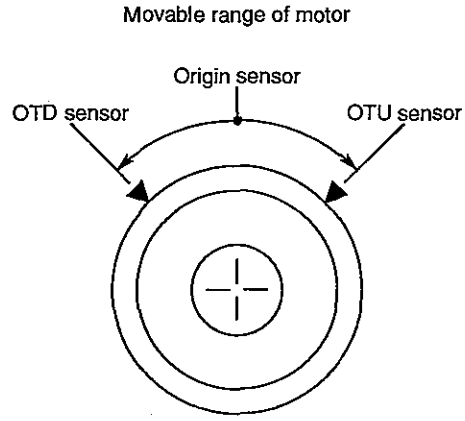
- Gain tuning is not performed. (Perform tuning.)
- The positioning completion width is too small.
  (Re-set the POSW switch on the front panel. If the motor resonates, it cannot be settled unless the switch is set to a large value.)
- Wiring of the origin sensor is disconnected. (Check that the ORG LED on the front panel is on. If not, disconnection is a probable cause.)

(3) Initialization If the Overtravel Detection Function Is Set

When the overtravel detection function is effective with the No. 7 I/F setting sub-switch turned on, the motor rotates in the opposite direction set by the SIGN signal and stops instantly when an OUT or OTD signal is detected. Then, the motor rotates in the direction set by the SIGN signal to execute initialization.

If the ORG origin signal is detected before an OTU or OTD signal, the motor stops after traveling once beyond the ORG origin signal and reverses the direction at low speed for initialization.

Therefore, the initialization position is always the same in either occasion.



Position of origin of the motor, and OUT and OTD sensors shown from the load mounting surface.

(4) PTP Positioning Data Setting

The positioning data described in this section is the generic name of the data for position, direction of rotation, curves for cam, speed, etc.

- The setting range of the positioning data is as follows.
- The maximum speed command value varies with each model of DYNASERV.
- The maximum command time for one movement is 30 seconds.
- The position data item is initialized to 0 when the power is turned on or when the driver is reset.
- The speed or acceleration time takes the set values in maintenance mode.

1) Positioning data setting range

Data		Setting Range	Unit
Incremental command	Feed pulse input	1 to (encoder resolution)	Number of pulses
	Feed angle input	1 to 360000	0.001 degree
Absolute command	Pulse position input	0 to 9999999	Number of pulses
	Angle position input	0 to 9999999	0.001 degree
Speed		1 to the maximum speed command value	0.001 rps
Acceleration time		1 to 99	10 msec

2) Maximum speed command value for each DYNASERV model

Model	Maximum speed command value (rps)
DR/B series	2.4
DR1070E to 1100E	2.4
DR1130E to 1250E	1.2
DR1050A	1.8
DR1100A to 1400A	1.2
DR 5000B series	5.0
DM/B series	2.4
DM/A series	1.2

3) The contents of the SIGN signal varies with the command inputs.

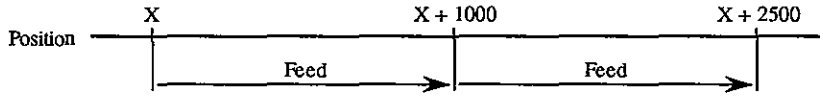
Command input		Contents
Incremental command	Feed pulse input	Rotating direction: CW for L, CCW for H
	Feed angle input	
Absolute command	Pulse position input	Position data codes: + for L, and - for L
	Angle position input	+ for the CW side of 0 (electrical origin), and - for the CCW side of 0

4) Positioning mode and command input

<1> Feed input mode (incremental command)

Feed pulse input	Commands movement on an encoder pulse basis. One command must be within the encoder resolution (one rotation).
Feed angle input	Specifies movement in steps of 0.001 degree. One command is within 360.000 degrees.

Example

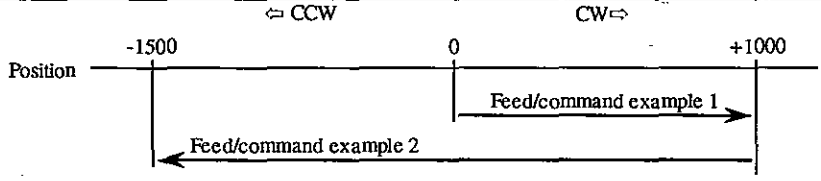


Command example	1000	1500
Feed pulse input	1000 pulses	1500 pulses
Feed angle input	1.000 degree	1.500 degrees

<2> Position input mode (Absolute command)

Pulse position input	Commands movement on the encoder pulse basis. One command is within the encoder resolution (one rotation). The command range is 9999999 to -9999999.
Angle position input	Specifies movement in steps of 0.001 degree. One command is within 360.000 degrees. The command range is 9999.999 to -9999.999 degrees.

Example



SIGN signal	H(CCW)	L(CW)
Command example	1500	1000
Feed position input	-1500 pulses	+1000 pulses
Angle position input	-1.500 degrees	+1.000 degree

NOTE

If the Servo motor is turned off in feed angle-, pulse position- or angle position-input, re-start from the initialization operation.

(5) Startup Procedure of PTP Positioning Mode

1) Wait until the BUSY signal holds at H.

2)
- ♦ Cam curve/CAMSL signal
- ♦ Speed/DI 0 to 7 and STBV 0 to 1 signal
- ♦ Acceleration time/DI 0 to 7 and STA signal
- ♦ Rotating direction/SIGN signal
- ♦ Position data/DI 0 to 7 and STP 0 to 3 signal

Set the above data in any order. As the set values for speed-, acceleration time, and position data are saved, there is no need for repetitive setting of the same set values.

3) Set the START signal from H to L. When the driver detects this signal, the BUSY signal set in item 2) holds at L. However, if any error is found in the setting, the ERROR signal holds at L. At that point, return the START signal to H.

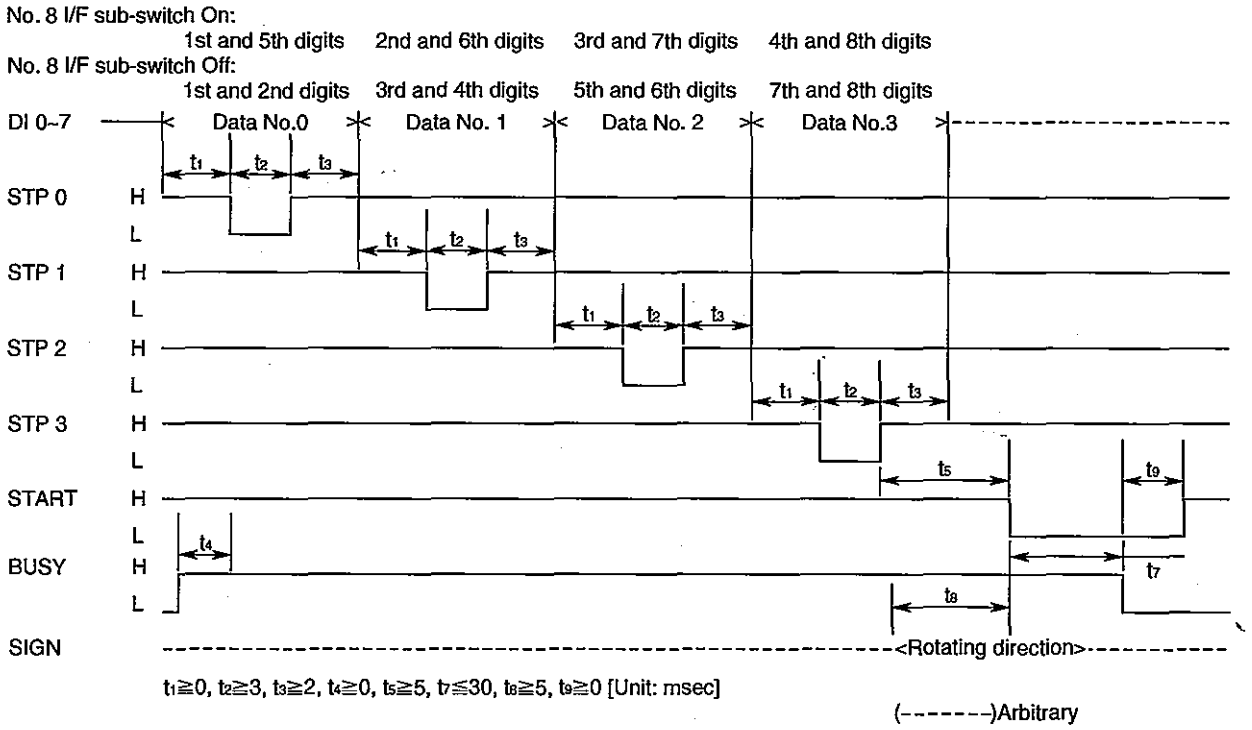
4) Set the START signal from L to H after the BUSY signal has changed to L. The motor is then activated.

(Note)

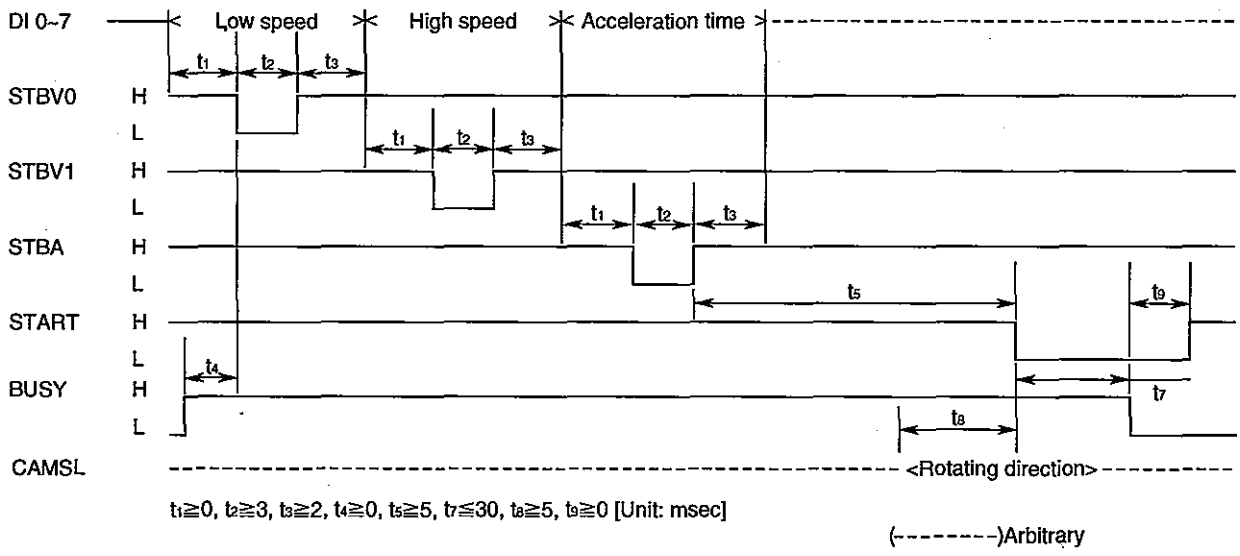
<1> If an error is found in the data setting, the 7-segment LEDs on the front panel display 11.

<2> If the DI data cannot be displayed in BCD code, the LEDs display 13.

<3> Besides the above causes, a mismatch in the signal logic of the sequencer and driver, and mistiming or wrong wiring can also be the causes.



(When setting position data and rotating direction only)



(When setting cam curve, speed and acceleration time only)

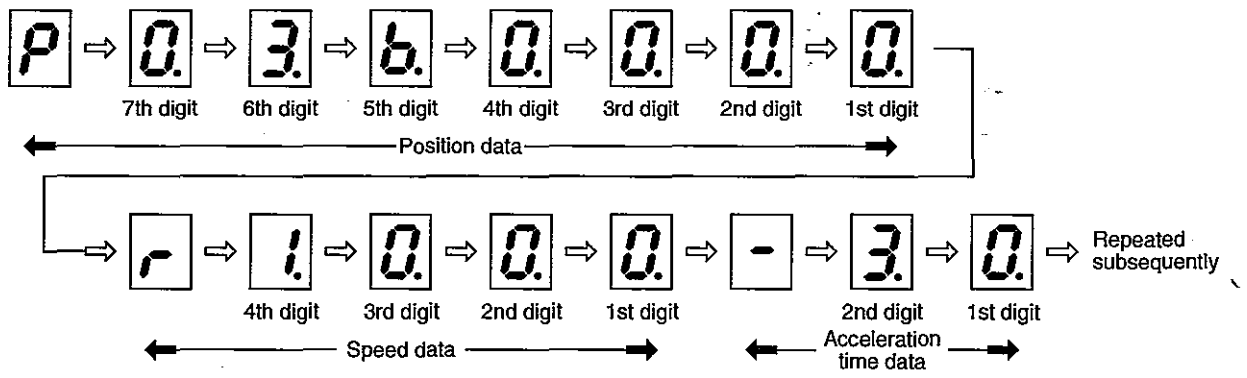
(6) Special Display When the START Signal Holds at L

In the positioning mode, if the START signal continues to hold at L, the 7-segment LEDs on the front panel display the positioning data received by the driver. This function operates also in abnormal data setting, or when displaying in BCD code is impossible as well as in normal data setting. Even if ERROR signal does not hold at L, if any fault is found in the motor operation, check data by this function. Data are displayed sequentially and repeatedly on the right LED as follows: It is preferable to take a note for collation. Also, if 1 is displayed on the left LED, it indicates an alarm status.

