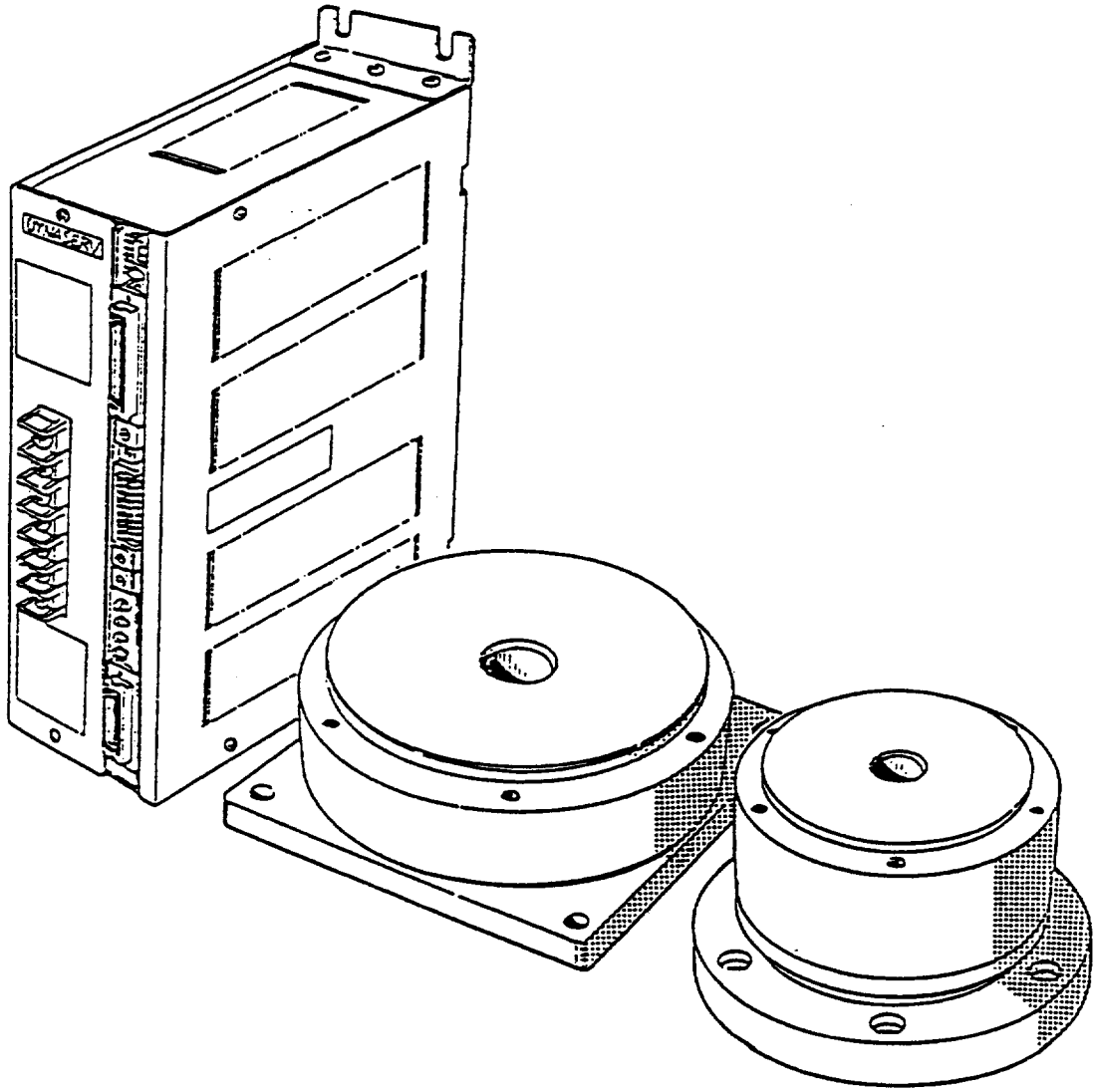
Instruction Manual

DD Servo Actuator
DM Series
Small-diameter and Flat Model

IM A311-E



Parker
Automation

Compumotor
p/n 88-016248-01 Rev A
June 23, 1997

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 series of small-diameter and flat model. Be sure to read this instruction manual prior to operating the DYNASERV.

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Warning on Installation and Operation

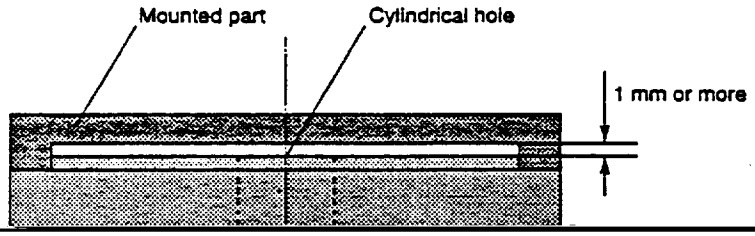
1. Never install the motor with the rotor fixed and the stator set free for rotation.

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 a 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 with a 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 below.)



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1. PRODUCT OVERVIEW

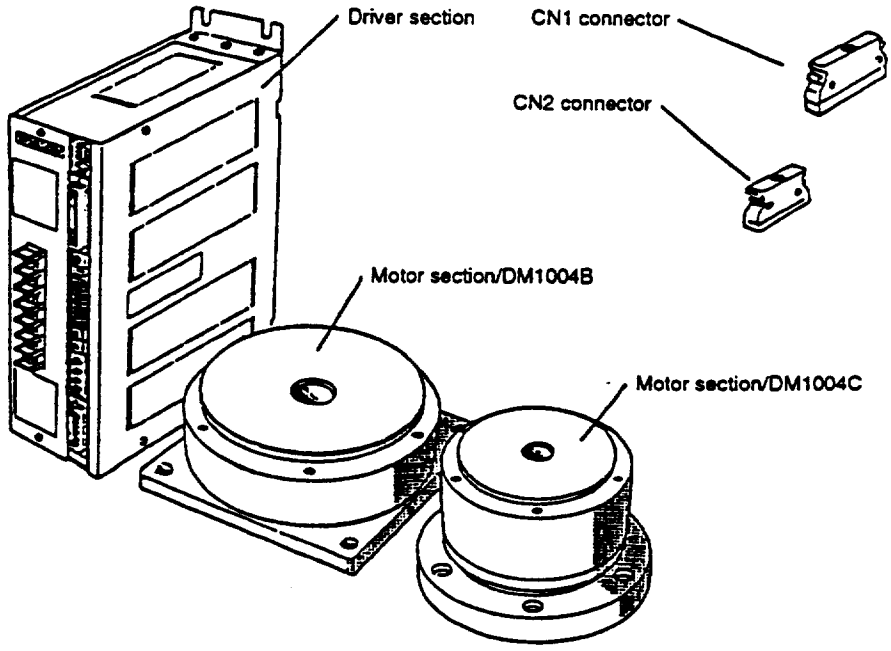
1.1 DYNASERV, DM Series of Small-diameter and Flat Model

The DYNASERV, provided by Parker Hannifin Compumotor Division, is a servo actuator which features high speed, high torque and high accuracy with an outer rotor motor. This DM series controller has a smaller outer diameter and more flattened appearance than conventional DM series controllers based on the basic performance of conventional ones, realizing an outer diameter of 116 mm in the DM small-diameter servo actuator and a height (thickness) of 45 mm in the DM flat servo actuator. Both types incorporate an optical encoder, high resolution and mechanical high accuracy each of which are characteristics of the DM series. These two optimum actuators that are excellent when space is a factor can be used in various applications such as semi-conductor-manufacturing equipment, close examination equipment, or other stages.

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
Main unit	Motor section	1	
	Driver section	1	
Standard accessories	Connector (for CN1 terminal)	1	Manufactured by Fujitsu Connector: FCN241J050-G/E Cover: FCN230C050-D/E
	Connector (for CN2 terminal)	1	Manufactured by Fujitsu Connector: FCN241J020-G/E Cover: FCN230C020-D/E



1.3 Compumotor's Dynaserv P/N Format

D □ — □ □□□ □ — □□□ — □□□

Motor Series Name
M—Encoder
R—Resolver

Motor Speed
1—Standard (up to 2.0 rps)
5—Resolver

Peak Torque (Nm)
004 - 500
Depending on motor type

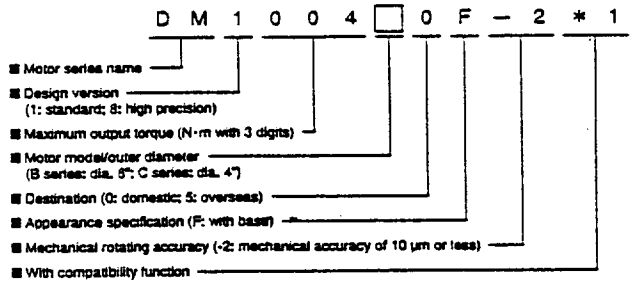
Motor Diameter
A—10"
E—8"
B—6"
C—4"

***Input AC* Voltage**
- **115**
- **200**
- **230**

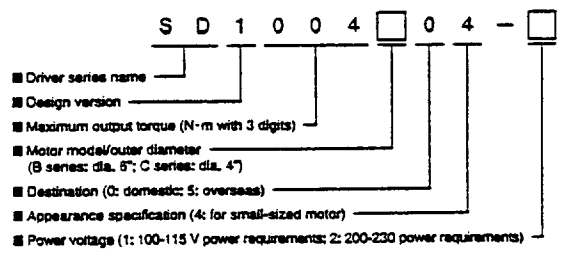
CE Compliance
EMC—EMC & LVD Compliance.
Includes CE-Marked motor, drive, filter, and installation instructions.
The -EMC option is not available with the DR5000A Series.