Display example

Position data item: 360.000 degrees
Speed data item: 1.000 rps
Acceleration time data item: 30 msec

When the above data are set, the display is as follows:



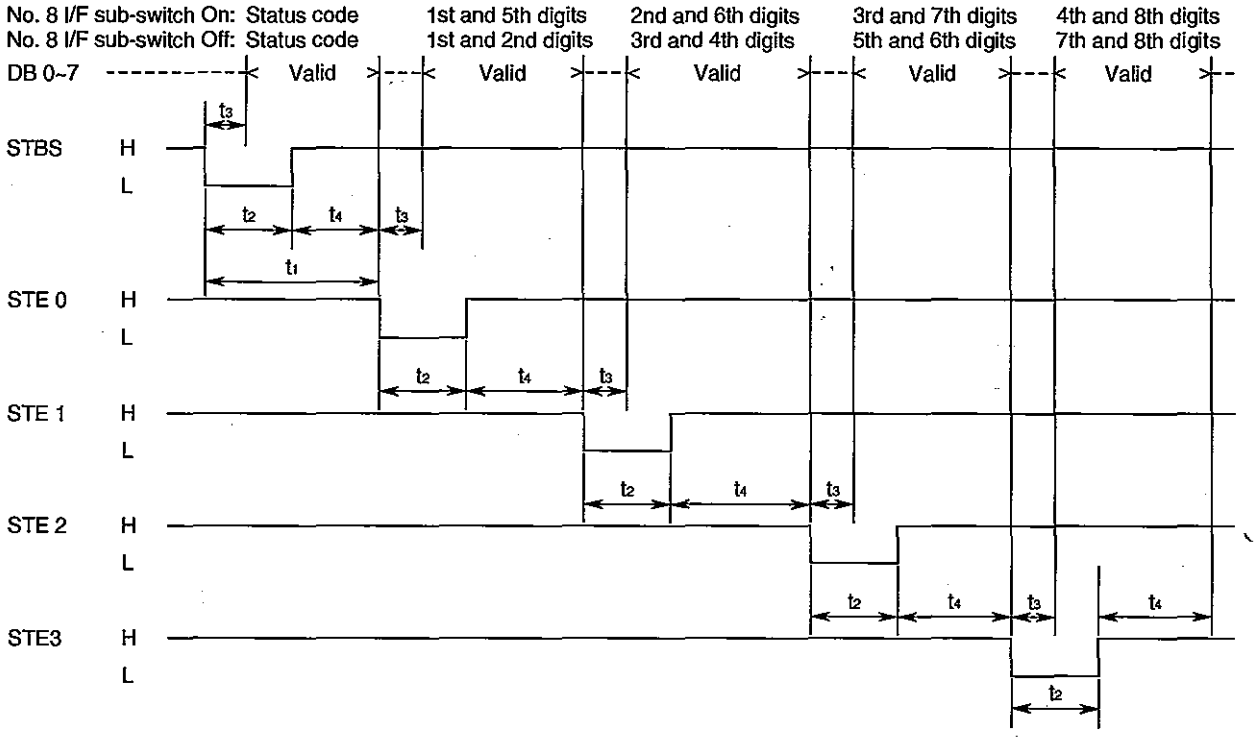
(7) Reading of the Encoder Data

Data of the encoder housed in the motor become effective after initialization. Correct value cannot be read before initialization. Data latching is performed first to read out the encoder data. Actually, set the STBS signal in the order of H, L, H. This allows the encoder counter inside the driver to be latched for conversion to the BCD code. Then set STE 1 to 3 signals in the order of H, L, H, and the corresponding 2-digit data are output for DB 0 to 7. The order of STE 1 to 3 signals is unspecified. Only necessary digits may also be read out. The range of the encoder data varies with the setting of the command input. If the value is negative, the most significant bit in the 8th digit (DB 7 signal) holds at L.

Encoder data		Range	Unit
Incremental command	Feed pulse input	0 to (encoder resolution - 1)	Pulse
	Feed angle input	0 to 359999	0.001 degree
Absolute command	Pulse position input	-9999999 to 9999999	Pulse
	Angle position input	-9999999 to 9999999	0.001 degree

(8) Correspondence Between DI 0 to 7 and DI 0 to 7 Signals and BCD Codes

DB 0 to 7 and DI 0 to 7								BCD code
7	6	5	4	3	2	1	0	
H	H	H	H	H	H	H	H	0
H	H	H	H	H	H	H	L	1
H	H	H	H	H	H	L	H	2
H	H	H	H	H	H	L	L	3
•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•
L	H	H	L	H	L	L	L	97
L	H	H	L	L	H	H	H	98
L	H	H	L	L	H	H	L	99



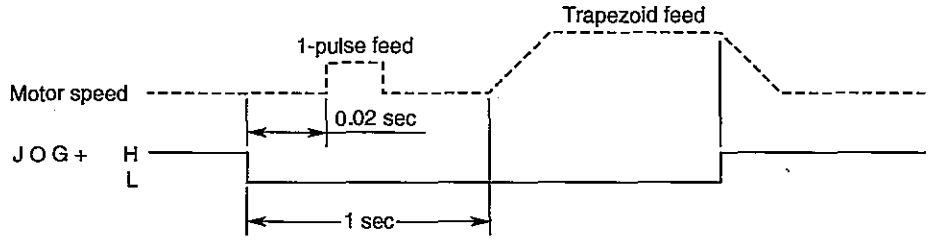
If the START or BUSY signal holds at L, $t_1 \geqq 50$ Except for the above condition, $t_1 \geqq 15$, $t_2 \geqq 5$, $t_3 \leqq 8$, $t_4 \geqq 2$ [Unit: msec]
(--------)Arbitrary

Example of encoder data read out

(9) JOG Mode Operation

The JOG mode is used when setting an electrical origin and when the motor is stopped by an error due to overtravel detection, etc.

Operation is carried out when the BUSY signal is set to H, and the motor rotates in a clockwise direction with the JOG+ signal set to L and in a counterclockwise direction with the JOG- signal set to L. This mode is the combination of the 1-pulse feed function and trapezoid feed function. If the JOG command holds at L for 0.02 seconds or more, the 1-pulse feed function is executed. If the JOG command holds for 1 second or more, the trapezoid feed function is executed.



Example of JOG+ operation

(Note)

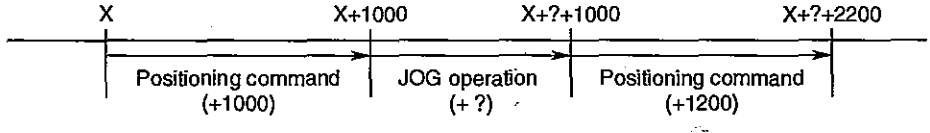
<1> When JOG+ and JOG- signals are simultaneously commanded, JOG+ has a priority.

<2> The trapezoid feed speed can be set.(For details, see "Modification of maintenance data.")

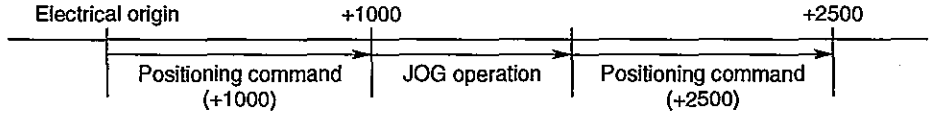
<3> Related to the positioning mode and JOG mode, if operation is carried out in the JOG mode when inputting a feed pulse or feed angle, the next positioning data item is the command value in the position where the motor stopped after operation in the JOG mode.

<4> If operation is carried out in the JOG mode when inputting the pulse position or angle position, the next positioning data item is the position value from the electrical origin.

(Feed pulse or feed angle input)



(Pulse or angle position input)



(10) JOG Operation and Overtravel Detection Function

When turning the No.7 I/F sub-switch on in the positioning mode, the OTU and OTD signals for the origin switch connectors become valid. If the OTU and OTD signals hold at H while the motor is operated in the positioning mode, the motor stops in an emergency. At that point, return the motor to the JOG mode or manually operate it with the servo off status.

If overtravel is detected, the ERROR signal holds at L and the status code changes. Even if the motor travels through the overtravel area, the situation is held. Also, even if the motor moved from the OTU to the OTD area or in the reverse direction, the situation is held. When the motor is operated in the JOG mode or initialization is started, this situation is canceled. Note that cancellation will not be carried out in the servo-off status.

When returning the motor to the JOG mode, if it enters the OTD or OTU area, the ERROR signal is held to L again and the status code is changed. If the motor passes beyond the area, the ERROR signal is canceled. This can be confirmed visually by the display on the 7-segment LEDs. Although initialization is carried out even if the overtravel alarm is on, return the motor to the area between the OTD and OTU sensors before carrying out initialization. Initialization is normally carry out within the area of the ORG sensor. When the motor is stopped by the STOP signal during initialization, an overtravel alarm may occur again. However, it will be canceled if initialization starts.

NOTE

The No. 7 I/F setting sub-switch must not be changed over during initialization or operation of the motor. Change this switch when the BUSY signal holds at H. This switch can also be changed even when an overtravel alarm occurs.

5.3 Tuning Mode

(1) Control Mode Setting

Control modes in DYNASERV are as follows.

Position control modes
- I-PD position control
- P-P position control
- P-I position control

The following table describes the validity or invalidity of the switches and variable registers related to the control modes and jumper pin setting for each control mode.

Relationship Between Control Modes and the Jumper Pin or Switch Settings

Position	Jumper name or Switch name	Position control		
		I-PD mode	P-P mode	P-I mode
JP1	MODE	Short	Short	Short
	CALIB	Open	Open	Open
	RATE #1	Short	Short	Short
	RATE #2	Short	Short	Short
	UD/AB	Short	Short	Short
	VFFH	○	○	○
	VFFM	○	○	○
	VFFL	○	○	○
	GAIN H	○	○	○
JP2	I	Open	Open	Short
	P	Short	Short	Open
	100	○	○	○
	200	○	○	○
	PV	Short	Short	Short
	VEL	Open	Open	Open
	TORQ	Open	Open	Open
V1	DC GAIN	○	○	○
	AC GAIN	×	×	○
S1	POSW	○	○	○
S	fc	○	○	○
	I-LIM	○	×	×

(Note) ○ : Valid-when the set value affects motor operation
× : Invalid-when the set value does not affect motor operation

If the IACT/PACT signal of the CN12 connector holds at H, the I-PD control system is selected while if that signal holds at L, the P control system is selected. Generally, the I-PD control system is selected for the positioning operation.

(2) I-PD Position Control

This method uses the integral feedback of the position suitable for highly accurate positioning. Also, stable control characteristics can be obtained against a load fluctuation. In this mode, the three elements fc switch, I-LIM switch and DC gain adjustable control must be adjusted.

a) fc switch

Each scale division 0 to F corresponds to 1 to 16 Hz of the position control band.

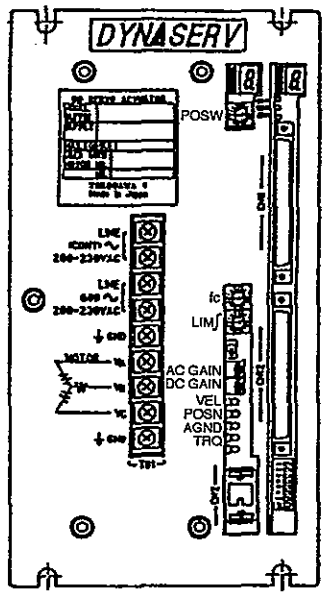
b) I-LIM switch

A limiter is provided to the output from the digital integrator under a software servo calculation to avoid wind-up phenomena. The larger the switch number, the larger the limiter value becomes.

As the smaller limiter value is set, the wind-up phenomena become smaller and the settling time will be shortened. However, if the limiter value is too small, the motor output torque is restricted. Therefore, providing a larger switch number to the extent that the wind-up phenomena are not found is preferable. The final adjustment should be carried out during the adjustable-speed operation.

c) DC gain adjustable control

DC gain can be adjusted in the range of 6 to 72 times upon factory shipment. When the jumper "JP 2 GAIN" is open, the range changes 0.5 to 6 times. It is desirable to increase the DC gain as much as possible with the gain to be optimum at the maximum load if the inertia changes.



(3) P Position Control

As proportional control is utilized for position feedback, positioning accuracy is not so high. For the simultaneously selectable velocity control, P or I can be set by jumper connection. In P velocity control (P-P), as the torque output is proportional to the positional deviation, compliance control is possible. Only the fc switch and DC gain adjustment control are adjusted in this control mode. In I velocity control (P-I), highly precise positioning is possible. In this control mode, the fc switch, DC gain adjustment control, AC gain adjustment control and velocity feed-forward amount are adjusted by jumper connection.

(4) Tuning Mode

The tuning mode is started by setting the I/F setting sub-switches as follows.

	1	2	3	4	5	6	7	8
ON		●				Arbi-trary		Arbi-trary
OFF	●		●	●	●		●	

In this mode, the positioning operation or initialization by the START signal cannot be carried out, but operation in the JOG mode is possible. Also, as the overtravel detection function does not work, operation must be carried out in the area without any obstacle. Use the STOP signal for an emergency stop. Turn off the motor startup signal JOG signal or Nos. 5 and 7 I/F setting sub-switches before cancellation of the STOP signal. Two tuning methods, manual and automatic, are provided, but automatic tuning cannot be used on the following occasions.

1) When a mechanical resonance filter is installed (In a DM1075B this is always incorporated.)
2) When the load or rigidity of the equipment is low
3) When a strong external force is applied to the driving direction of the motor
4) When the load inertia is too large
5) When using automatic tuning in modes except standard control mode

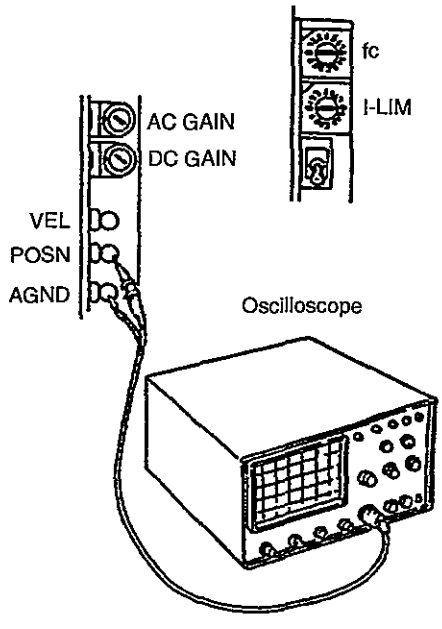
Manual tuning is valid on any occasion and best tuning can be obtained. However, measuring equipment such as an oscilloscope is required. In automatic tuning, it is possible to adjust to the almost satisfactory range, although not to the optimum value.

(5) Adjustment Procedure for Manual Tuning of Position Control System

The procedure is as follows.

Turn off the No. 6 I/F setting sub-switch first and set the SERVO signal from H to L. Next, turning on the No. 7 I/F setting sub-switch allows the position command signal in square a waveform of 2.5 Hz to be generated inside the driver, and the motor position is output to the POSN signal terminal. Note that the motor reciprocates in a fine rotational angle at this time.

<1> The adjustment procedure for I-PD type position control in the test run mode is as follows.



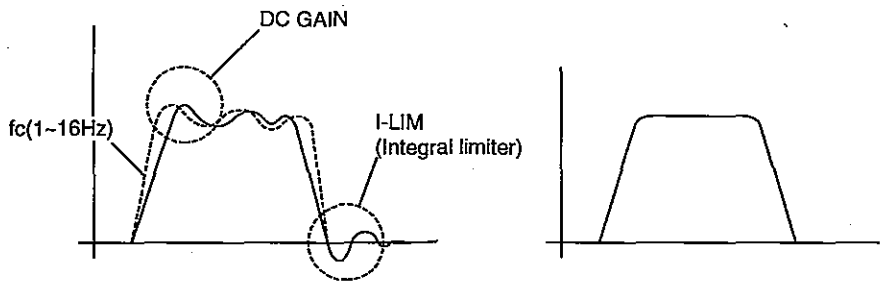
Step 1: Connect an oscilloscope to the POSN signal terminals.

Step 2: Set the CN12 connector SERVO signal to L.
At this time, turn off the No. 7 I/F setting sub-switch.

Step 3: Turn on the No. 7 I/F setting sub-switch.

Step 4: Adjust the fc switch. Its variable range is from 1 to 16 Hz and it should be set to about 10 Hz (scale division: 9) in the normal load condition.
Set the I-LIM switch to a large value within the range where there is no hunting.
Select the GAIN H or L signal whichever matches the load condition. A fine adjustment is done through DC gain adjustment control. Perform the above adjustment so that the POSN signal becomes a square wave.

Step 5: Turn off the No. 7 I/F setting sub-switch.



Waveform before adjustment　　Optimum waveform

<2> The adjustment procedure for P-I position control in the test run mode.

Step 1: Connect an oscilloscope to the POSN signal terminals.

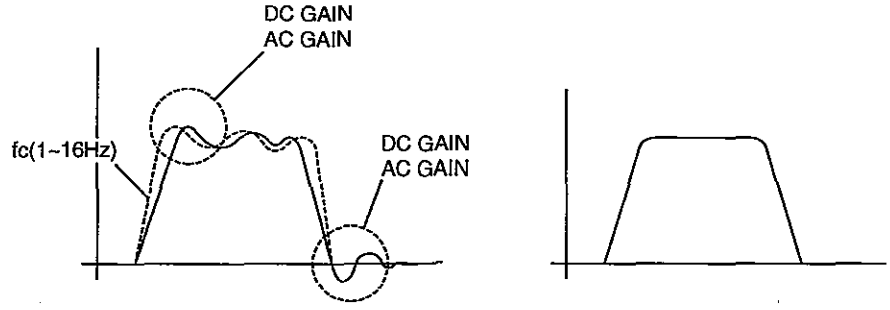
Step 2: Set the CN12 connector SERVO signal to L.
At this time, turn off the No. 7 I/F setting sub-switch.

Step 3: Turn on the No. 7 I/F setting sub-switch.

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

Step 5: Turn off the No. I/F setting sub-switch.

Step 6: Set the CN12 connector SERVO signal to H.



Waveform before adjustment　　Optimum waveform

(6) Procedure for Tuning (Adjustment) without Measuring Instruments

The preceding section describes the procedure for making adjustments while monitoring the waveform. This section describes an adjustment procedure that uses no measuring instruments. This adjustment method is valid only in the case of the position control mode (I-PD type, the setting upon shipping).

1) Calculate or otherwise verify the load inertia. To use this adjustment method, the load inertia must be known accurately. In doing this, calculate the load multiplication (K) by dividing the load inertia (JL in kg•m^2) by the motor (DYNASERV) rotor inertia (JM).

2) Refer to the calculated load multiplication table "setting of the DYNASERV controls" on the next page. For example, suppose K for DM1200A is 15, and it corresponds to the range 5 in this case.
We can obtain the set values of the same row in the table.

3) First, read the value in the DC gain of the same row. Because the value is 25, turn the DC gain control to 25.

4) Also, select the value for fc, LIM $\int$ of the same row respectively, and set the value to each control.

5) Turn on the No. 7 I/F setting sub-switch.

6) When the above setting is completed, turn off this sub-switch. This completes the adjustment.

Remote setting of DC gain

If the installation load inertia is too heavy, or if inertia varies greatly, a sufficient adjustment may not be obtained by adjusting the DC gain control on the front panel only. In this case, the sequencer can set the gain and switch the range. Basically, if the inertia is doubled, the DC gain also is doubled and if the inertia is halved, the DC gain is also halved. When DC gain is set in proportion to the load inertia, other gains are not so much affected by the degree of the load. The table below shows the relationship between the DC gain and settings and if other codes except this are set, the gain is indefinite. The DC gain is set for 13 times (jumper/short) upon shipment and the DC gain adjustment control can change the ranges from 0.5 to 5.5 times.

Therefore, remote setting is generally not necessary, and tuning is possible by adjusting the control only.

No. 6 I/F setting sub-switch	Setting by sequencer	GAIN H jumper	DC gain multiplication factor
Off	0	Short	×13
		Open	×1
	1	None	×1
	2		×4
	3		×7
	4		×10
	5		×13
	6		×16
	7		×19
	8		×22
	9	None	×0
On	9	None	×0
	Except 9	None	Automatic selection

<1> Setting of the DYNASERV Controls (For SD/A series)

Range	Load multiplication factor: K			Set value		
	SD1200A02	SD1150A02	SD1100A02	DC GAIN	fc	LIM ∫
1	~1.1	~0.9	~0.5	3	E	6
2	1.1~2.2	0.9~1.8	0.5~1.2	4	D	6
3	2.2~5.4	1.8~4.6	1.2~3.5	8	C	4
4	5.4~11	4.6~9.3	3.5~7.2	13	B	3
5	11~21	9.3~19	7.2~15	25	A	3
6	21~53	19~47	15~37	50	9	1
7	53~75	47~66	37~52	65	8	2
8	75~107	66~94	52~75	80	7	1
9	107~160	94~141	75~112	100	5	2
10	160~320	141~282	112~224	110	2	4

Load multiplication factor: K	Set value		
SD1050A02	DC GAIN	fc	LIM ∫
No load	3	E	6
~0.4	4	D	6
0.4~1.8	8	C	4
1.8~4.1	13	B	3
4.1~8.7	25	A	3
8.7~23	50	9	1
23~32	65	8	2
32~46	80	7	1
46~69	100	5	2
69~138	110	2	4

<2> Setting of the DYNASERV Controls (SD/B series)

Range	Load multiplication factor: K				Set value		
	SD1060B02	SD1045B02	SD1030B02	SD1015B02	DC GAIN	fc	LIM ∫
1	~1.9	~1.6	~1.2	~0.4	3	E	6
2	1.9~3.4	1.6~3.0	1.2~2.4	0.4~1.1	4	D	6
3	3.4~7.7	3.0~6.9	2.4~5.7	1.1~3.2	8	C	4
4	7.7~15	6.9~14	5.7~11	3.2~6.7	13	B	3
5	15~30	14~27	11~22	6.7~14	25	A	3
6	30~73	27~67	22~56	14~35	50	9	1
7	73~103	67~93	56~78	35~49	65	8	2
8	103~146	93~133	78~112	49~70	80	7	1
9	146~219	133~199	112~168	70~105	100	5	2
10	219~438	199~398	168~336	105~209	110	2	4

<3> Setting of the DYNASERV Controls (SR/A series)

Range	Load multiplication factor: K					Set value		
	SR1400A	SR1300A	SR1200A	SR1150A	SR1100A	DC GAIN	fc	LIM ∫
1	~1.2	~0.9	~0.5	~0.4	~0.1	3	E	5
2	1.2~2.3	0.9~1.9	0.5~1.3	0.4~1.2	0.1~0.6	4	D	3
3	2.3~5.6	1.9~4.8	1.3~3.6	1.2~3.3	0.6~2.3	8	C	2
4	5.6~11	4.8~9.7	3.6~7.5	3.3~6.9	2.3~5.1	13	B	2
5	11~22	9.7~19	7.5~15	6.9~14	5.1~11	25	A	2
6	25~55	19~49	15~38	14~36	11~27	50	9	2
7	55~77	49~68	38~54	36~50	27~38	65	8	2
8	77~110	68~97	54~77	50~72	38~55	80	7	2
9	110~166	97~146	77~116	72~108	55~82	100	5	3
10	166~331	146~292	116~232	108~215	82~165	110	2	6

Load multiplication factor: K	Set value		
SR1050A	DC GAIN	fc	LIM ∫
—			
—			
~0.2	3	C	3
0.2~1.2	13	B	3
1.2~3.3	25	A	3
3.3~9.4	50	9	2
9.4~13	65	8	2
13~20	80	7	2
20~30	100	5	3
30~60	110	2	5

<4> Setting of the DYNASERV Controls (SR/B series)

Range	Load multiplication factor: K					Set value		
	DR1060B	DR1045B	DR1030B	DR1015B	DR1008B	DC GAIN	fc	LIM ∫
1	~1.1	~1.0	~0.4			3	E	6
2	1.1~2.2	1.0~2.0	0.4~1.2	~0.2		4	D	6
3	2.2~5.3	2.0~5.0	1.2~3.3	0.2~1.5	~1.0	8	C	4
4	5.3~11	5.0~10	3.3~7.0	1.5~3.5	1.0~2.8	13	B	3
5	11~21	10~20	7.0~14	3.5~7.7	2.8~6.1	25	A	3
6	21~53	20~50	14~36	7.7~20	6.1~16	50	9	1
7	53~74	50~70	36~50	20~28	16~23	65	8	2
8	74~105	70~100	50~72	28~41	23~33	80	7	1
9	105~158	100~150	72~108	41~61	33~50	100	5	2
10	158~315	150~300	108~217	61~123	50~102	110	2	4

<5> Setting of the DYNASERV Controls (SR/E series)

Range	Load multiplication factor: K				Set value		
	SR1250	SR1220E	SR1160E	SR1130E	DC GAIN	fc	LIM ∫
1	~1.4	~1.3	~1.0	~0.8	3	E	4
2	1.4~2.6	1.3~2.4	1.0~2.0	0.8~1.7	4	D	3
3	2.6~6.2	2.4~5.9	2.0~5.0	1.7~4.4	8	C	3
4	6.2~12	5.9~12	5.0~10	4.4~8.8	13	B	3
5	12~24	12~23	10~20	8.8~18	25	A	2
6	24~60	23~57	20~50	18~44	50	9	1
7	60~85	57~80	50~70	44~62	65	8	1
8	85~121	80~115	70~99	62~89	80	7	1
9	121~181	115~172	99~149	89~134	100	5	1
10	181~362	172~344	149~298	134~267	110	2	5

Load multiplication factor: K		Set value		
SR1100E	SR1070E	DC GAIN	fc	LIM ∫
—	—			
~0.2	—	4	D	5
0.3~1.5	~1.0	8	C	5
1.5~3.6	1.0~2.6	13	B	4
3.6~7.8	2.6~5.9	25	A	3
7.8~20	5.9~16	50	9	3
20~29	16~22	65	8	3
29~41	22~32	80	7	2
41~62	32~49	100	5	2
62~125	49~98	110	2	5

<6> Setting of the DYNASERV Controls (SR 5000B series)