YPC P/N Format (Reference)

(1) Motor

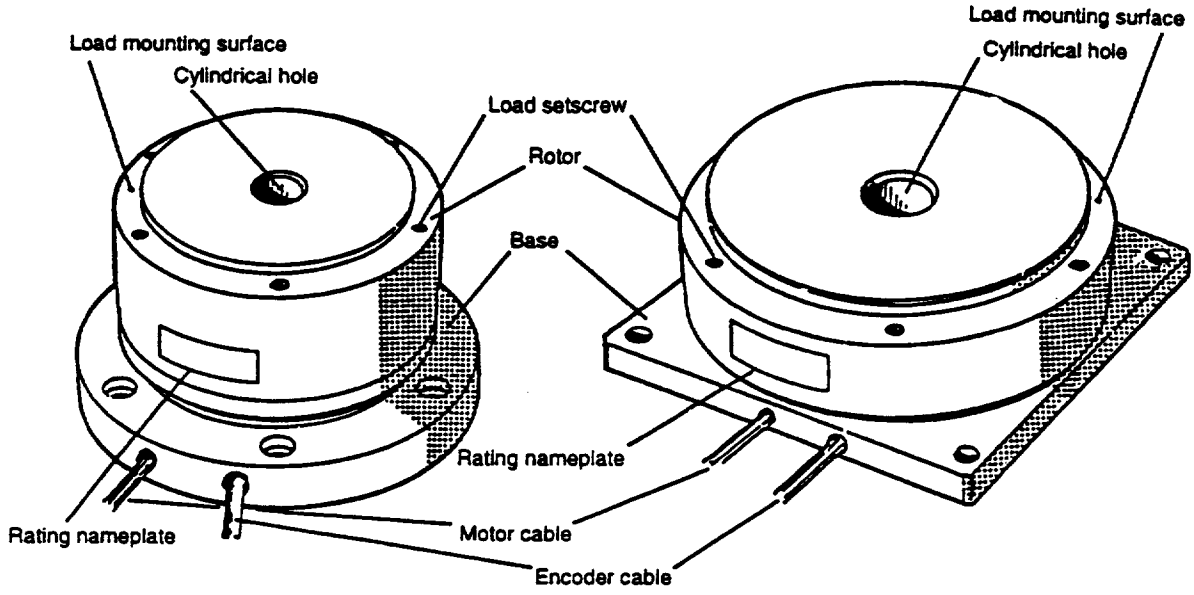


(2) Driver [*: optional]

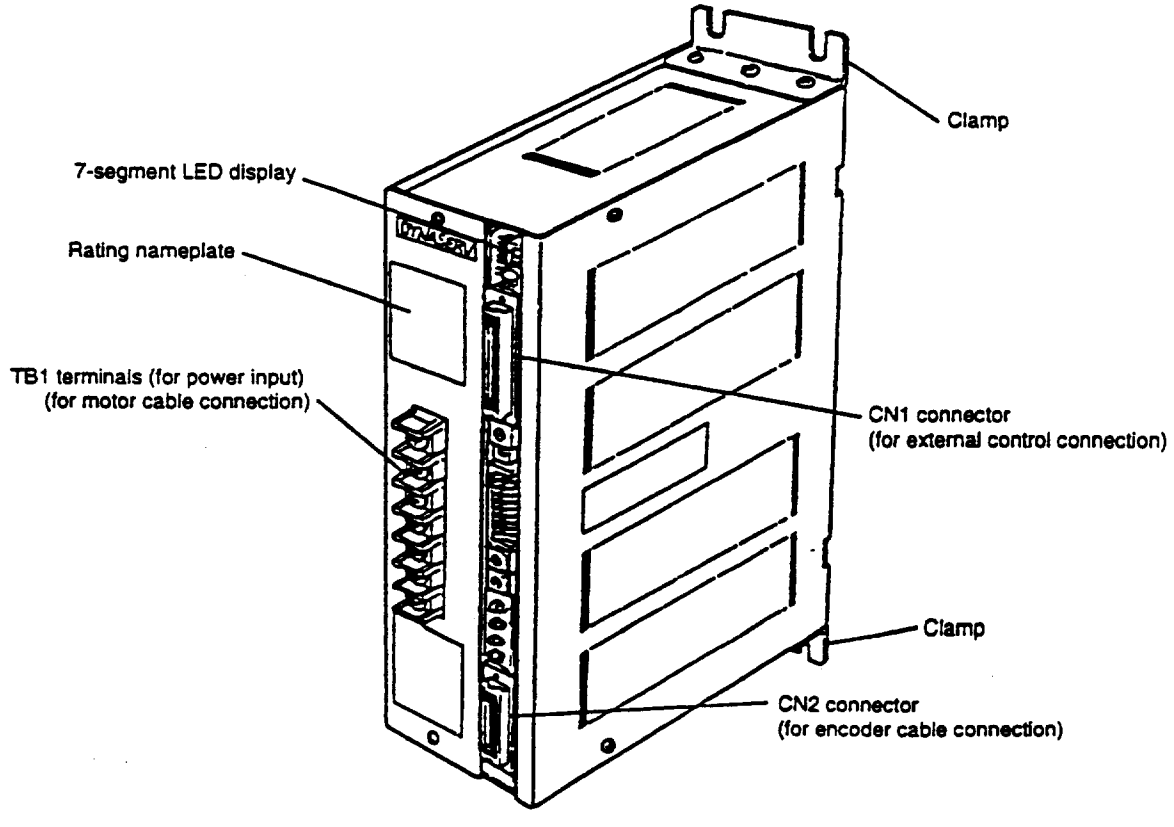


2. FUNCTIONAL DESCRIPTION

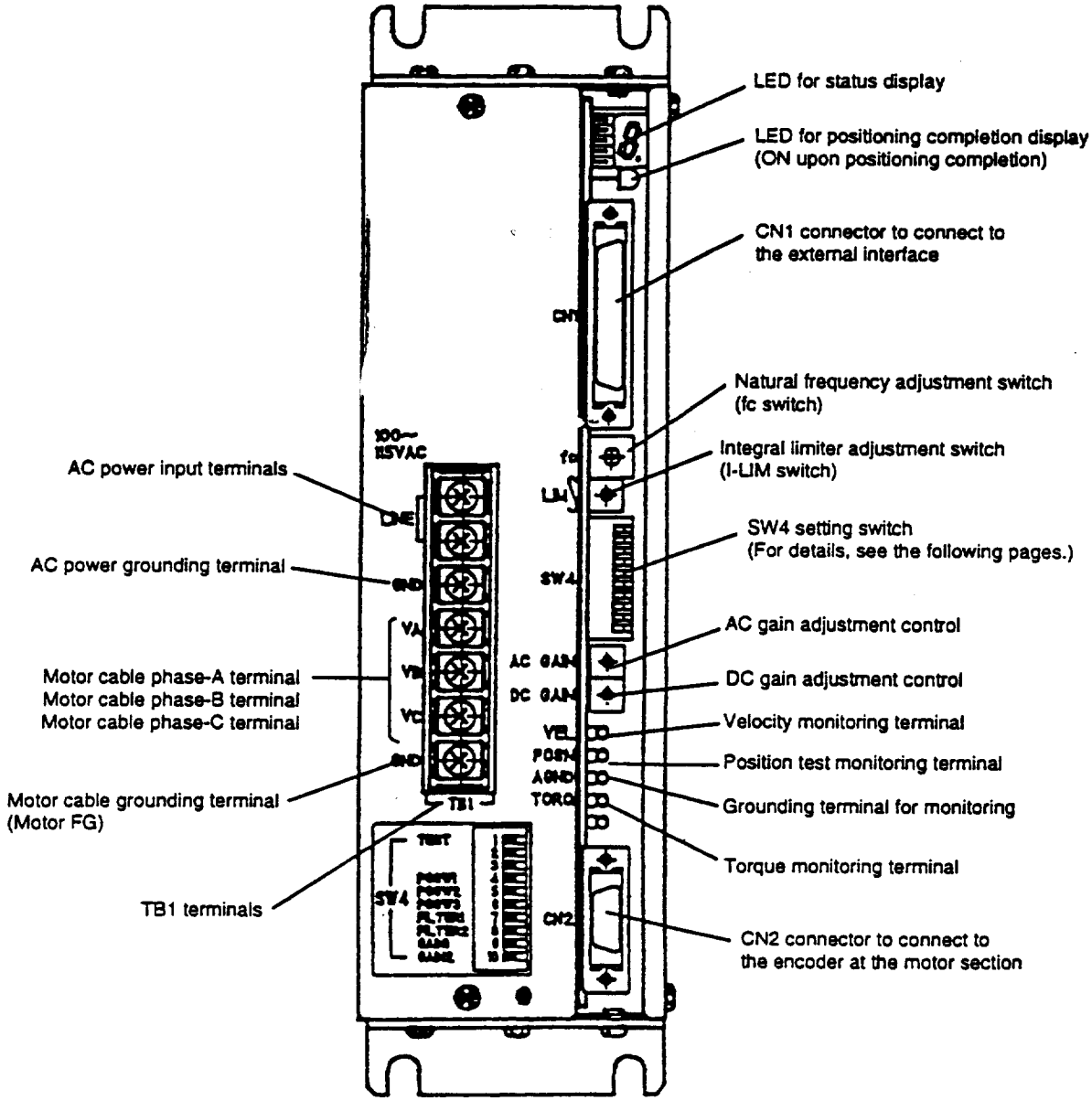
2.1 Motor Section



2.2 Driver Section



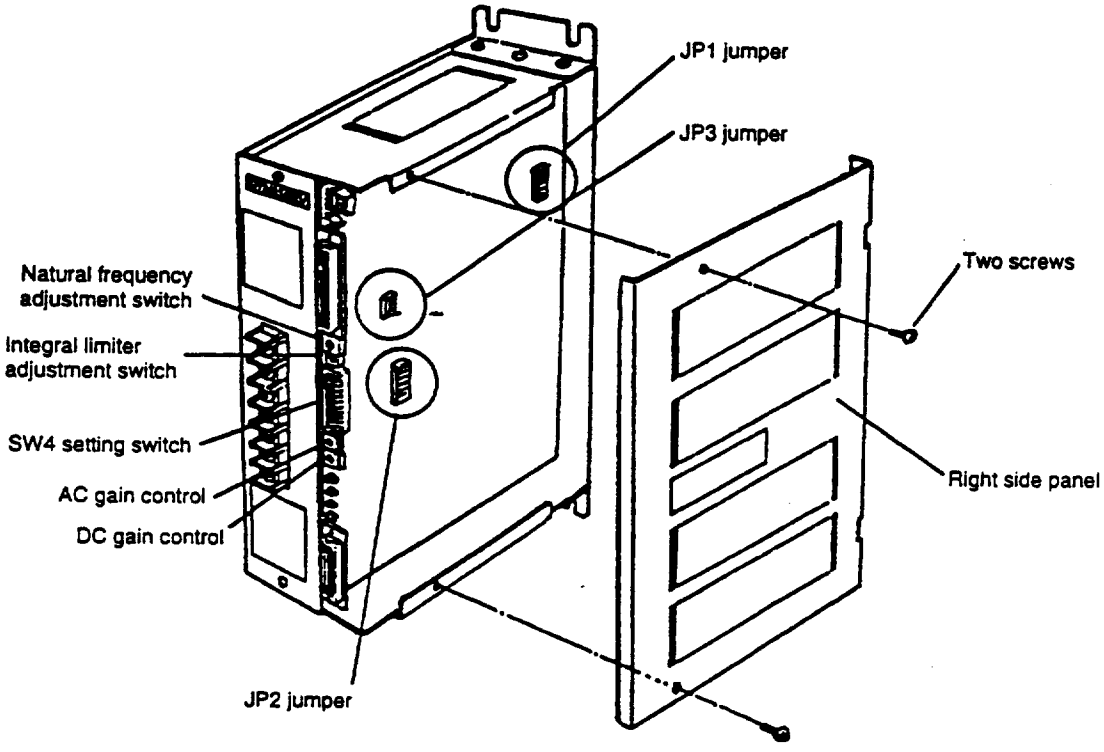
2.3 Driver Section (Panel Surface)



3. PREPARATION FOR OPERATION

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

(2) Jumper Settings Done Prior to Shipment

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

JP1 jumper

Name	Setting status
MODE	■–■
CALIB	□ □
RATE #1	■–■
RATE #2	■–■
UD/AB	■–■

■–■ : Shorted
□ □ : Open

JP2 jumper

Name	Setting status
I	□ □
P	■–■
100	□ □
200	□ □
PV	■–■

■–■ : Shorted
□ □ : Open

JP3 jumper

Name	Setting status
VEL	□ □
TORQ	□ □

□ □ : Open

SW4 switch

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

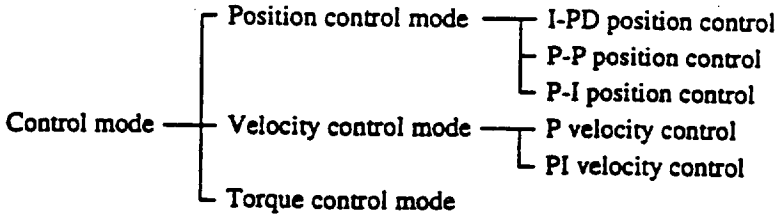
Variable resistors, switches

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

3.2 Control Mode Setting

(1) Control Mode Types

The following six control modes are available for the DYNASERV DM Series:



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

Control Modes and Jumper Pin Switch Settings

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

■-■: Jumper shorted

□ □: Jumper open

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

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

(2) Functions and Details on Jumpers and Switches

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

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

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

Setpoint		Multiplication factor
<RATE#1>	<RATE#2>	
■-■	■-■	1
□ □	■-■	2
■-■	□ □	4
□ □	□ □	8

b) [UD/AB] jumpers (JP1)

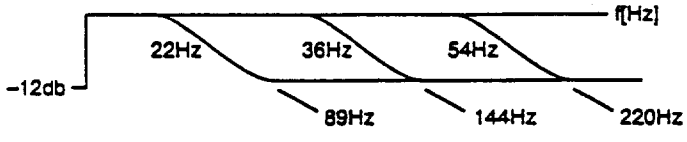
The selection of these jumpers enables selection of the A/B phase or the UP/DOWN phase. The shorted jumper results in the A/B phase, and the open jumper, the UP/DOWN phase.

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

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

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

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



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

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

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

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

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

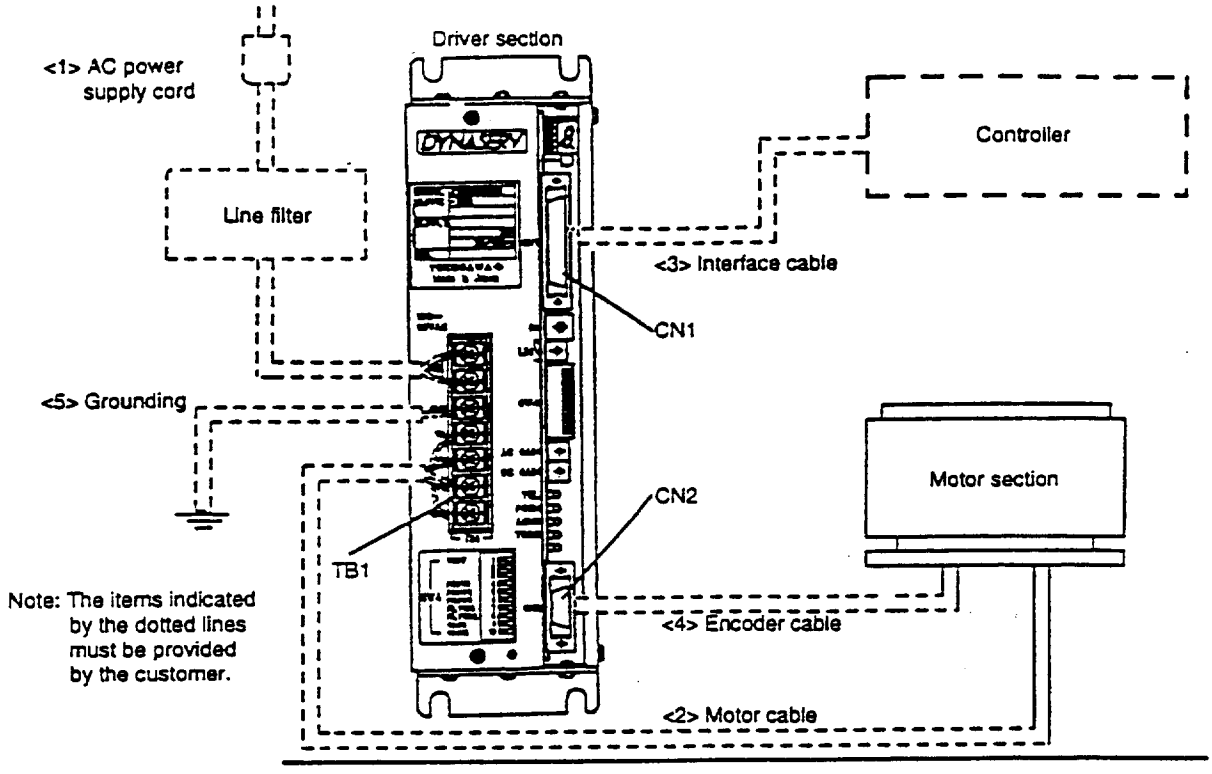
These are subswitches to set the loop gain magnification when the loop gain is variably adjusted using the DC GAIN adjustment control provided at the front panel of the driver. Setting the two subswitches can select the magnification shown in the table. The function to vary the gain magnification by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

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

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

3.3 Connection

(1) External Connection Diagram



(2) Cable Sizes and Rated Currents

Cable			Specification
Power Line	① AC Power Cable	Current (A)	10
		Cable Size	More than 0.5mm²(20 AWG); Length: ≤ 30 m(98 ft)
	② Motor Cable	Current (A)	5
		Cable Size	More than 0.5mm²(20 AWG); Length: ≤15 m(49 ft)
Signal Line	③ Controller Cable	Current (A)	100 mA DC Maximum
		Cable Size	0.2mm²(24 AWG) twisted pair cable having an outer diameter of 14mm(0.55in) or less. Collectively shielded wire. Length: ≤ 3m(10 ft)
	④ Encoder Cable	Current (Arms)	100 mA DC Maximum
		Cable Size	0.2mm²(24 AWG) twisted pair cable having an outer diameter of 14mm(0.55in) or less. Collectively shielded wire. Length: ≤ 10m(30ft)
	⑤ Grounding	Cable Size	More than 0.5mm²(20 AWG)

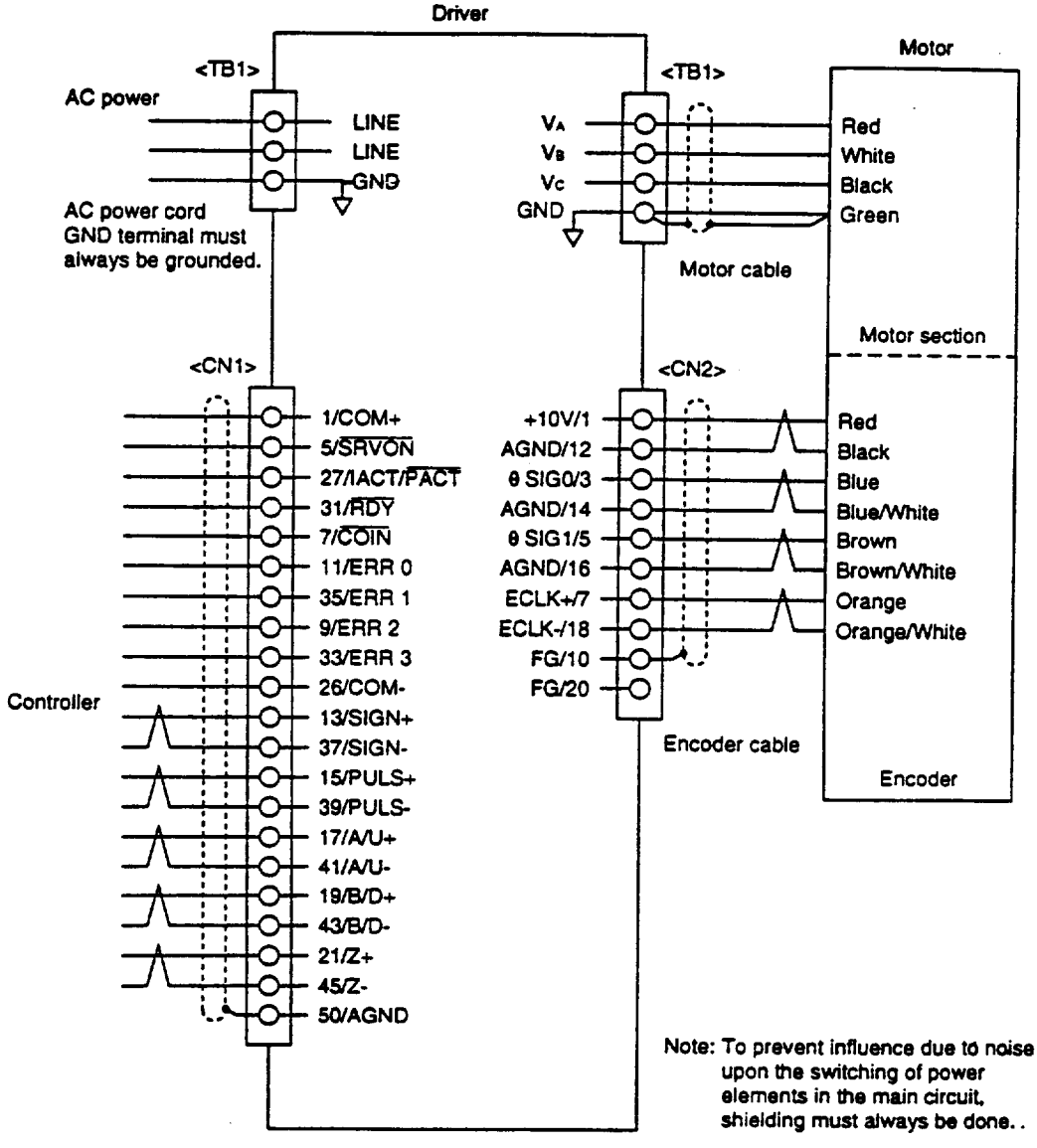
1. Current values = rms of rated current

Wiring Cautions

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

(3) Connection Between the Motor and the Driver; Connection Between the Driver and the Controller

(Connection between the driver and the controller: in the position control mode)