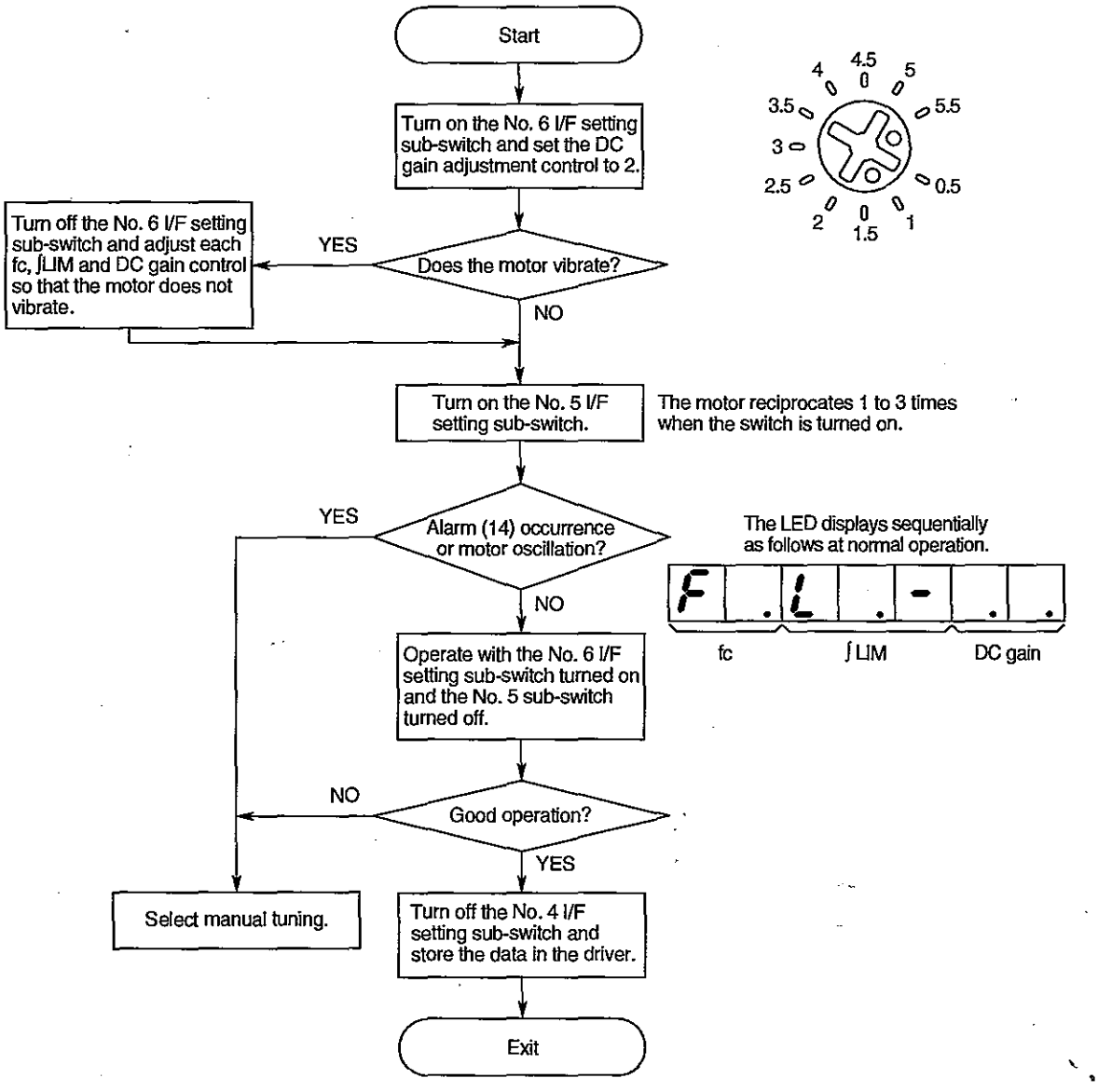
Range	Load multiplication factor: K			Set value		
	SR5070B	SR5050B	SR5030B	DC GAIN	fc	LIM ∫
1						
2				4	D	6
3	~0.7	~0.5	~0.4	8	C	4
4	0.7~2.0	0.5~1.7	0.4~1.5	13	B	3
5	2.0~4.8	1.7~4.0	1.5~3.8	25	A	3
6	4.8~13	4~11	3.8~11	50	9	1
7	13~19	11~16	11~15	65	8	2
8	19~27	16~23	15~22	80	7	1
9	27~41	23~36	22~34	100	5	2
10	41~82	36~72	34~68	110	2	4

(7) Automatic Tuning

Automatic tuning can be executed in the tuning mode as well as in the positioning mode. For the tuning upon shipment, follow the procedure described below.

NOTE

As the motor reciprocates during automatic tuning, choose a place without any obstacles.

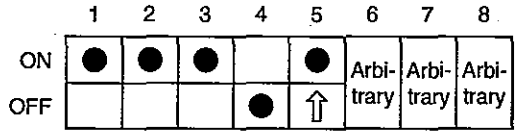


5.4 Maintenance Mode

Maintenance mode is operated to maintain the data stored in the driver and to check connections. Also, when status code 27 (EEPROM data checksum disagreement) is displayed, the alarm is automatically canceled by starting the system in this mode.

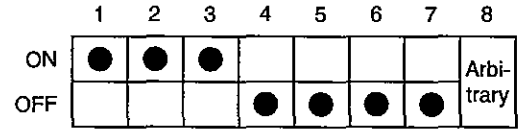
(1) Parameter Clearing

This operation is used to return the set values in the driver to the values at shipping. All the parameters for an electrical origin and automatic tuning gain, etc. return to the default values. This operation is carried out by turning off the No. 5 I/F setting sub-switch. If the parameters are normally cleared, the 7-segment LEDs display HE. After confirming this status, turn off the power of the driver.



(2) Modification of the Maintenance Data

The initialization speed or JOG speed is changed by the sequencer with the No. 7 I/F setting sub-switch turned off.



For the setting number and set value, set the data in the format described to the driver using the STP 0 to 3 signals and DI 0 to 7 signals. Next, the data are set by setting the SIGN signal to L and the START signal from H to L. The value of the digits set once holds unless the setting of the I/F setting switch is changed. When resetting the above mentioned setting of the I/F setting switch, all the data are initialized to 0.

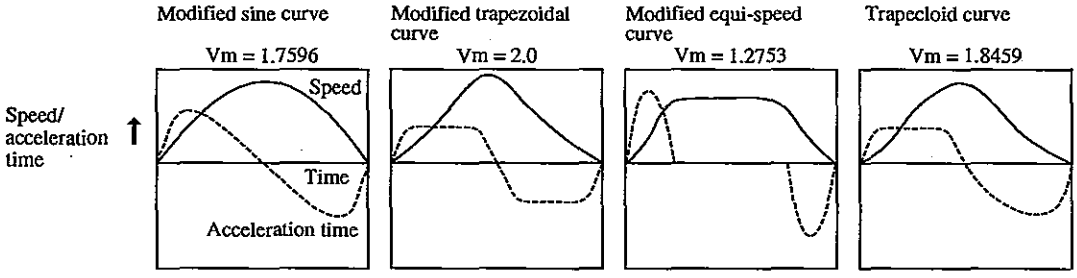
	<STP 3>		<STP 2>		<STP 1>		<STP 0>	
Number of digits	8	7	6	5	4	3	2	1
	0	Set value					Setting number	

The maintenance data which can be changed are limited to those shown in the table below. Setting beyond the data range does not cause an error. When data are changed, be sure to check them by the method described below. If other data are changed by mistake, return them to their values before the change, or clear the parameters. In this case, all the data return to their default values.

Maintenance data which can be changed

Setting number	Parameter	Set value	Default value
20	Initialization speed	10 to 500 (Unit 1/1000 rps)	100
21	JOG speed	5 to 100 (Unit 1/1000 rps)	10
22	Default speed/speed at driver resetting	1 to the maximum speed (Unit 1/1000 rps)	200
23	Default acceleration time/acceleration time at driver resetting	1 to 99 (Unit 10 msec)	10
24	Default DC gain/DC gain at driver resetting	See the table on page 5-15	0
25	Cam curve number	1: Modified sine (Vm = 1.76) 2: Modified trapezoid (Vm = 2.0) 3: Modified equi-speed Vm = Dimensionless speed	0: trapecloid (Vm = 1.86)
29	Wait time for initialization/motor settling time	1 to 3000 msec	1000

(Note) Typical examples of the above-mentioned cam curve



Minimum feed time is calculated by the following equation.

$$\text{Minimum feed time (S)} = \frac{\text{Feed amount (P)}}{\text{Maximum feed speed (pps)}} \times \text{Maximum dimensionless speed (Vm)}$$

[P: Number of pulses; pps: Encoder resolution × speed (rps)]

The setting sequence is almost the same as that of the position data. For details, see the timing chart described below. After the (BUSY) signal returns to H, the sequence can be read to check the data set. The data format is as it is set.

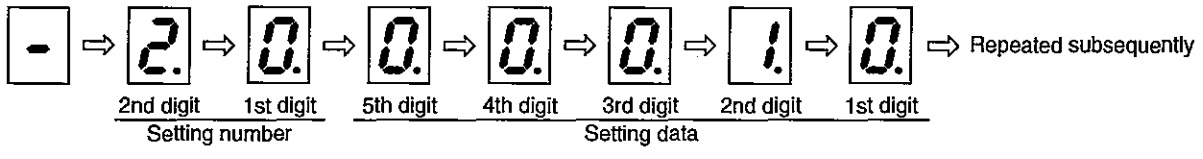
Do not change the setting no. except above table.

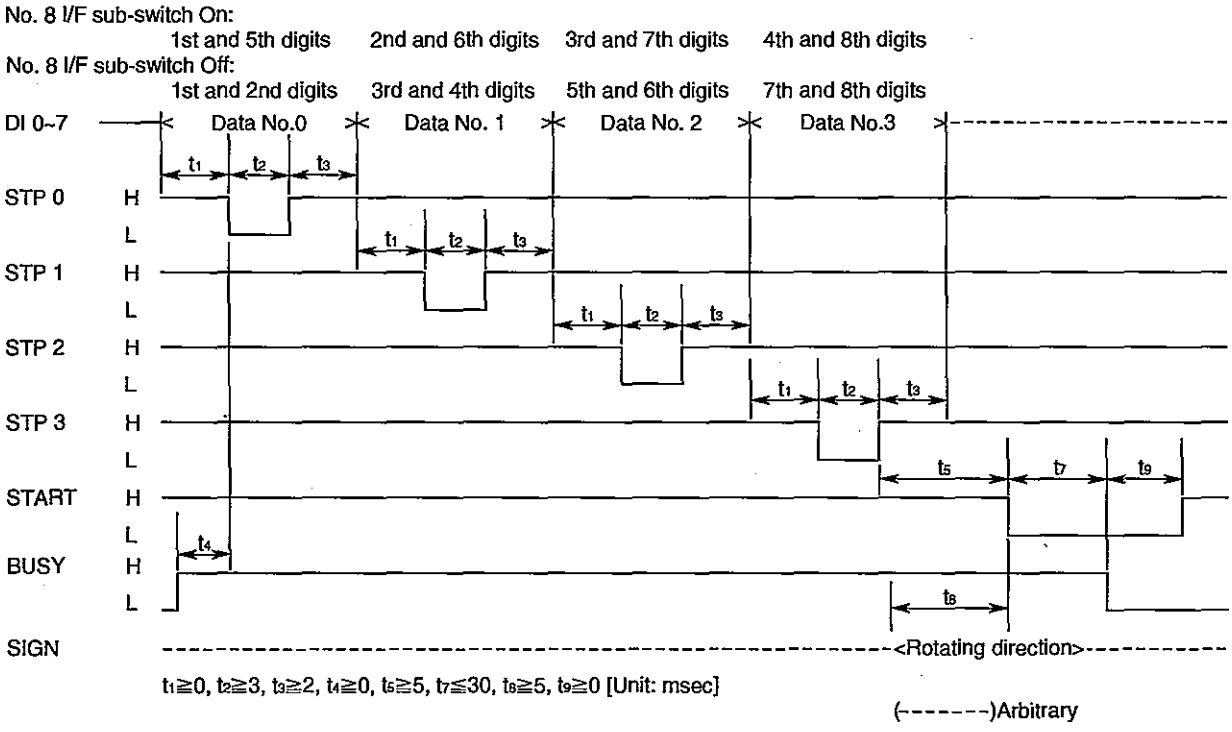
To see the currently set value, set the SIGN signal to H and send the setting number to the driver in the same sequence when setting is carried out. (Any set value is available if it can be displayed in the BCD code.) After the BUSY signal returns to H, execute the sequence described in the timing chart. Then the current set value can be read out.

If the STBS, STE 0 to 3 and DB 0 to 7 signals are not connected, hold the START signal at L. At this point, if an error does not occur, or if the BUSY signal holds at L, the 7-segment LED displays the setting number and the setting data as follows.

Setting example

Setting number: 20; Setting data: 10

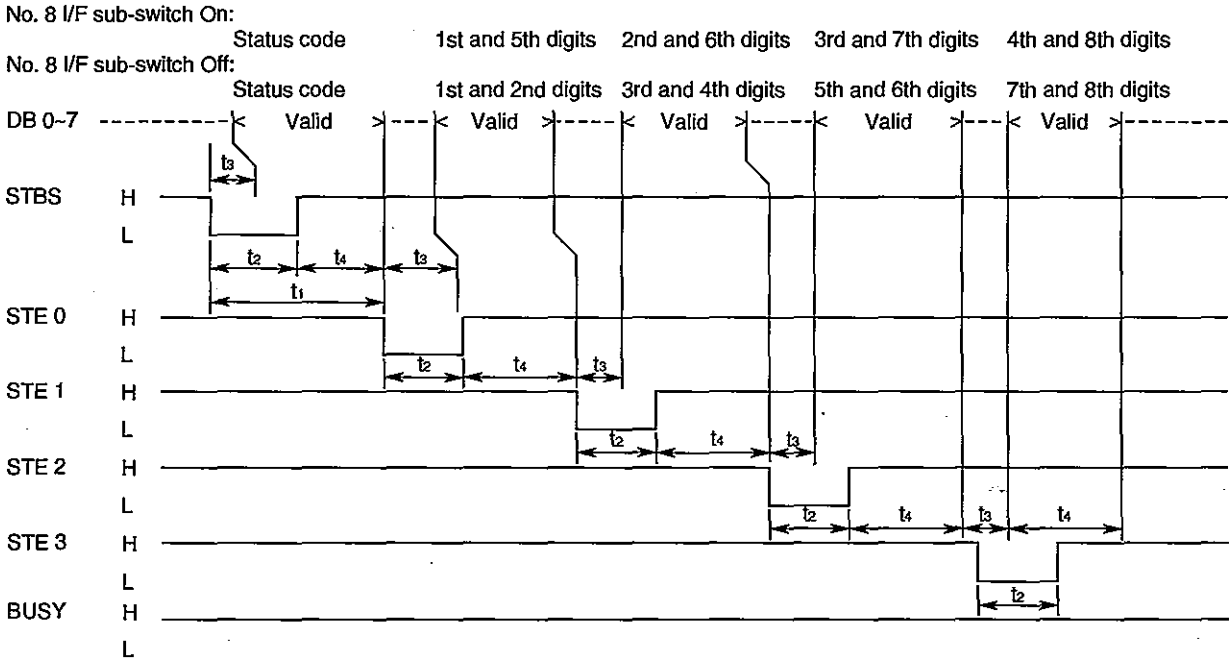




$t_1 \geqq 0$, $t_2 \geqq 3$, $t_3 \geqq 2$, $t_4 \geqq 0$, $t_5 \geqq 5$, $t_7 \leqq 30$, $t_8 \geqq 5$, $t_9 \geqq 0$ [Unit: msec]

(-------)Arbitrary

(Parameters change)



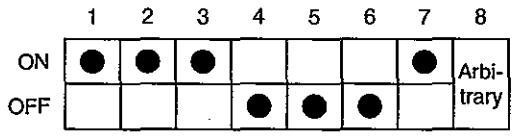
$t_1 \geqq 15$, $t_2 \geqq 5$, $t_3 \geqq 8$, $t_4 \geqq 2$ [Unit: msec]

(-------)Arbitrary

(Confirmation of parameters)

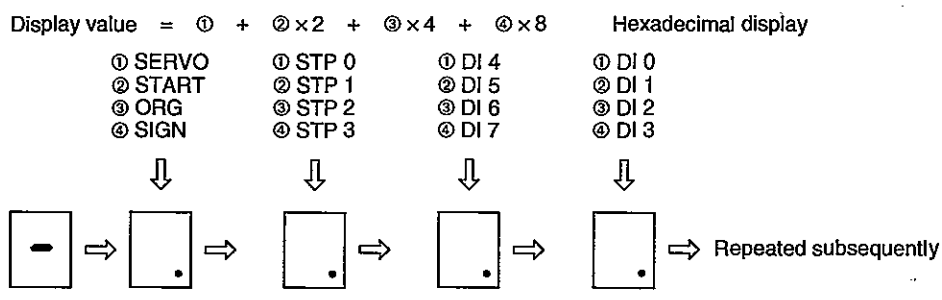
(3) Wiring Check Function

The START, SIGN, DI 0 to 7 and STP 0 to 3 are the most important input signals to the driver. When turning the No. 7 I/F setting sub-switch on, the 7-segment LED (right) in the upper right corner of the front panel displays the signal statuses sequentially.



Display format

The result of the calculation by the equation below is displayed substituting 1 for the signal holding L and 0 for the signal holding H.

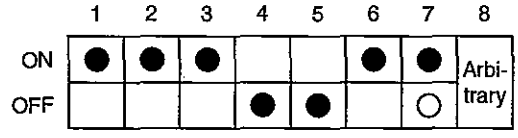


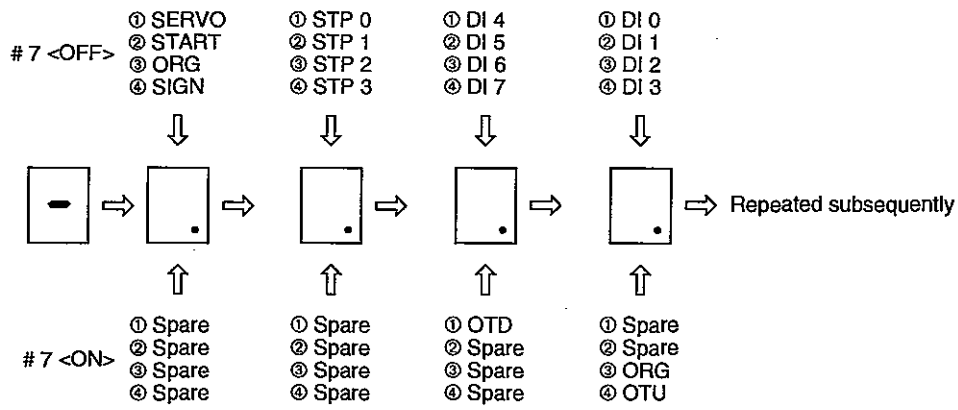
Input Signal Display -1

Also, if the STBS and STE 0 to 3 signals hold H in this case, input values are output for DB 0 to 7 after several milliseconds.

Output signal	Contents
DB 0 to 7	The input value of DI 0 to 7 outputs as it is.
BUSY	The input value of the START signal outputs as it is.
COIN	The input value of the SIGN signal outputs as it is.

Other input signals can also be checked by changing the I/F setting sub-switches. Spare signal states are uncertain. Ignore them.





Input signal display -2

For the output signals of the driver, RDY and ERROR signals are also provided.

Checking of RDY and ERROR signals

Signal name	How to check the signal
RDY	H is held in the maintenance mode, and L is held in the normal condition in the other mode.
ERROR	H is held in the normal condition and L is held if an error occurs. For example, if maintenance data are changed for the setting number 0, an error occurs. (The error is canceled by returning the (START) signal to H.)

(4) Display in the Maintenance Mode

LED display	Status	Output signal		Status code (BCD)
		RDY	ERROR	
<H0>	In normal condition	<H>	<H>	09
<HE>	At the completion of parameters clear (mode completion)	<H>	<H>	09
<H1>	Faulty set data (The maintenance data which cannot be changed are set.)	<H>	<L>	11
<H2>	Data storage disabled	<H>	<L>	12
<H3>	Cannot be displayed in the BCD code.	<H>	<L>	13

6. MAINTENANCE AND INSPECTION

6.1 Motor Section

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.

6.2 Driver Section

There is no need for daily maintenance of the driver section. However, clean the driver section periodically to prevent it from poor insulation caused by accumulated dust.

7. TROUBLESHOOTING AND MEASURES

7.1 Motor Problems and Measures

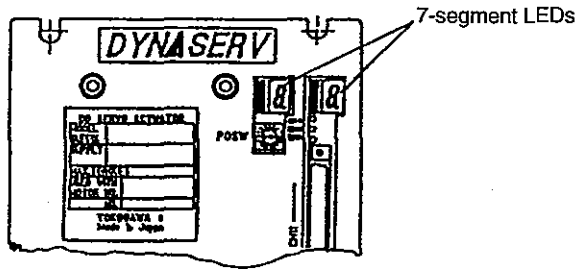
Whenever any abnormal condition occurs while operating the motor, check the LED display on the front panel of the driver first. If the cause of the abnormal condition is not determinable by the LED indicated on the display, take appropriate countermeasures as shown in the table below. If the motor still 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 for Reference
The motor is not servo-locked.	♦ No AC power is fed.	Wiring	Apply the specified AC power	3-4 - 3-5
	♦ The servo ON (SERVO) terminal is set to H.	Inspection	Set to L	3-10
	♦ fc, I-LIM, or DC gain is too small.	Inspection	To be adjusted to an appropriate value	5-13 - 5-17
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 large output motor.	
	♦ Position data not set	Check of position data	Set the data if not set.	5-4 - 5-7
	♦ Incorrect external wiring	Inspection of wiring	Re-wire correctly by referring to the connection diagram.	3-9 - 3-11
	♦ fc, I-LIM, or DC gain is too small.	Inspection	To be adjusted to an appropriate value	5-13 - 5-17
The motor is rotating improperly	♦ Imperfect connection	Check of connection of each phase of A, B, C and GND.	Re-wire correctly by referring to the connection diagram.	3-9
	♦ 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.	1-2, 2-1, 2-2

Problem	Estimated Cause	Inspection Item	Measure	Page for Reference
The motor overheats.	♦ Ambient temperature is high.	Check for ambient temperature 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 large output motor.	
Abnormal sound is produced.	♦ Incorrect mounting	Looseness of screws	Tighten the screws.	
	♦ Problem with bearings	Check for sound and vibration near the bearings.	Motor replacement (Contact us.)	
	♦ Mounting base vibration	Check the mounting base.	Reinforce the mounting base.	
Abnormally small motor torque	♦ Incorrect motor/driver combination	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-2, 2-1, 2-2
	♦ Overloaded	Check of LED display	Recheck the operation. Lighten the load.	
	♦ fc, I-LIM, or DC gain is too small.	Inspection	To be adjusted to an appropriate value	5-13 - 5-17
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.	1-2, 2-1, 2-2
	♦ Improper jumper setting	Inspection	Perform correct jumper setting.	3-3 - 3-7
	♦ Imperfect connection	Check of motor/encoder connection.	Re-wire correctly by referring to the connection diagram.	3-9
Position is dislocated.	♦ Incorrect fc, I-LIM and DC gain settings	Inspection	To be adjusted to an appropriate value	5-13 - 5-17
	♦ Improper position to mount origin sensor	Inspection	To be adjusted to an appropriate value	5-2 - 5-4
	♦ The initialization direction differs from when electrical origin is set.	Inspection	Set the initialization direction to the same way.	5-2 - 5-4

7.2 LED Display

The driver alarm can be identified by two 7-segment LEDs provided on the front panel and status codes (BCD) that can be read from the sequencer. This section describes the LED displays. However, as described separately, only the maintenance mode executes special displays. Moreover, there is another special example of an LED display such as when the START signal is in the L status.



(1) LED Display in Accordance with Operation Signals upon Normal Operation

LED Display	Status	Output Signal		Status Code (BCD)
		RDY	ERROR	
<00>	Upon servo operation status or positioning operation	<L>	<H>	00
<01>	SERVO signal input H level (stop status)	<L>	<H>	01
<02>	Under data storage (electrical origin setting, etc.)	<L>	<H>	02
<03>	Under initialization	<L>	<H>	03
<04>	JOG mode	<L>	<H>	04
<05>	Test mode	<L>	<H>	05
<07>	STOP signal L level	<L>	<H>	07

(2) Abnormal Operation and Setup Data

LED Display	Status	Output Signal		Status Code (BCD)
		RDY	ERROR	
<11>	Setup data failure	L	L	11
<12>	Data storage disabled	L	L	12
<13>	Non-BCD (check logics of signals, timing, and wiring between sequencer and driver)	L	L	13
<14>	Automatic tuning function disabled (set the mode to manual tuning)	L	L	14
<15>	Motor started up at SERVO signal level H (change the level to L)	L	L	15
<16>	OTU signal detected (overtravel)	L	L	16
<17>	OTD signal detected (overtravel)	L	L	17
<19>	Setup mode not available (a mode outside of specification is set)		L	19
<27>	EEPROM data checksum mismatch	H	L	27
<40>	Overload (recheck operation)	L	L	40
<60>	Counter overflow (excessive position deviation)	L	H	60
<66>	Position deviation greater than 45° (optional)	H	L	66
<80-89>	Main power supply voltage lowered (confirm input power supply voltage)	[H]	[L]	[80-89]
<30-39>	Encoder signal failure (connection failure) <30-32>: burnout <36-39>: abnormal frequency (contact failure, noise)	H	L	[30-39]

Note: The output signals and status codes in brackets may be indefinite.

(3) Abnormal Main Power Supply for Driver

LED Display	Status	Output Signal		Status Code (BCD)
		RDY	ERROR	
<A1>	Overvoltage (power supply voltage too high, overload)	H	L	51
<A3>	Overcurrent (incorrect power wiring connection)	L	H	01
<90-99>	Failure of driver control board In this case, the driver output signal may not be output correctly. (consult YPC)	L	H	[90-99]
<20-24>	I/F board failure due to cause(s) other than the above (consult YPC)	H	L	[20-24]

Note: The output signals and status codes in brackets may be indefinite.

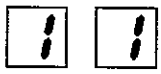
(4) Detailed Description

LED Display	Description	
<01>	SERVO signal input level: H (stop status)	
	Cause	This LED appears when the SERVO signal level is H in the stop status. This LED also appears if the power supply is not 24 V DC.
	Action	To rotate the motor, set the SERVO signal level to L. You can identify whether the level is L by the decimal point on the left LED on the front panel. If the point appears, then the SERVO signal level is L. If not, check the power supply of 24 V DC.
<12>	Data storage disabled	
	Cause	This error may occur if data storage has been done thousands of times.
	Action	Redo its setting. However, if the alarm still occurs even after you redo its setting, consult YPC.
<16> <17>	OTU signal detected (overtravel clockwise) OTD signal detected (overtravel counterclockwise)	
	Cause	This LED appears when the overtravel sensor is detected (when the detection function is set). This LED also appears if the power supply is not 24 V DC.
	Action	Set the operation mode to the JOG mode or set the SERVO signal level to H and rotate the motor manually to remove the signal from the overtravel area. Since the alarm is not yet released even if you set the SERVO signal level to H, perform a JOG operation and initialization. If this LED appears out of the overtravel area, check the 24 V DC power supply.
<19>	Setup mode not available	
	Cause	This LED appears if you set a mode other than specified.
	Action	Check the I/F setting switch.
<27>	EEPROM data checksum mismatch	
	Cause	Turning off the power during data storage may display this LED.
	Action	The alarm can be reset if the system is started up in the maintenance mode (using I/F setting switch). If the alarm still cannot be reset, consult YPC.