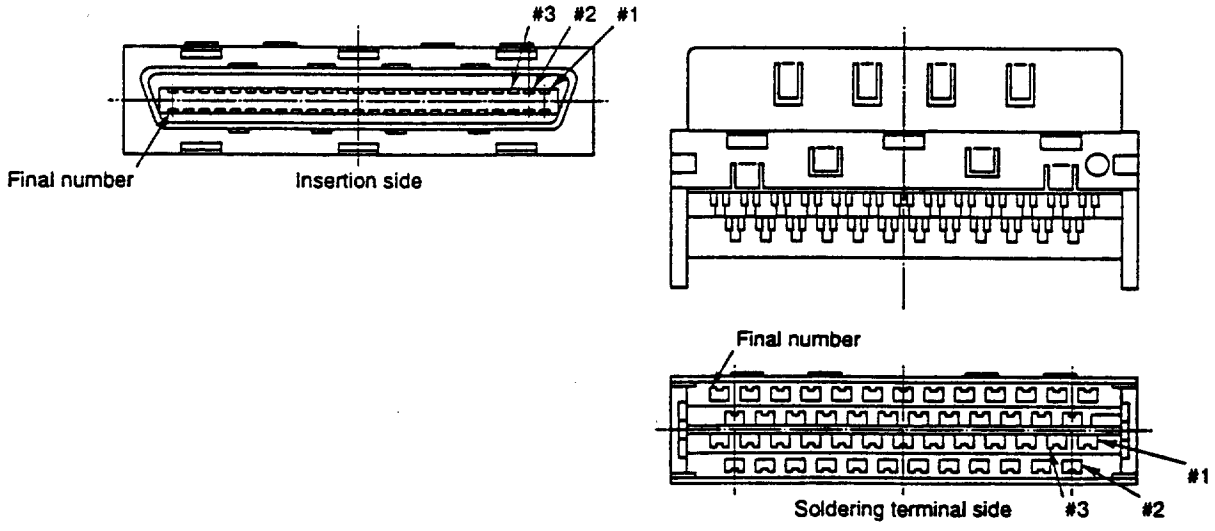
(4) Pin Arrangement of CN1 and CN2 Terminals and Connection Signals

a) CN1 terminal

Pin #	Signal name	Pin #	Signal name	Pin #	Signal name	Pin #	Signal name	Pin #	Signal name
1	COM+	11	ERR 0	21	Z+	31	$\overline{\text{RDY}}$	41	A/U-
2	———	12	———	22	AGND	32	———	42	———
3	$\overline{\text{GAIN 2}}$	13	SIGN+	23	TRQIN	33	ERR 3	43	B/D+
4	———	14	———	24	AGND	34	———	44	———
5	$\overline{\text{SRVON}}$	15	PULS+	25	VELIN	35	ERR 1	45	Z-
6	———	16	———	26	COM-	36	———	46	———
7	$\overline{\text{COIN}}$	17	A/U+	27	IACT/$\overline{\text{PACT}}$	37	SIGN-	47	TLIM
8	———	18	———	28	$\overline{\text{IRST}}$	38	———	48	GND
9	ERR 2	19	B/D+	29	$\overline{\text{RST}}$	39	PULS-	49	VELMON
10	———	20	———	30	———	40	———	50	AGND

b) CN2 terminal

Pin #	Signal name	Pin #	Signal name
1	+10V	11	———
2	———	12	GND
3	SIG 0	13	———
4	———	14	GND
5	SIG 1	15	———
6	———	16	GND
7	ECLK+	17	———
8	———	18	ECLK-
9	———	19	———
10	FG	20	FGS



Arrangement of terminal pin numbers (50 pins)

(5) Connections to 6000 Series Controllers/Indexers

DM1004B/C		6250/AT6n50	
50 Pin Connector (CN1)		Drive Connector	
- - -		COM	Pin 2
Servo On -	Pin 5	SHNO	Pin 4
Ready +	Pin 31	DFT	Pin 5
Com -	Pin 26	AGND	Pin 6
Agnd-TQ(Agnd-VEL)*	Pin 22(24)*	CMD -	Pin 8
Vin-TQ(Vin-VEL)*	Pin 23(25)*	CMD +	Pin 9
		Encoder Connector	
- - -		GND	Pin 2
Com +	Pin 1	+5V	Pin 9
A -**	Pin 41**	A +**	Pin 8**
A +**	Pin 17**	A -**	Pin 7**
B +	Pin 19	B +	Pin 6
B -	Pin 43	B -	Pin 5
Z +	Pin 21	Z +	Pin 4
Z -	Pin 45	Z -	Pin 3

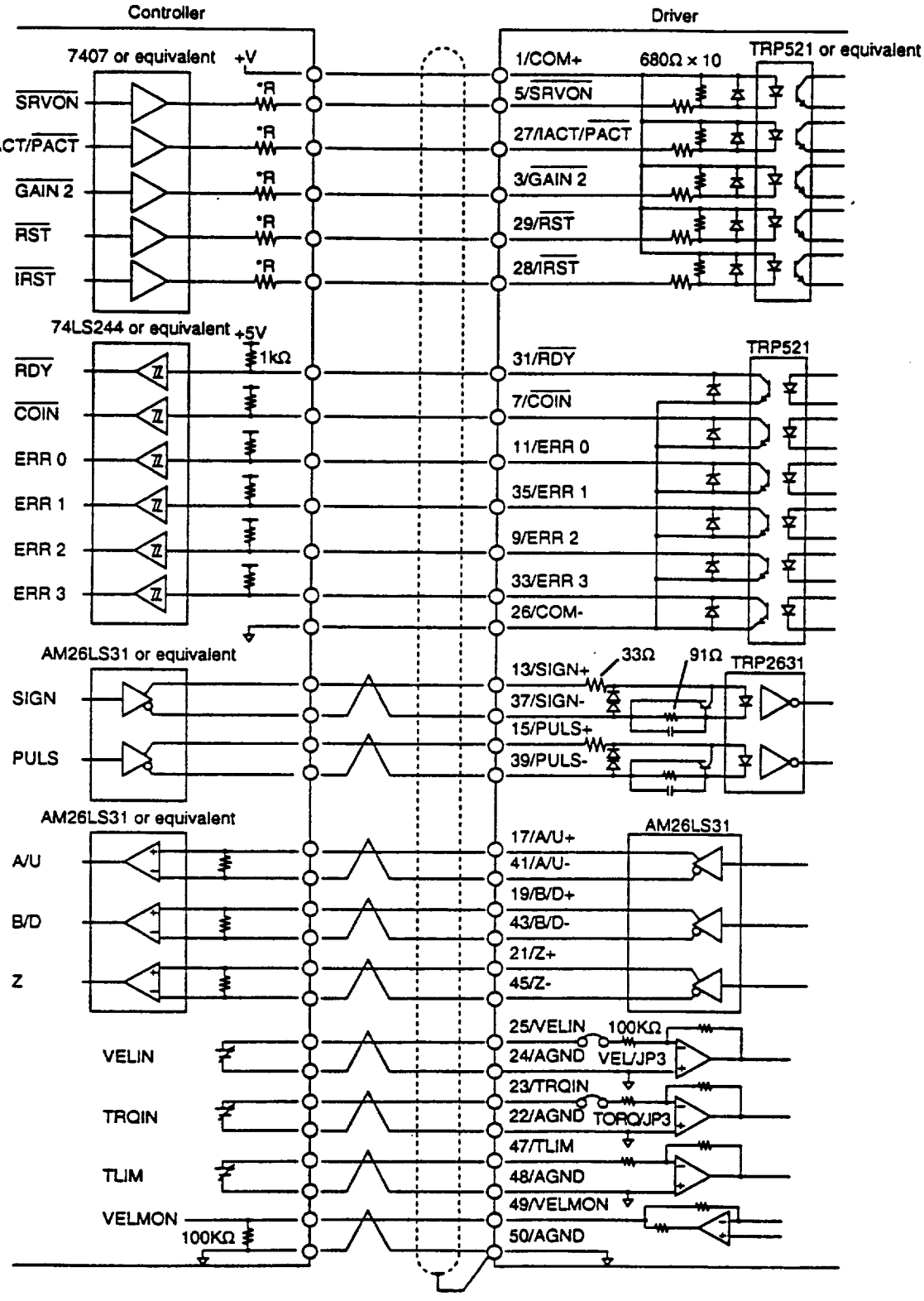
NOTE: Connect COM to GND

* Pins 23 & 22 are CMD+/- in Torque mode(25 & 24 in Velocity mode)
**Please note that A+ and A - are swapped.

DM1004B/C		6200/AT6n00	
50 Pin Connector (CN1)		Drive Connector (15 pin D)	
Pulse +	Pin 15	Step +	Pin 1
Pulse -	Pin 39	Step -	Pin 9
Sign +	Pin 13	Dir +	Pin 2
Sign -	Pin 37	Dir-	Pin 10
Com +	Pin 1	Sht -	Pin 12
Servo On -	Pin 5	Gnd	Pin 14
Servo Ready +	Pin 31	Dft +	Pin 5
Servo Ready -	Pin 26	Dft -	Pin 13
		Encoder Connector	
A -**	Pin 41**	A +**	Pin 8**
A +**	Pin 17**	A -**	Pin 7**
B +	Pin 19	B+	Pin 6
B -	Pin 43	B -	Pin 5
Z +	Pin 21	Z +	Pin 4
Z -	Pin 45	Z -	Pin 3

**Please note that A+ and A - are swapped.

(6) Connection to External Controller



Insert a resistance of 0Ω at 5 V, 680Ω at 12 V, and 1.2 kΩ at 24 V in the circuits marked *R.

3.4 I/O Signals

(1) **Input** (Note: Number in parentheses indicates Vcc signal input terminal.)

Signal name	Pin No.	Meaning	Details
COM +	1	Signal power	Usually a voltage of 5 V is entered (voltages from 5 to 24 V are allowed). However, if you enter a voltage of 24 V, insert a resistance of 1.2 kΩ.
SIGN+ SIGN-	13 37	Rotating direction command	The motor rotates clockwise with this signal set to H and counterclockwise with the same signal set to L. (When viewed from the load side, it is the same hereafter.)
$\overline{\text{IRST}}$	28 (1)	Integral capacitor reset	The integral capacitor in the velocity loop is shorted.
$\overline{\text{SRVON}}$	5 (1)	Servo ON	The motor is in the servo ON status 0.2 sec. after this signal is set to L to bring the driver to the command wait status.
IACT/$\overline{\text{PACT}}$	27 (1)	Integral/proportional action selection	Integral action is selected when this signal is set to H and proportional action is selected when this signal is set to L in the position control mode.
TLIM	47 48	Torque limit	The maximum torque is limited according to the torque limit signal (analog) thus entered. The voltage between -8 and +8 V must be entered. When a voltage of -8 V is entered, it becomes the maximum torque. If this signal is not used, always keep it open.
$\overline{\text{GAIN2}}$	3 (1)	Gain selection	This selects the DC gain variable range. This has the same function as GAIN 2 in the SW4 switch. To use this signal, the GAIN 2 subswitch must be set to off. (see Note 1)
$\overline{\text{RST}}$	29 (1)	CPU reset	The driver control section is initialized with this signal set to L for more than 1 msec (the same status as power on). It takes about 3 seconds to be in the operable [RDY] status.
PULS+ PULS-	15 39	Position command pulse	Position command pulse signal. A pulse width of 150 nsec or more is required.
VELIN	25 24	Velocity command input	This is an analog signal to enter a velocity command to the motor when this actuator is in the velocity control mode. The maximum number of rotations is obtained at ± 10V input. The input sensitivity is 2.5 V/rps.
TRQIN	23 22	Torque command input	Maximum torque is generated at ±8V.

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

Signal name	Pin N	Meaning	Details
COM -	26	Signal GND	Usually a voltage of 5 V is entered (voltages from 5 to 24 V are allowed). However, if you enter a voltage of 24 V, insert a resistance of 1.2 kΩ.
A+/U+ A-/U- B+/D+ B-/D-	17 41 19 43	Position feedback pulse signal	Pulse signal to indicate the motor's rotating position. Either an A/B phase or UP/DOWN phase pulse can be selected with the jumper on the board. These are differential output signals because the velocity of frequency is very high.
$\overline{\text{RDY}}$	31 (26)	Servo ready	The motor is ready to operate with this signal set to L. This signal is set to the H level about 3 seconds after driver power on.
VELMON	49 50	Velocity monitoring	Signal for monitoring the number of motor rotations to output positive voltage for clockwise rotation and negative voltage for counterclockwise rotation.
$\overline{\text{COIN}}$	7 (26)	Positioning completion signal	This signal shows that the position deviation is within the positioning completion width. This signal is set to L when positioning is completed.
ERR 0 ERR 1 ERR 2 ERR 3	11 (26) 35 (26) 9 (26) 33 (26)	Error status output	These signals output error statuses. Generally, the RDY signal turns off as an error occurs. However, RDY signal remains as is depending on error contents.
Z+ Z-	21 45	Origin pulse	Signal for detecting the position of origin at any of 124 positions obtained by equally dividing the periphery of the motor.

(Note 1)

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

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, if the product needs to be mounted upside down, consult*** *Parker Hannifin Compumotor Div. or its authorized agency.* 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:

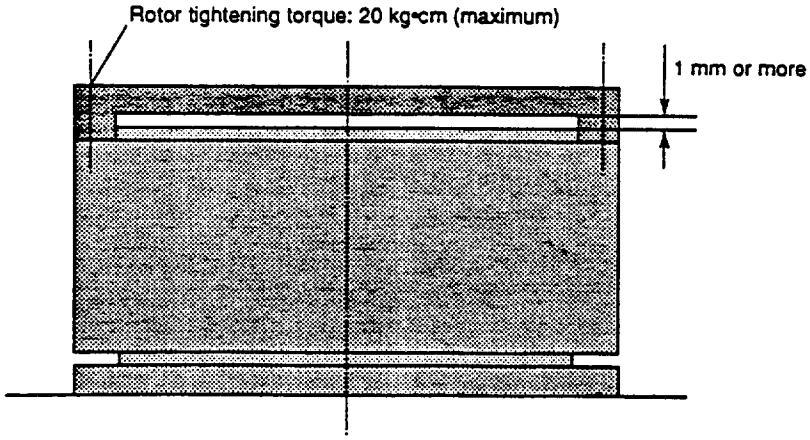
- There are no corrosive or explosive gases.
- The ambient temperature is between 0° and 45°C.
- Dust concentration is low, with adequate air ventilation and low humidity.

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's upper surface and the load.
- Secure the motor's 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.



(2) Driver Mounting

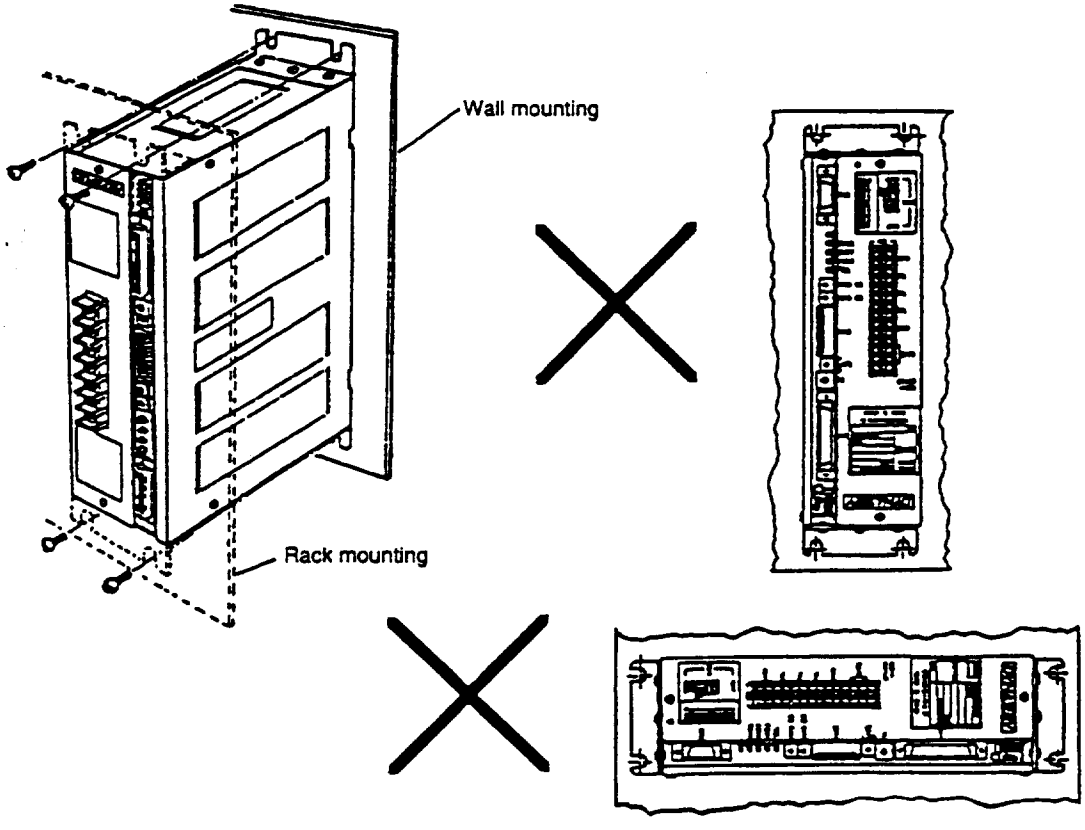
The standard driver is designed for rack mounting or wall mounting.

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 a rack with appropriate vibration insulators.
- Further, installation must be in 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. (See the figure below.)
- Never use screws having a length of 6 mm or more to fix the clamps to the driver box to avoid damaging the controller board.



4. CAUTION ON OPERATION

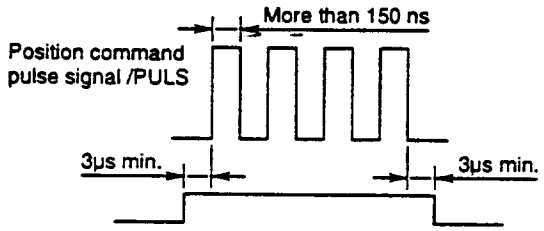
4.1 Cautions on I/O Signals

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

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

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

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



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

(3) Velocity Command Input (VELIN)

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

(4) Torque Command Input (TRQIN)

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

(5) Torque Limit Input (TLIM)

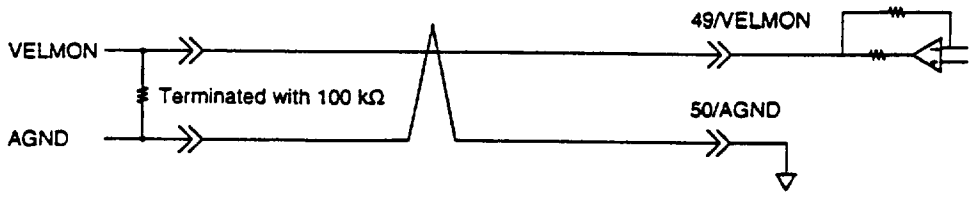
This is an analog signal to limit (regulate) the motor current.

(6) Velocity Monitoring Output (VELMON)

Motor analog velocity monitoring output

Output voltage: At maximum velocity +6 V (clockwise)

At maximum velocity -6 V (counterclockwise)

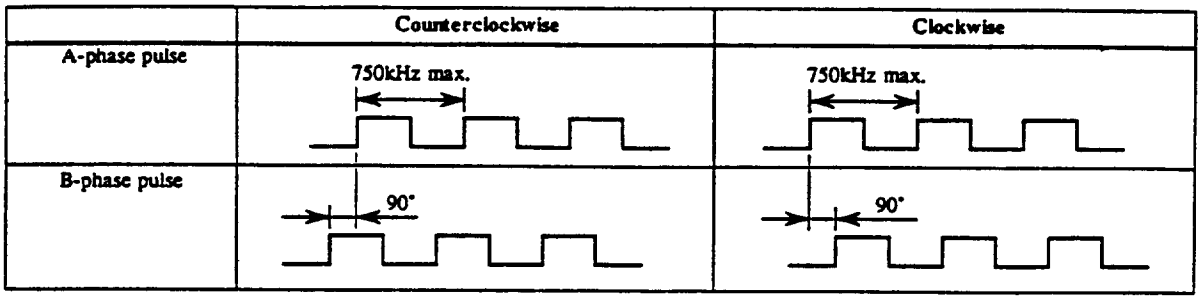


(7) A/B Phase, UP/DOWN Pulse Output Signals (A/U±, B/D±)

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

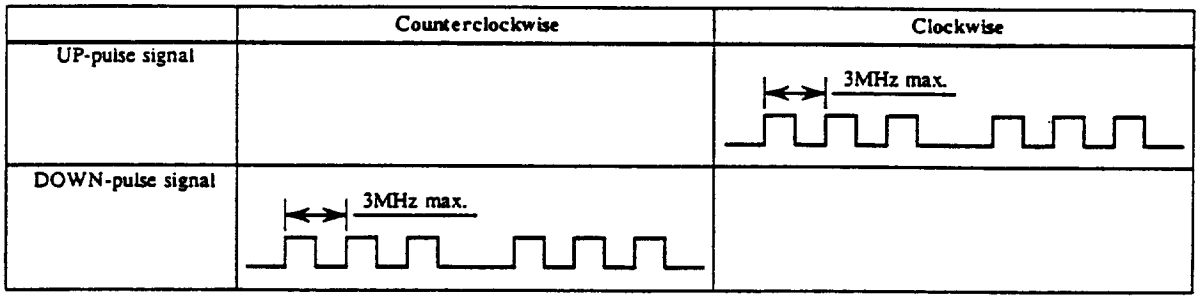
a) A/B Phase Output Pulse

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



b) UP/DOWN Output Pulse

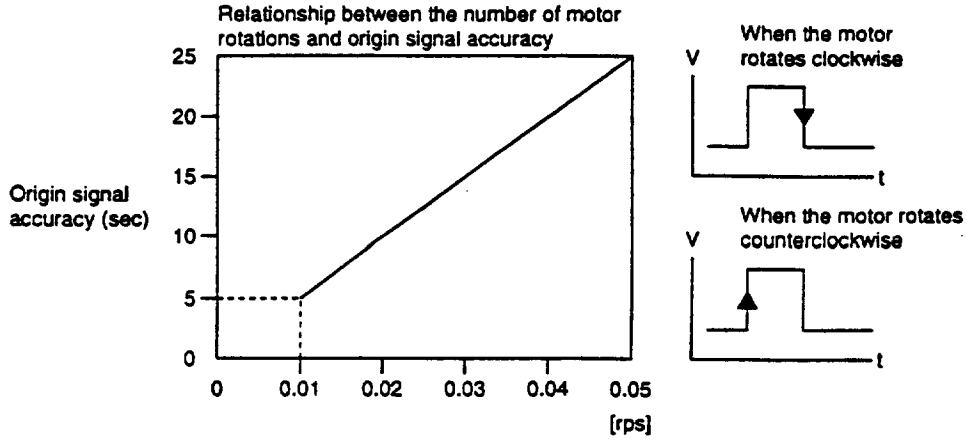
The following pulse signal is output with the jumper [UD/AB] on the controller board opened.



Note: Because PULS±, SIGN±, A/U±, B/D±, and Z± are high speed pulse signals, a differential I/O interface is required.