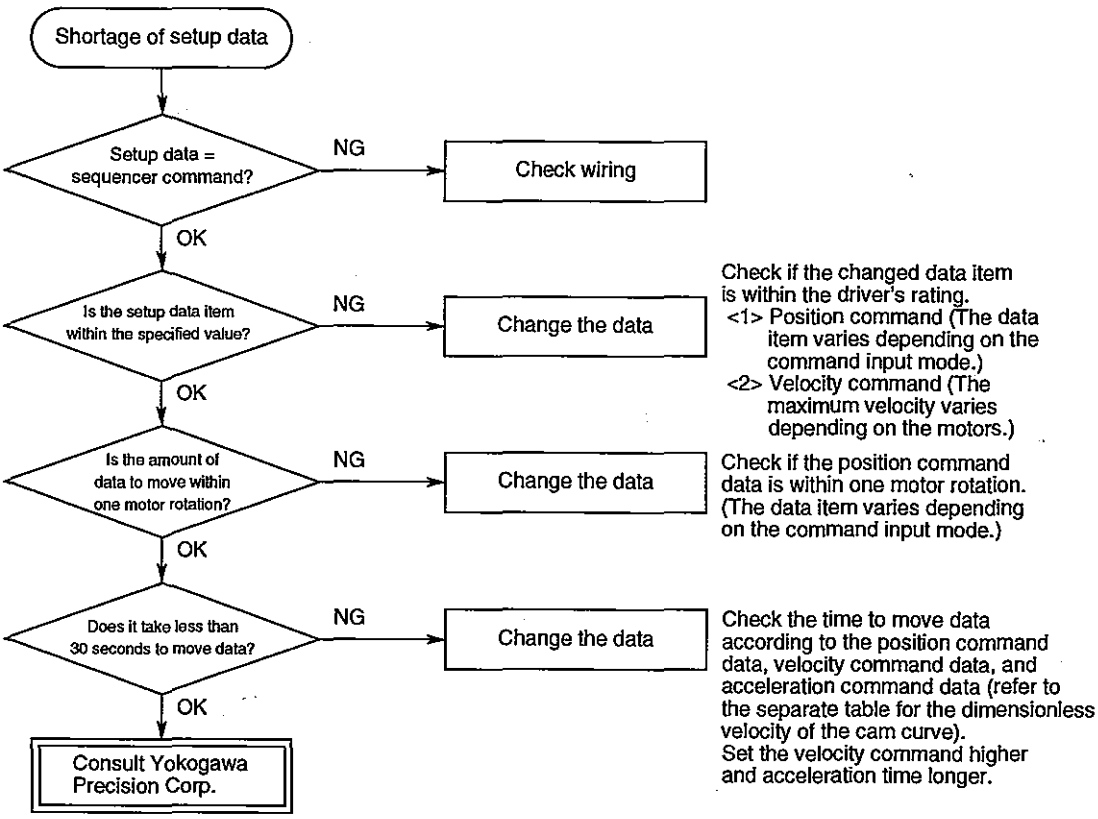
7.3 Procedure for Error Correction

(1) Shortage of Setup Data

This alarm occurs when a setup data item is out of the specified range, when it takes more than 30 seconds to move the data, or when the amount of data to move exceeds one motor rotation.



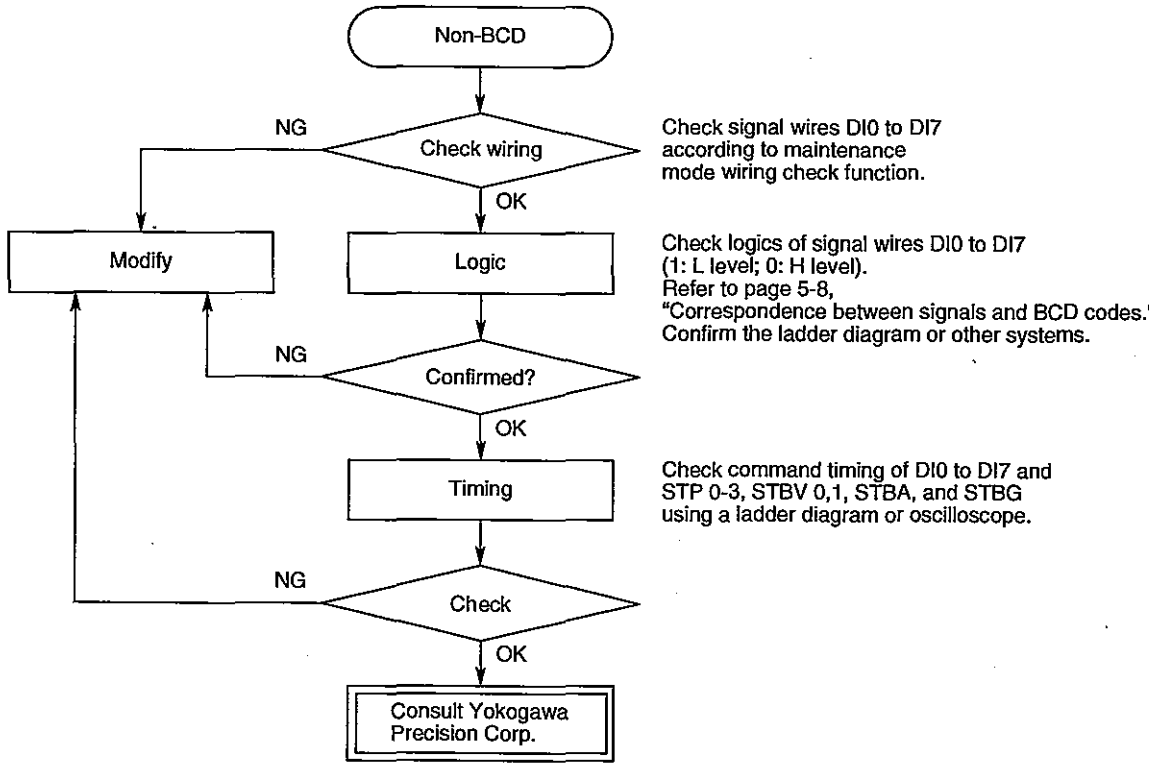
This alarm occurs when a setup data item is out of the specified range, when it takes more than 30 seconds to move the data, or when the amount of data to move exceeds one motor rotation.



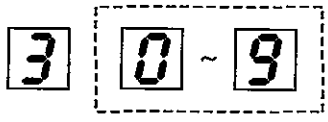
(2) Non-BCD

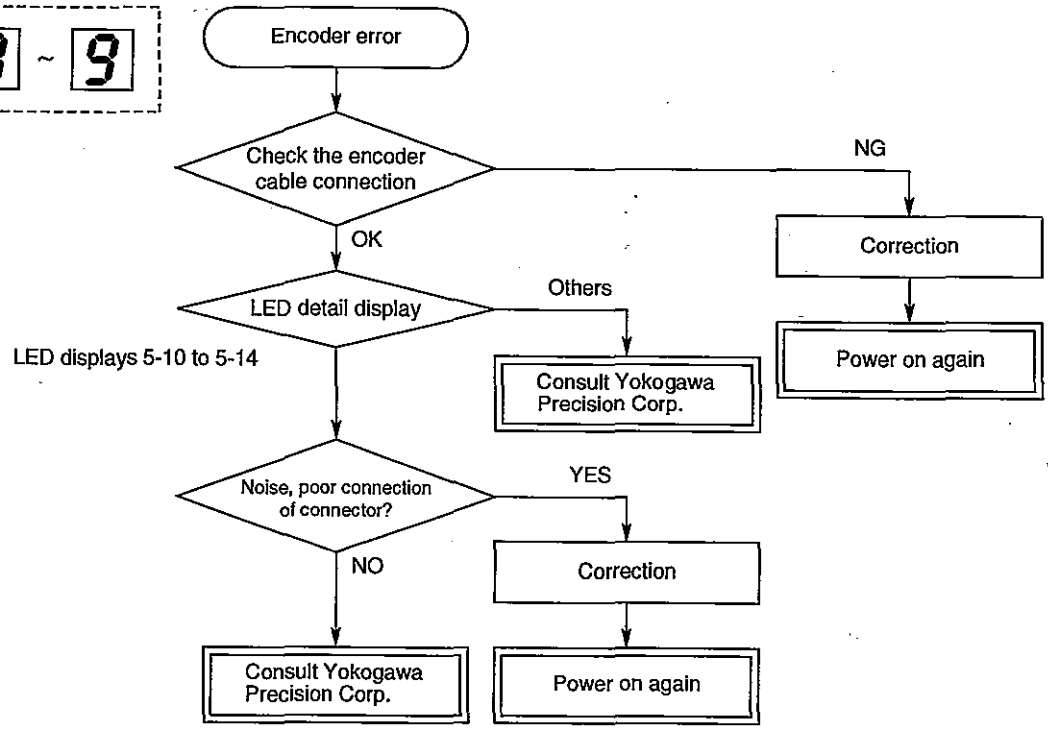
(Maintenance mode)

This alarm occurs when the data given to DI0 to DI7 and the BCD codes (0 to 9) do not match.



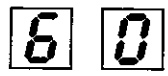
(3) Encoder Error





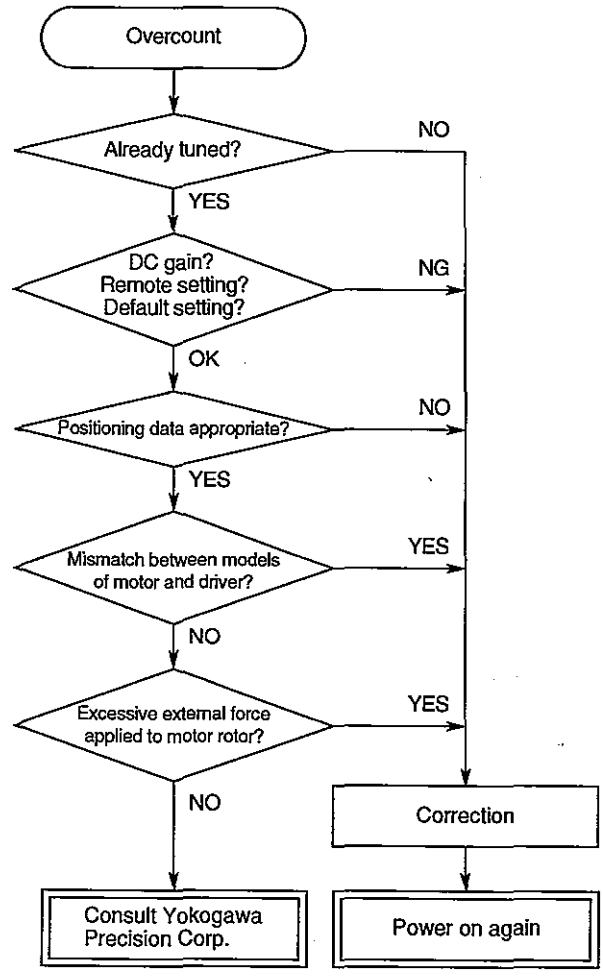
(4) Counter Overflow

(Excessive positioning deviation)

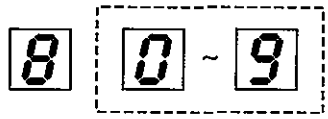


This number appears when the load applied to the motor is excessive and the degree of position shift is too large against the driver command.

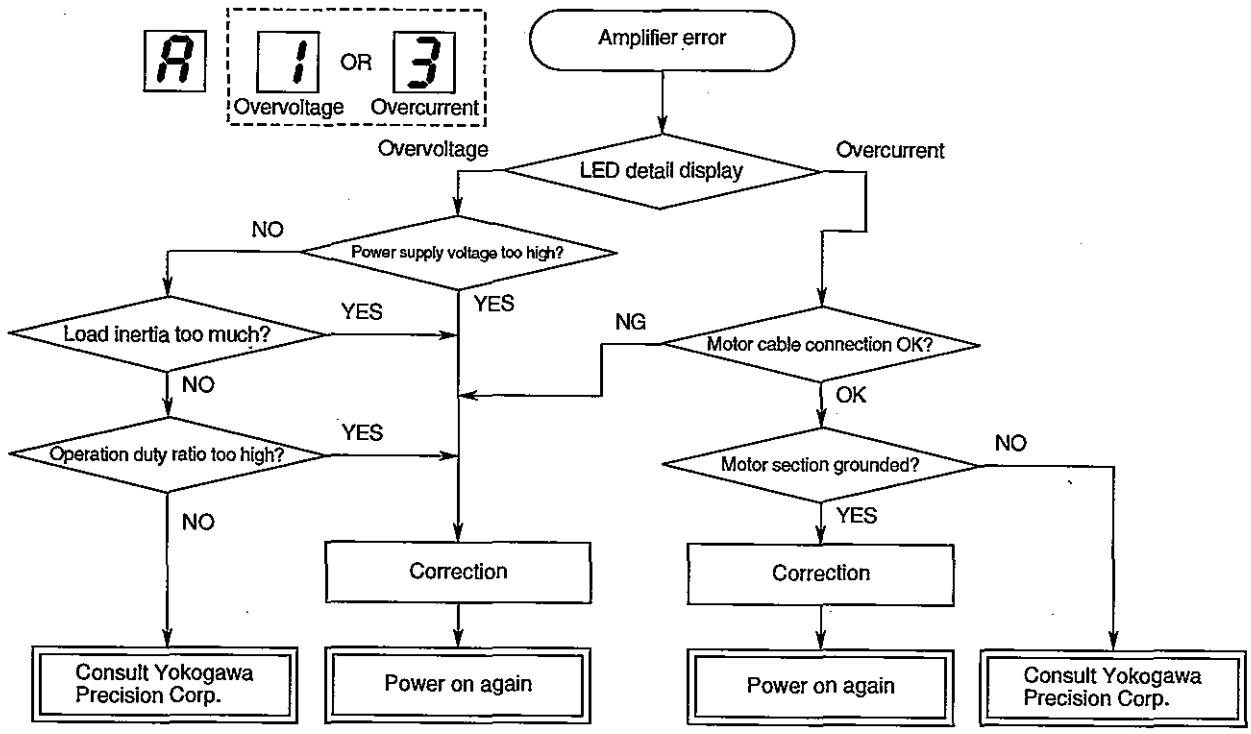
Excessive velocity or acceleration against the load



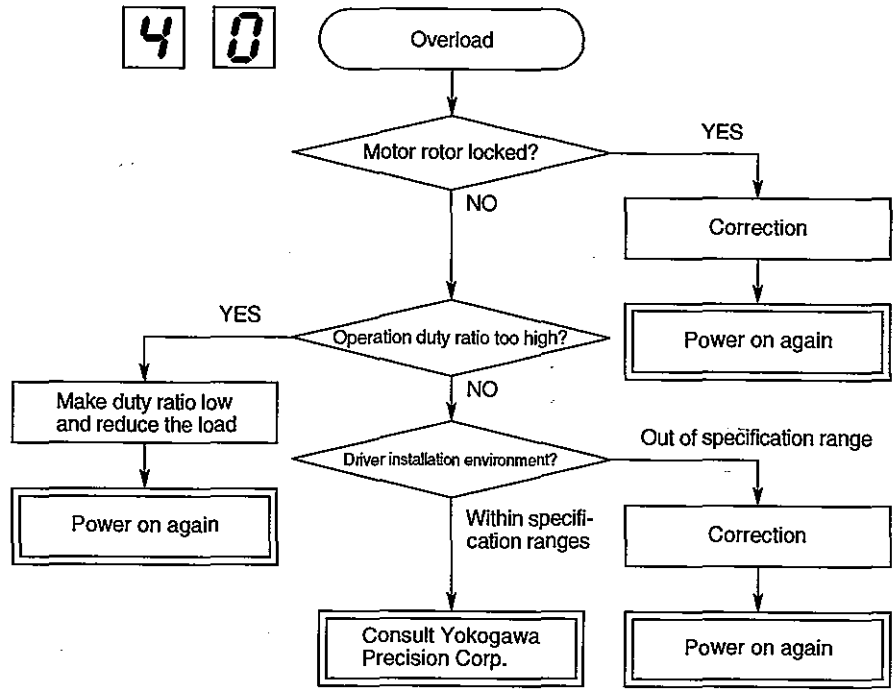
(5) Main Power Supply Voltage Too Low



(6) Amplifier Error



(7) Overload



8. REFERENCE

8.1 Specifications

(1) Standard Specifications of Motor Section

a) DM/B Series

Series					DM/B Series			
Motor model					DM1015B 00*1	DM1030B 00*1	DM1045B 00*1	DM1060B 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	15(1.5)	30(0.3)	45(4.5)	60(6.0)
	Maximum number of revolutions			rps	2.4			
	Rated revolutions			rps	2.0[2.0]	2.0[1.5]	2.0[1.0]	1.5[1.0]
	Positioning	Encoder resolution		p/rev	655,360			
		Absolute positioning accuracy*		sec	±15			
		Repeatability		sec	±2			
Motor section	Rotor inertia			$kg•m^2$	12×10^{-3}	15×10^{-3}	19×10^{-3}	23×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	$3.0\times10^{4}(3.0\times10^{3})$			
			Tension		$1.0\times10^{4}(1.0\times10^{3})$			
		Overhang load		N•m(kgf•m)	200(20)			
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	$2.5\times10^{-6}(2.5\times10^{-5})$			
			Tension		$3.0\times10^{-6}(3.0\times10^{-5})$			
		Radial stiffness		rad/N•m (rad/kgf•m)	$1.0\times10^{-6}(1.0\times10^{-5})$			
	Weight			kg	5.5	7.5	9.5	12
	Length L (see the external dimensions)			mm	$92.5^{\pm1}$	$118^{\pm1}$	$143^{\pm1}$	$168^{\pm1}$

b) DM/A Series

Series					DM/A Series			
Motor model					DM1050A 00*1	DM1100A 00*1	DM1150A 00*1	DM1200A 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	50(5.0)	100(10)	150(15)	200(20)
	Maximum number of revolutions			rps	1.2			
	Rated revolutions			rps	1.0[1.0]		1.0[0.5]	
	Positioning	Encoder resolution		p/rev	1,024,000			
		Absolute positioning accuracy*		sec	±15			
		Repeatability		sec	±2			
Motor section	Rotor inertia			$kg•m^2$	96×10^{-3}	119×10^{-3}	142×10^{-3}	167×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	$4.0\times10^{4}(4.0\times10^{3})$			
			Tension		$2.0\times10^{4}(2.0\times10^{3})$			
		Overhang load		N•m(kgf•m)	400(40)			
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	$2.0\times10^{-6}(2.0\times10^{-5})$			
			Tension		$3.0\times10^{-6}(3.0\times10^{-5})$			
		Radial stiffness		rad/N•m (rad/kgf•m)	$4.0\times10^{-7}(4.0\times10^{-6})$			
	Weight			kg	14.5	19	24	29
	Length L (see the external dimensions)			mm	$113^{\pm1}$	$138^{\pm1}$	$163^{\pm1}$	$188^{\pm1}$

c) DR/B Series

Series					DR/B Series				
Motor model					DR1008B 00*1	DR1015B 00*1	DR1030B 00*1	DR1045B 00*1	DR1060B 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	8(0.8)	15(1.5)	30(3.0)	45(4.5)	60(6.0)
	Maximum number of revolutions			rps	2.4[2.4]			2.4[1.8]	2.4[1.4]
	Rated revolutions			rps	2.0[2.0]		2.0[1.5]	2.0[1.0]	1.5[1.0]
	Positioning	Encoder resolution		p/rev	507,904				
		Absolute positioning accuracy*		sec	±45				
		Repeatability		sec	±5				
Motor section	Rotor inertia			kg•m^2	15×10^{-3}	21×10^{-3}	24×10^{-3}	26×10^{-3}	33×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	3.0×10^4(3.0×10^3)				
			Tension		1.0×10^4(1.0×10^3)				
		Overhang load		N•m(kgf•m)	200(20)				
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	3.0×10^{-6}(3.0×10^{-5})				
			Tension		4.0×10^{-6}(4.0×10^{-5})				
		Radial stiffness		rad/N•m (rad/kgf•m)	2.0×10^{-6}(2.0×10^{-5})				
	Weight			kg	6.0	9.0	11	13	15.5
	Length L (see the external dimensions)			mm	85±1	123±1	151±1	179±1	207±1

d) DR/E Series

Series					DR/E Series					
Motor model					DR1070E 00*1	DR1100E 00*1	DR1130E 00*1	DR1160E 00*1	DR1220E 00*1	DR1250E 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	70(7)	100(10)	130(13)	160(16)	220(22)	250(25)
	Maximum number of revolutions			rps	2.4[2.0]	2.4[1.5]	1.2[1.2]	1.2[1.0]	1.2[0.7]	
	Rated revolutions			rps	2.0[1.5]	1.5[1.0]	1.0[0.5]			
	Positioning	Encoder resolution		p/rev	614,400					
		Absolute positioning accuracy*		sec	±45					
		Repeatability		sec	±5					
Motor section	Rotor inertia			kg•m^2	85×10^{-3}	100×10^{-3}	125×10^{-3}	140×10^{-3}	170×10^{-3}	185×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	4.0×10^4(4.0×10^3)					
			Tension		2.0×10^4(2.0×10^3)					
		Overhang load		N•m(kgf•m)	400(40)					
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	2.0×10^{-6}(2.0×10^{-5})					
			Tension		3.0×10^{-6}(3.0×10^{-5})					
		Radial stiffness		rad/N•m (rad/kgf•m)	4.0×10^{-7}(4.0×10^{-6})					
	Weight			kg	22	26	32	36	44	48
	Length L (see the external dimensions)			mm	183±1	210±1	243±1	271±1	327±1	355±1

e) DR/A Series

Series					DR/A Series					
Motor model					DR1050A 00*1	DR1100A 00*1	DR1150A 00*1	DR1200A 00*1	DR1300A 00*1	DR1400A 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	50(5)	100(10)	150(15)	200(20)	300(30)	400(40)
	Maximum number of revolutions			rps	1.8[1.8]	1.2[1.2]	1.2[1.0]	1.2[0.8]	1.0[0.5]	0.8[0.4]
	Rated revolutions			rps	1.5[1.5]	1.0[1.0]	1.0[0.5]		0.5[0.25]	
	Positioning	Encoder resolution		p/rev	819,200					
		Absolute positioning accuracy*		sec	±30					
		Repeatability		sec	±5					
Motor section	Rotor inertia			kg•m²	180×10^{-3}	200×10^{-3}	230×10^{-3}	285×10^{-3}	340×10^{-3}	400×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	$4.0\times10^{4}(4.0\times10^{3})$					
			Tension		$2.0\times10^{4}(2.0\times10^{3})$					
		Overhang load		N•m(kgf•m)	400(40)					
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	$2.0\times10^{-6}(2.0\times10^{-5})$					
			Tension		$3.0\times10^{-6}(4.0\times10^{-5})$					
		Radial stiffness		rad/N•m (rad/kgf•m)	$4.0\times10^{-7}(4.0\times10^{-6})$					
	Weight			kg	26	31	36	45	55	65
	Length L (see the external dimensions)			mm	158±1	185±1	212±1	250±1	304±1	358±1

f) DR/5000B Series

Series					DR/5000B Series		
Motor model					DR5030B 00*1	DR5050B 00*1	DR5070B 00*1
Motor and driver coupling	Maximum output torque			N•m(kgf•m)	30(3.0)	50(5.0)	70(7.0)
	Maximum number of revolutions			rps	5.0		
	Rated revolutions			rps	4.0		
	Positioning	Encoder resolution		p/rev	278,528		
		Absolute positioning accuracy*		sec	±90		
		Repeatability		sec	±10		
Motor section	Rotor inertia			kg•m²	27×10^{-3}	34×10^{-3}	37×10^{-3}
	Rated maximum load	Axial load	Compression	N(kgf)	$3.0\times10^{4}(3.0\times10^{3})$		
			Tension		$1.0\times10^{4}(1.0\times10^{3})$		
		Overhang load		N•m(kgf•m)	200(20)		
	Torsional stiffness	Axial stiffness	Compression	mm/N (mm/kgf)	$3.0\times10^{-6}(3.0\times10^{-5})$		
			Tension		$4.0\times10^{-6}(4.0\times10^{-5})$		
		Radial stiffness		rad/N•m (rad/kgf•m)	$2.0\times10^{-6}(2.0\times10^{-5})$		
	Weight			kg	13.5	16.0	18.0
	Length L (see the external dimensions)			mm	184±1	212±1	240±1

Common Specifications Motor insulation: class F (JIS C 4003);
withstanding voltage: 1500 V AC for one minute;
insulation resistance:10 MW or more (500 V DC); structure: outer rotor;
excitation: 3 phase; coating color: black

Note: Unless otherwise specified, the power supply is between 200 and 300 V AC. However, for numbers in brackets, the power supply is between 100 and 115 V AC.

*: Only upon input of feed pulse

(2) Standard Specifications of Driver Section

Item		Description
Positioning data setting		Data of position, speed, and acceleration: BCD digit serial I/F
Positioning method	Position setting	Increment, absolute value, PTP control, pulse (±9999999), degree (±360.000°)
	Speed	0.001 to 5.000 rps
	Acceleration time	1 to 99 (10 msec) from 0 to the specified speed
	Acceleration curve	Constant acceleration curve, cam curve (trapecloid)
Operation mode		PTP positioning, JOG, initialization
Servo control		I-PD/P-ID position control, manual/auto tuning
Input/output signal		BCD 2-digit I/O, SIGN, START, STOP, COIN, ORG, ERROR
Current encoder value output		BCD digits, 7-digit serial (sequencer I/F)
Monitor output		ORG, LED, ZERO LED, analog speed output: ±6 V max.
Protection function		Overcurrent, overvoltage, under voltage, overheating, encoder problem, overtravel, CPU problem
Power supply		100 to 115/200 to 230 V AC +10 -15% 50/60 Hz
Mass		6.5 kg

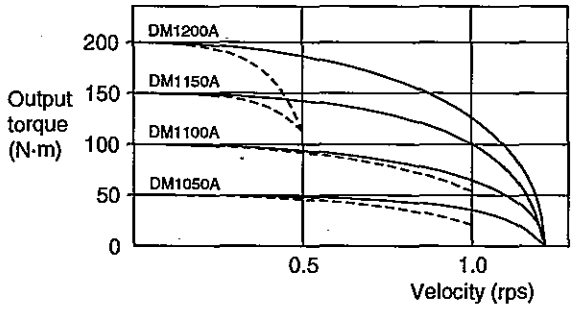
(3) Environmental Specifications

		Motor	Driver	Remarks
Ambient operating conditions	Temperature	0° to 45°C	0° to 50°C	
	Humidity	20% to 85% R.H.	20% to 90% R.H.	No condensation
Ambient storage conditions	Temperature	-20° to 85°C	-20° to 85°C	
	Humidity	20% to 85% R.H.	20% to 90% R.H.	No condensation
Operating environment		No corrosive gases; dust-free		