(8) Origin Pulse Output Signal (Z±)

The origin signal is generated at a position where one rotation of the motor is equally divided into 124. When the origin position is detected, the next pulse signal is output. The point at which H changes to L when the motor rotates clockwise, or L changes to H when the motor rotates counterclockwise, corresponds to the origin position.



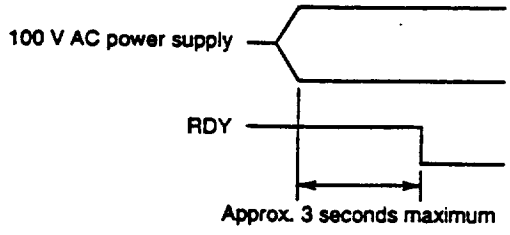
4.2 Power On/Off

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

(1) The inrush current in both the main and control power circuits is about 20 A (100 V AC source) peak.

(2) The motor is set to the servo status about 200 ms after the SRVON signal is set to L. At this time, serial pulse input becomes effective.

(3) After the power supply is turned on, the RDY=H condition is maintained up to 3 seconds.



5. CONTROL MODE AND ADJUSTMENT

5.1 Position Control Mode Adjustment

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

(1) I-PD Position Control

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

a) fc switch

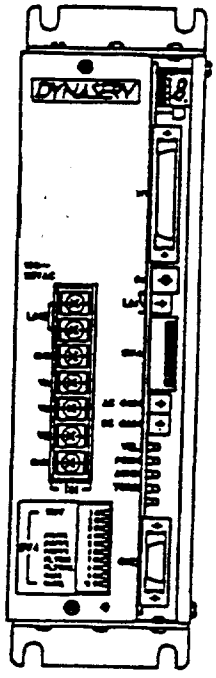
The 1 to 16 Hz position control system band is selected from a scale of 0 to F.

b) I-LIM switch

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

c) DC gain adjustment control

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



(2) **P Position Control**

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

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

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

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

The position control system can be adjusted in the test mode. Turning on the test switch at the front of the driver generates a 2.5-Hz square-wave position command signal inside the driver to output the motor position to the POSN signal terminal. At this time, note that the motor reciprocates in a fine rotating angle.

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

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

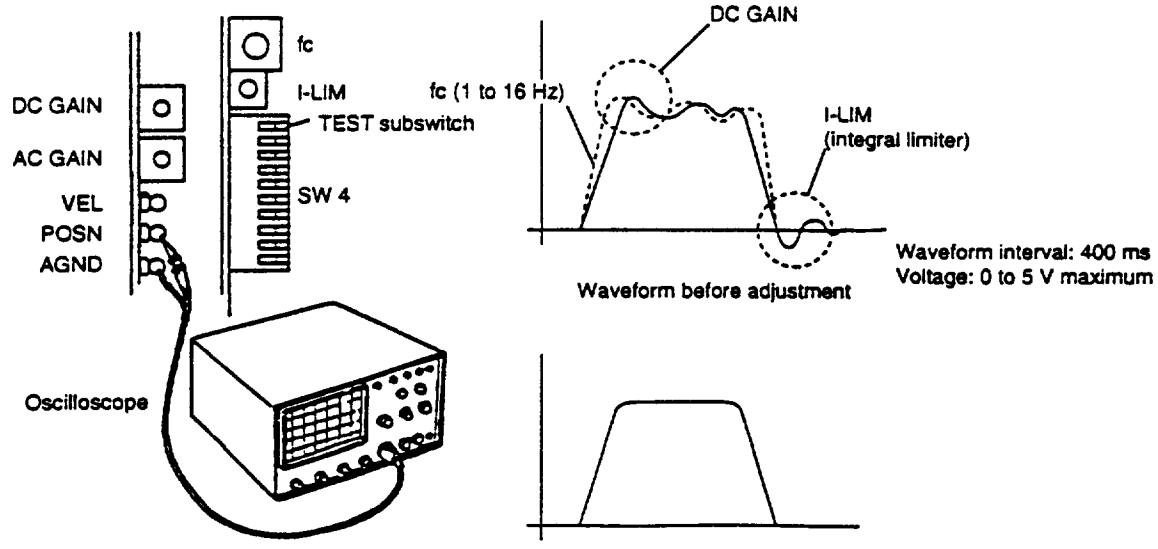
Step 2: Set the CN1 connector SRVON signal to L. At that time, set the TEST subswitch to off.

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

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

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

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



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

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

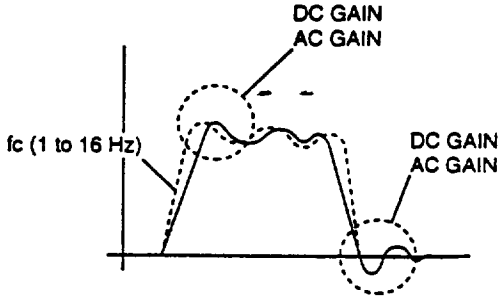
Step 2: Set the CN1 connector SRVON signal to L. At that time, set the TEST subswitch to off.

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

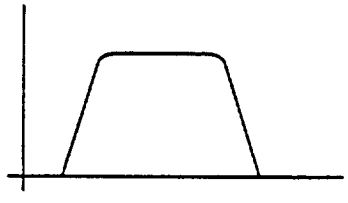
Step 4: Adjust the fc switch. Its variable range is from 1 to 16 Hz. Set AC gain control to a large value within the range in which there is no hunting. Fine adjustment is made by DC gain control. Perform the above adjustments so that the POSN signal becomes a square wave.

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

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



Waveform before adjustment



Waveform after adjustment (optimum waveform)

5.2 Velocity Control Mode Adjustment

In the velocity control mode, the motor rotating angle is controlled so as to correspond to the velocity command voltage (-10to +10 V) from the higher-level controller. The two control methods can be selected in the velocity control mode. The following table shows the relationship between the velocity command voltage and motor velocity.

Model	Velocity / Input voltage (rps/v)
DM1004B, DM1004C	2/5

(1) PI Velocity Control

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

a) DC gain

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

b) AC gain

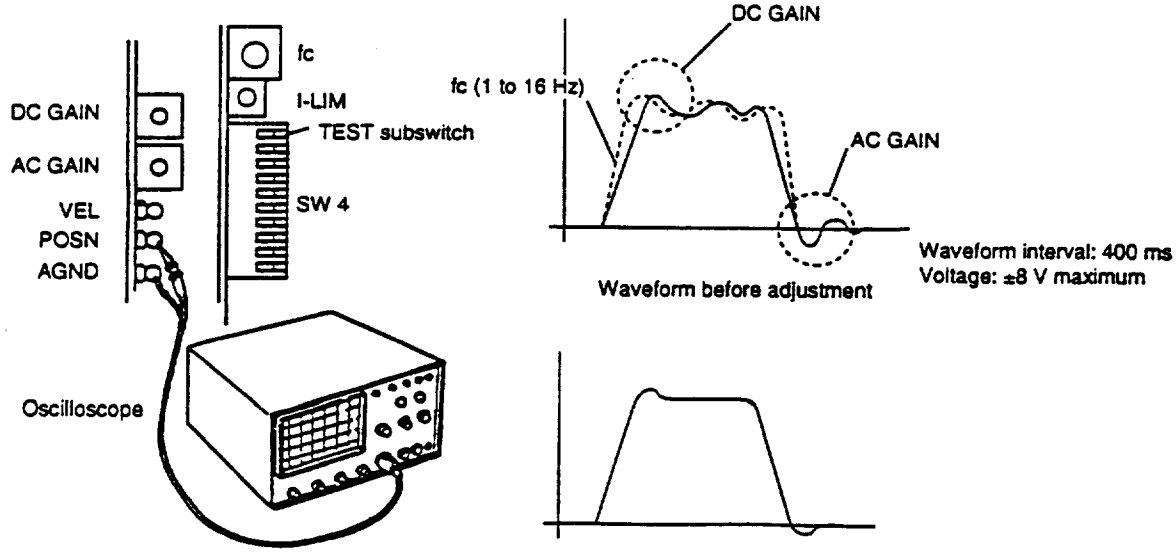
Velocity loop band damping is adjusted.

(2) P Velocity Control

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

(3) Adjustment of Velocity Control System

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



5.3 Torque Control Mode Adjustment

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

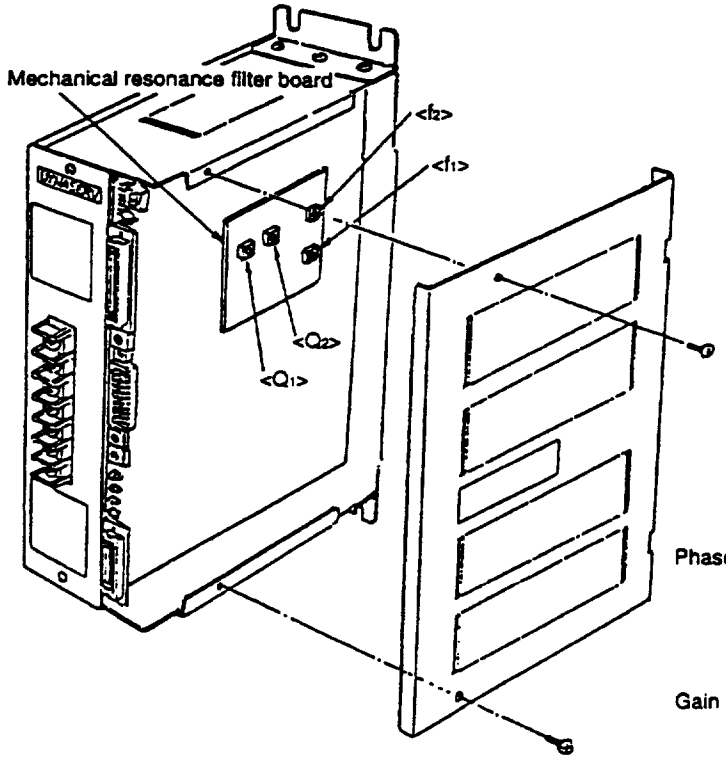
NOTE

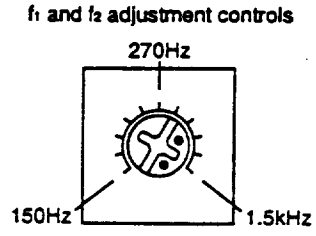
When desirous of using the torque control mode, carefully plan and design the velocity and position control loops and a proper interlocking system so that the final control system meets the exact specifications of the application. This mode must be designed after sufficient deliberation of safety.

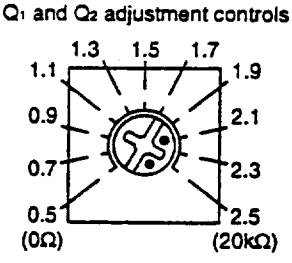
5.4 Mechanical Resonance Notch Filter Adjustment

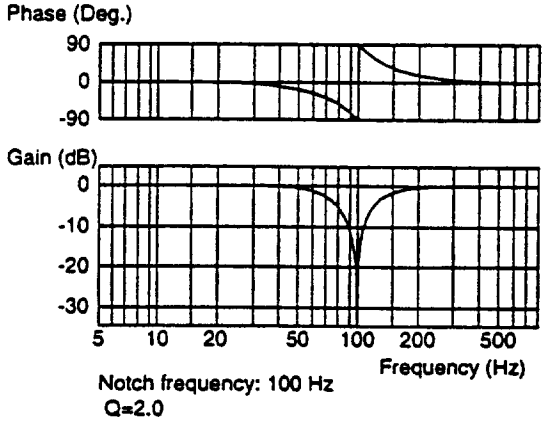
The following explains the adjustment procedure when a mechanical resonance notch filter is installed as an option. The board of the filter is located as shown in the figure below just inside the square cut-out on the side of the driver. Controls f_1 and f_2 on the board are used to set the notch frequencies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

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









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

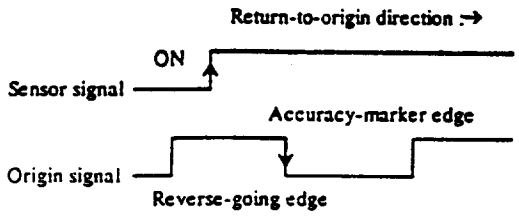
There is no need for daily maintenance of the driver section. However, clean the driver section periodically to prevent it from poor insulation caused by accumulated dust.

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 Parker Hannifin Compumotor Div.or its authorized agency.

Problem	Estimated Cause	Inspection Item	Measure	Page for Reference
The motor is not servo-locked.	♦ No AC power is being fed.	Wiring	Turn on the specified AC power	3-6, 3-7
	♦ The servo ON (SRVON) terminal is set to H.	Inspection	Set to L	3-11
	♦ The CPU reset (RST) terminal is set to L.	Inspection	Set to H	3-11
	♦ The integral capacitor reset (IRST) terminal is set to L.	Inspection	Set to H	3-11
	♦ fc, I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4
The motor does not start.	♦ Overloaded	Operation of the motor with no load.	When starting the motor, lighten the load or replace the motor with a larger output motor.	
	♦ Incorrect external wiring	Inspection of wiring	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
	♦ fc, I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4

Problem	Estimated Cause	Inspection Item	Measure	Page for Reference
Motor rotation is unstable.	♦ Imperfect connection	Check of connection of each phase of A, B, C and GND.	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
	♦ The motor and driver combination is inappropriate.	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-2
The motor overheats.	♦ Ambient temperature is high.	Check if ambient temperature is greater than 45°C.	Lower the ambient temperature to below 45°C.	
	♦ Overloaded	Operation of the motor with no load.	When starting the motor, lighten the load or replace the motor with a larger output motor.	
Abnormal sound is produced.	♦ Incorrect mounting	Looseness of screws	Tighten the screws.	
	♦ Problem with 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
	♦ Overloaded		Recheck the operation. Lighten the load.	3-11, 3-12
	♦ fc, I-LIM, or DC gain is too small.	Inspection	Adjust to the appropriate value	5-1 - 5-4
The motor runs out of control.	♦ Incorrect motor/driver combination	Check of combination numbers on the nameplate.	If the combination is wrong, then return to the appropriate combination.	1-2
	♦ Improper jumper setting	Inspection	Perform correct jumper setting.	3-1 - 3-5
	♦ Improper connection	Check of motor/encoder connection.	Re-wire correctly by referring to the connection diagram.	3-6, 3-7
Position is dislocated.	♦ Incorrect A/B-phase and U/D pulse jumper selection	To be inspected		3-1 - 3-5
	♦ Command pulse rate and width are not as specified.	Check the command pulse width.		4-1, 4-3
	♦ Feedback pulse rate and receive circuit response speed are not as specified.	Check the feedback pulse rate (3 MHz max.) and receive circuit response speed.		4-1, 4-3
	♦ Neither end of the feedback pulse transmission cable shield is connected to the ground.	To be inspected. If so, connect the driver to AGND and the controller to SG.		
The motor does not return to its origin accurately.	■ Connection with unmatched controller	Check the method for returnig the motor to its origin and reconfigure the settings.		
	■ Improper positioning of the "around-the-origin" sensor	Observe the positional relationship of the accuracy-marker edge of the "around-the-origin" sensor signal with the one for the origin signal using an oscilloscope to ensure that these two edges do not overlap.		
	■ Chattering in origin signal	Check for any chattering in the origin signal. Increasing the speed of the return-to-origin signal helps prevent chattering from occurring. If chattering still persists, adjust the position of the "around-the-origin" sensor. (If the reverse-going edge appears first, you may confuse it with the accuracy-marker edge.) 		

7.2 LED Displays

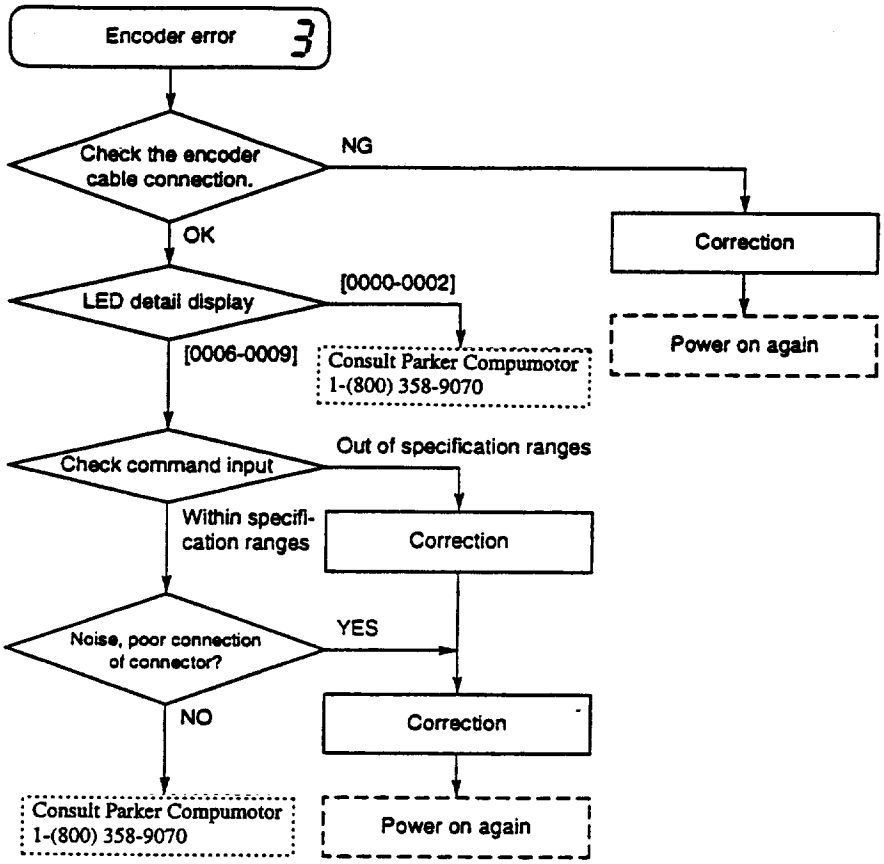
A 7-segment LED is mounted on the front panel of the driver to display the normal / abnormal status of the motor and driver. An error is output as a signal at the same time. Display details are as shown in the following tables.

LED display			Output signal					Status	Estimated cause	Possibility of recovery
Servo		Display details with TEST subswitch on	ERR				RDY			
OFF	ON		3	2	1	0				
0	0.	—	L	L	L	L	L	Normal display		
1	1.	—	L	L	L	H	L	Overspeed	Velocity detection signal exceeds the specified range (3 rps).	Possible
2		—	L	L	L	L	H	RAM error	RAM read/write error	Impossible
3		0000-0002	L	L	H	H	H	Encoder error	Encoder signal level is lowered. See Section 7.3, "Procedure for Error Correction."	Impossible
		0006-0009							Encoder signal having abnormal intervals is entered. See Section 7.3, "Procedure for Error Correction."	
6		—	L	H	H	L	H	Over count, shut down	Effective only upon option setting	Impossible
	6.						L	Counter overflow	Position deviation is greater than 32,767 pulses in the position control mode.	Possible
7		—	L	H	H	H	H	ROM error	ROM checksum error	Impossible
8		—	H	L	L	L	H	Main power supply lowered	Input AC power supply voltage is lowered.	Possible
8.		—	L	L	L	L	H	Driver reset	Driver reset status	Possible
9		0000	H	L	L	H	H	CPU error	Watchdog timer (WDT) error	Impossible
A		—	H	L	H	L	H	Overcurrent error	Excessive current flows through the motor.	Impossible
C	C.	—	H	H	L	L	L	Overload	Motor input power exceeds the specified value. The motor current becomes 1/ 2.5 as detection is done.	Possible
E		—	H	H	H	L	H	Overvoltage	Excessive voltage is entered into the driver or excessive load is made to rotate at high speed.	Impossible

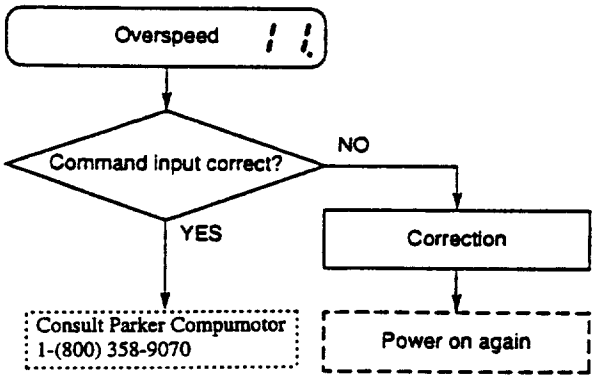
Note: Consult Parker Hannifin Compumotor Div. or its authorized agency for cases where recovery is impossible.