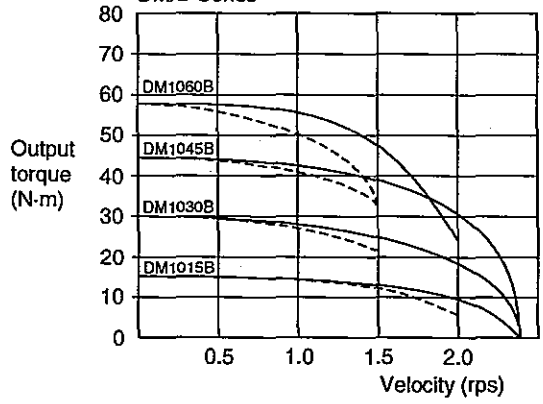
8.2 Velocity vs Torque Characteristics

—— 200-230 V AC power supply
--- 100-115 V AC power supply

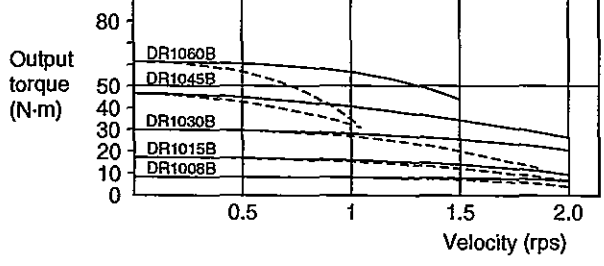
DM/A Series



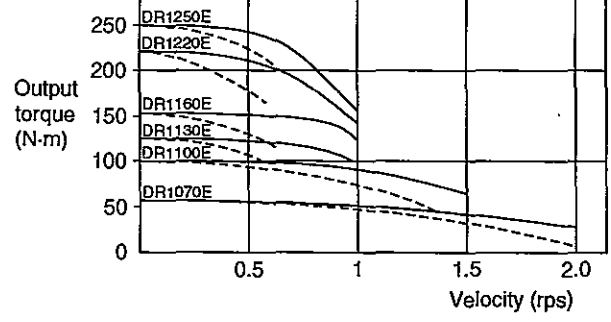
DM/B Series



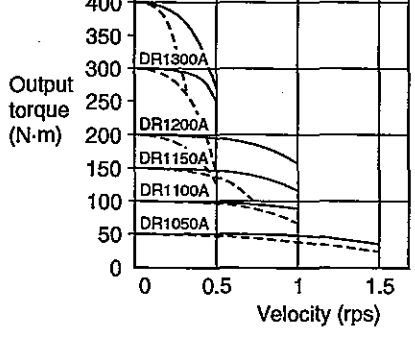
DR/B Series



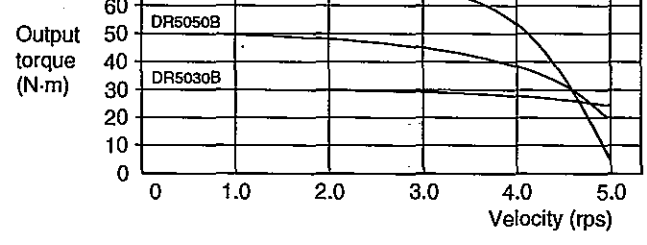
DR/E Series



DR/A Series

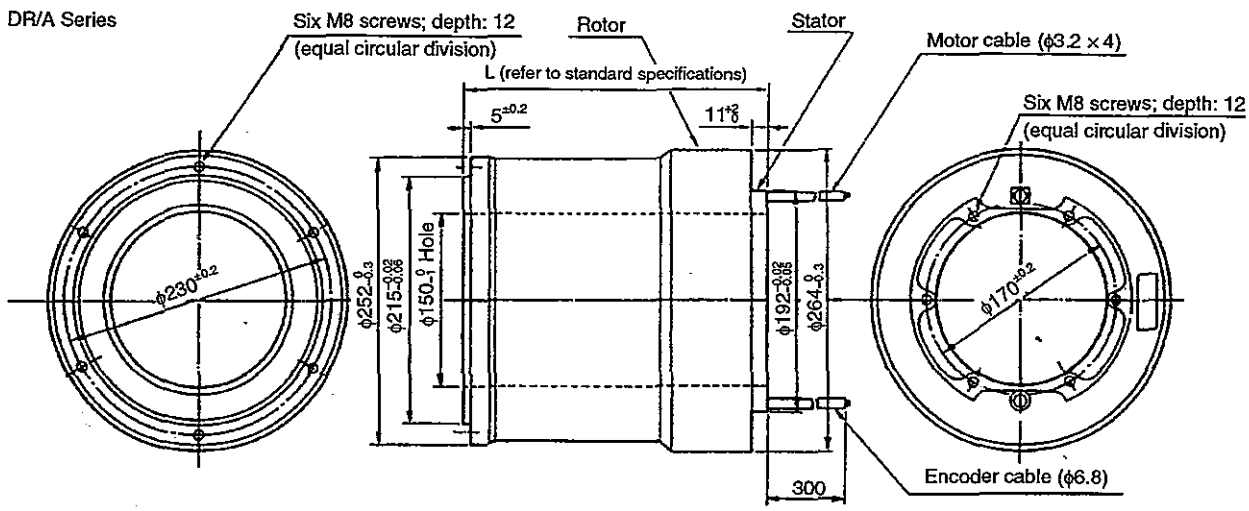


DR/5000B Series

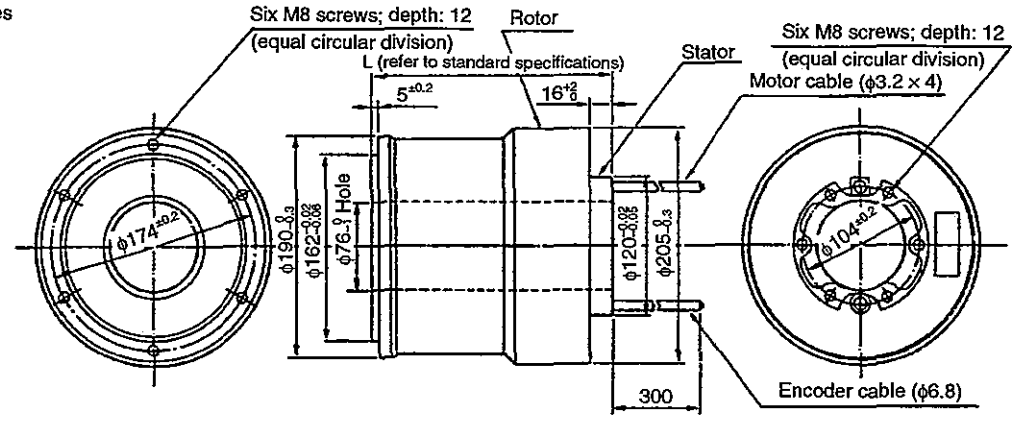


8.3 External Dimensions (unit: mm)

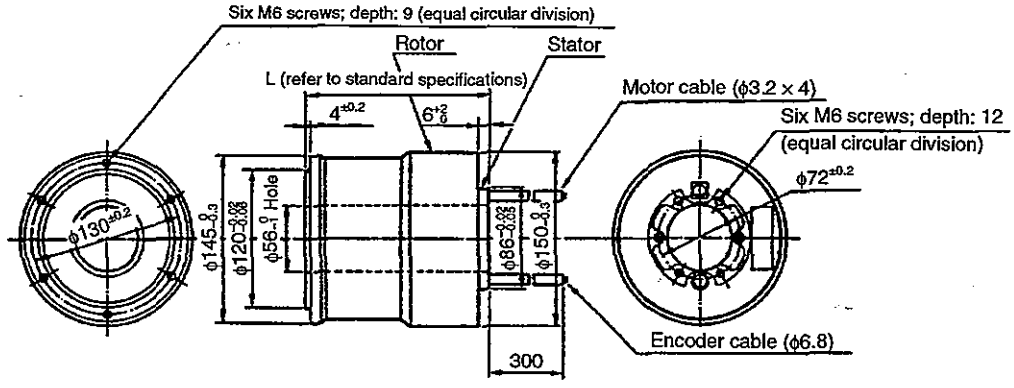
DR/A Series



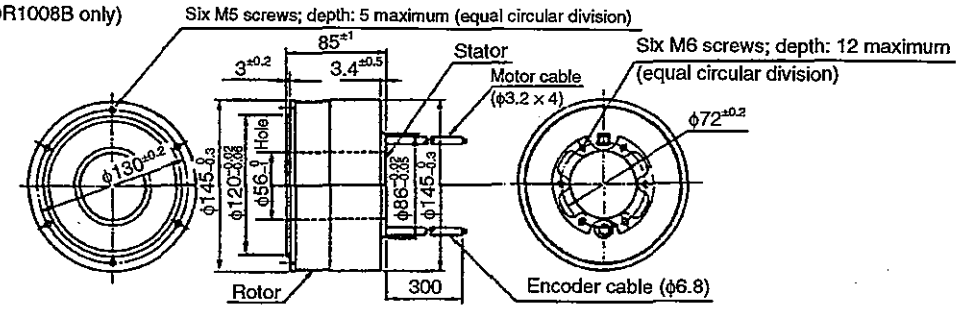
DR/E Series



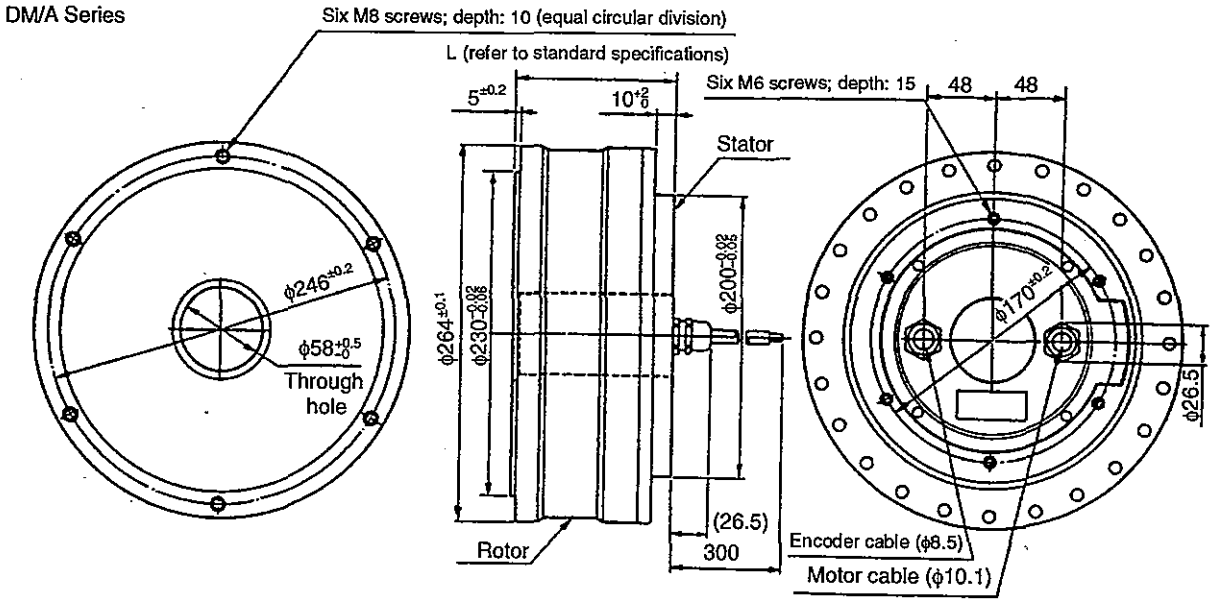
DR/B Series



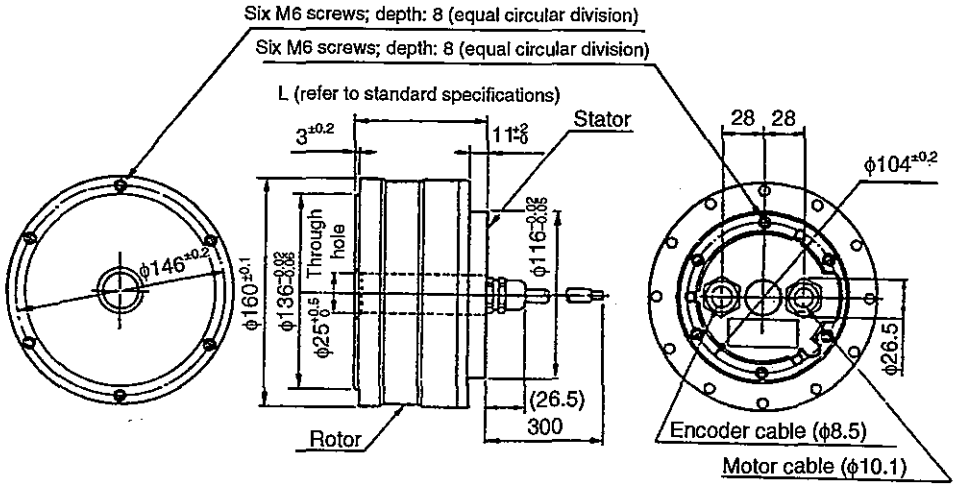
B Series (for the DR1008B only)



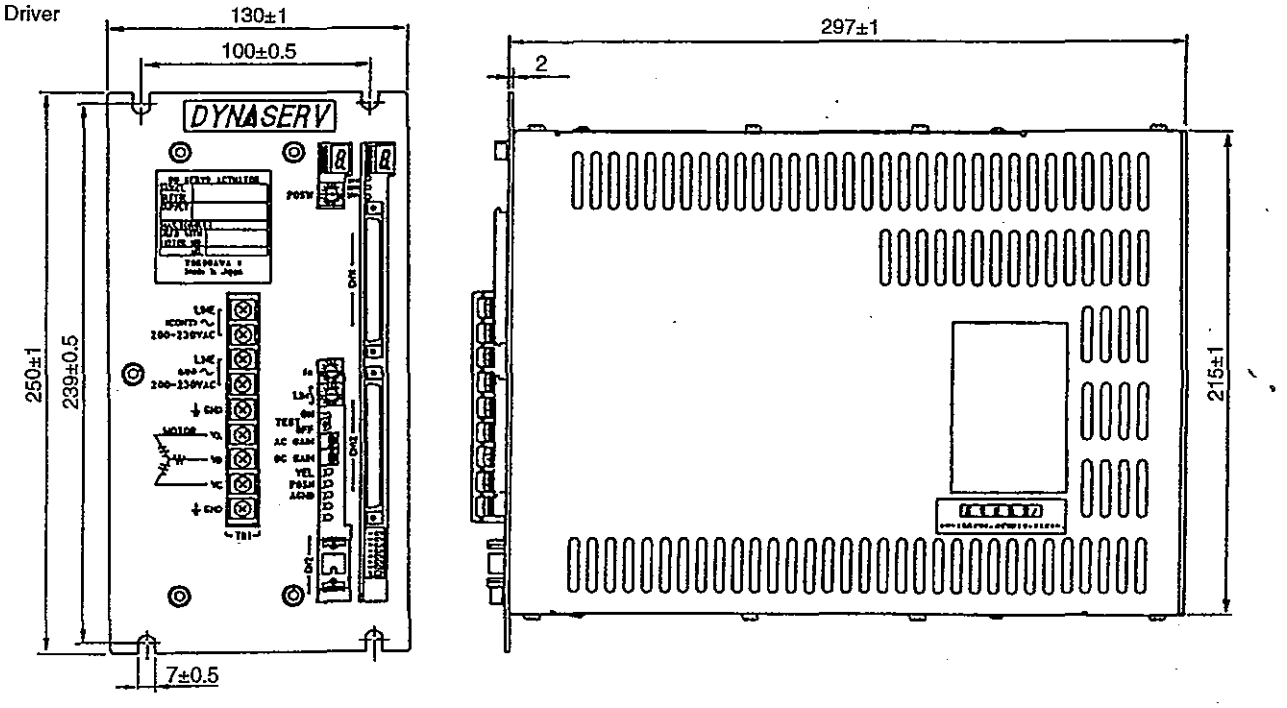
DM/A Series



DM/B Series



Driver



8.4 Driver Block Diagram