7.3 Procedure for Error Correction

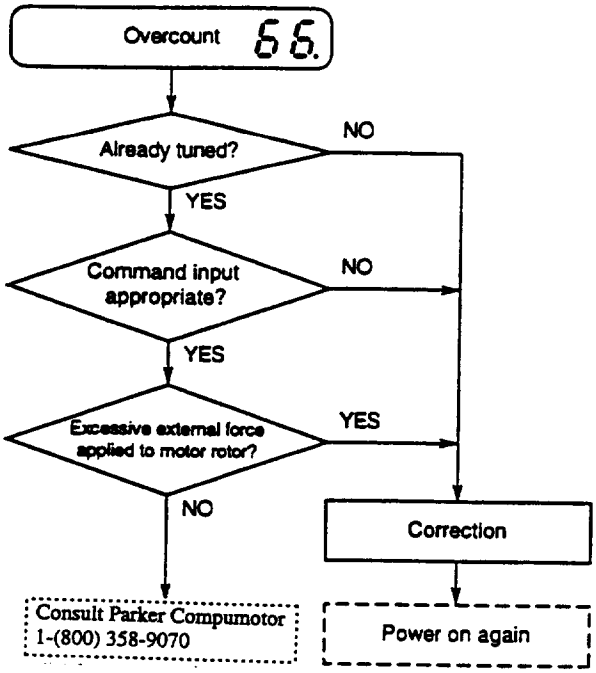
(1) Encoder error



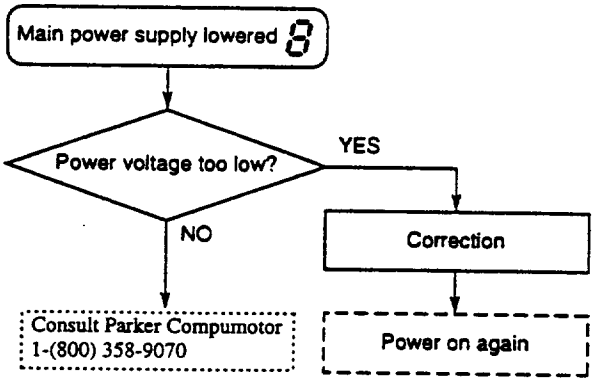
(2) Overspeed



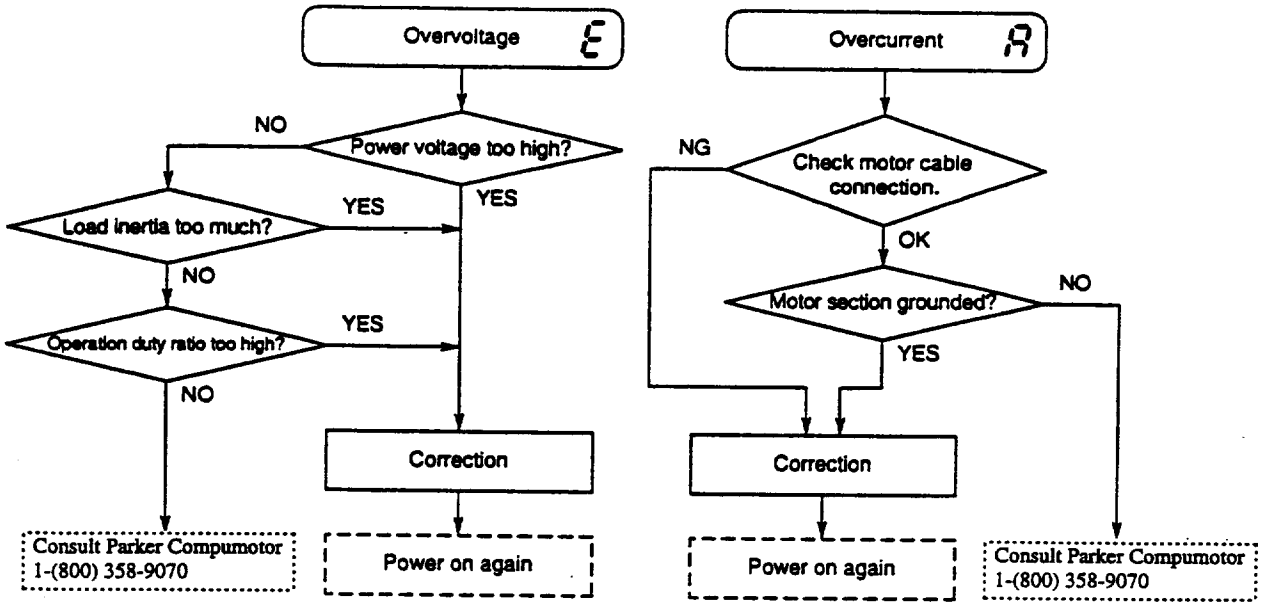
(3) Overcount



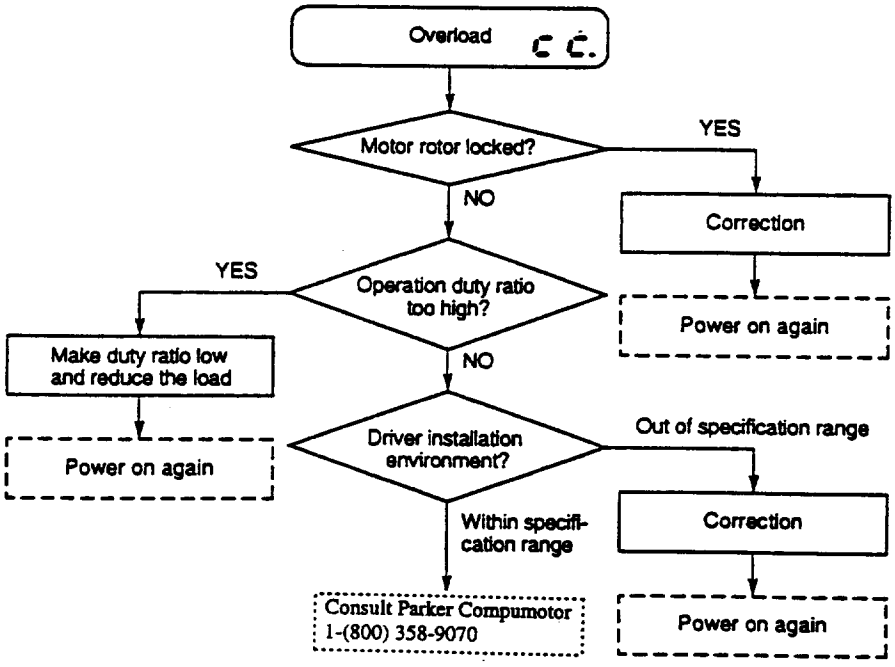
(4) Main power supply lowered



(5) Overvoltage, Overcurrent



(6) Overload



8. REFERENCE

8.1 Standard Specification

(1) Motor Section and (2) Drive Section
Each DM1004 Dynaserv system consists of a brushless servo motor, microprocessor-based drive, power supply, and an incremental encoder for position feedback. The primary benefit of the Dynaserv system is high accuracy and torque without speed reducers. Additional advantages include:

- Faster settling time than a traditional servo motor and speed reducer system
- Smooth rotation at slow speeds
- A flat speed/torque curve for high controllability
- Ability to operate in a position, speed or torque control mode
- Built-in test mode simplifies optimum tuning
- Can operate in Class 10 clean room applications with proper preparation.
- Mounting base standard fixture on motor
- Internal mechanical resonance filter
- Compatible with Compumotor's indexers and analog servo controllers with flexible control interface:
  - step and direction for position mode
  - ±10VDC analog input for velocity mode
  - ±8VDC analog input for torque mode
- Axial and radial run-out of 0.01 mm, a factor of 10 better than the standard DR and DM Series

DM1004 Motor Data Specifications

Parameter	Value (DM1004B and DM1004C)
Performance	
Repeatability	5 arc-sec (0.00139°)
Accuracy	±60 arc-sec (0.0167°) standard ±20 arc-sec (0.00556°) (version available)
Max. stepping rate	1,572,000 steps/sec
Power	
Volts	115VAC 1-phase, or 230VAC 1-phase
Range	+10% to -15%
Current	5 amps max.
Encoder output	400 kHz max.
Inputs	
Command interface	
Step input	Low going low pulse, 150 nanoseconds min. pulse width
Direction	Logic high = CW rotation, Logic low = CCW rotation
Analog input	±10V velocity signal; ±8V torque signal
Outputs	
Encoder output	A/B encoder output 393 kHz max. Z-channel—124 pulses/rev

Parameter		Value DM1004B	DM1004C
Peak torque	ft-lbs	3	3
	(N-m)	(4)	(4)
Rated speed	115VAC	2.5	2.5
rps	230VAC	2.5	2.5
Rotor inertia			
oz-in² x 10^2		3.01	1.37
(Kgm²) x 10^{-3}		(5.5)	(2.5)
Maximum steps/rev		655,360	655,360
Motor weight*	lbs	6.6	6.6
	(kg)	(3)	(3)
Maximum static axial load**			
Compression	lbs (kg)	440 (200)	770 (350)
Tension	lbs (kg)	154 (70)	770 (350)
Maximum static overhung load**			
	ft-lb (kg-m)	20 (2.7)	24.4 (3.3)
Maximum power consumption			
	KVA	0.3	0.3

* Drive weight is 4 lbs (1.8 kgs)

** When designing a system, the maximum static load and overhung load must be derated to the values specified below:

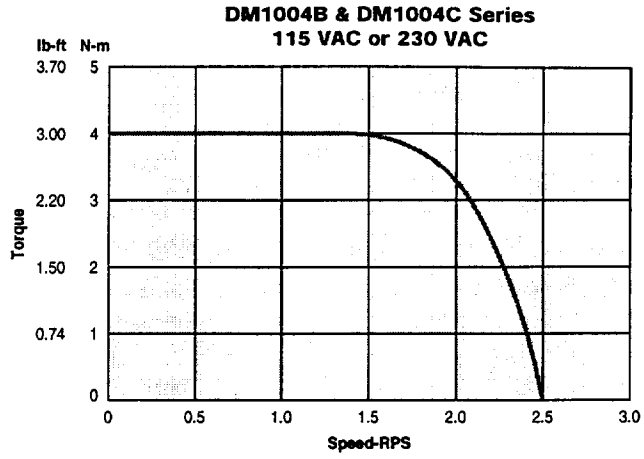
Application	De-rate Factor
Smooth, rotary motion	1/3
Intermittent press loading	1/5
Repetitive shock loading	1/10

(3) Environmental Specifications

Item		Motor	Driver
Ambient operating conditions	Temperature	0° to 45°C	0° to 50°C
	Humidity	20% to 85% R.H., no condensation	20% to 90% R.H., no condensation
Ambient storage conditions	Temperature	-20° to 80°C	-20° to 85°C
	Humidity	20% to 85% R.H., no condensation	20% to 90% R.H., no condensation
Operating environment		No corrosive gases; dust-free	

8.2 Velocity vs Torque Characteristics

The speed/torque curves represent peak torque available; continuous torques are approximately 2/3 of the peak value.

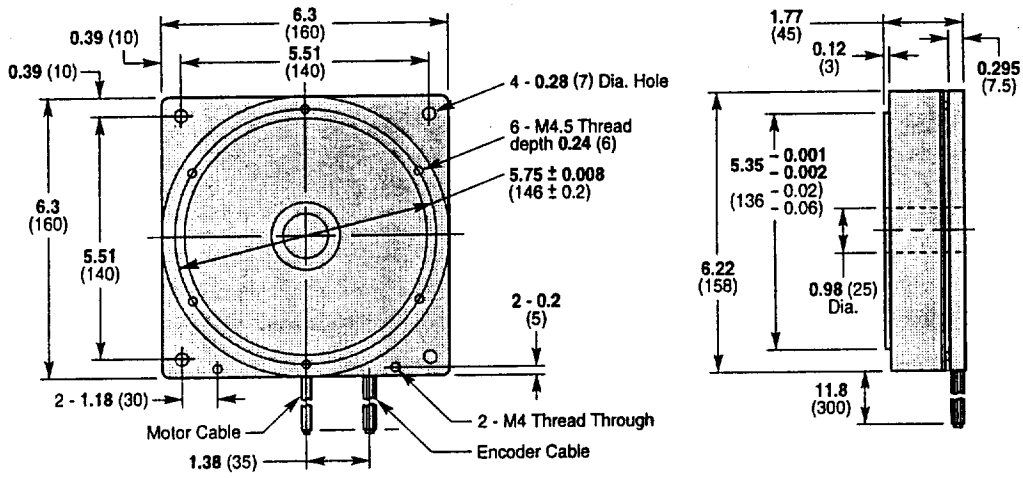


8.3 External Dimensions (unit: mm)

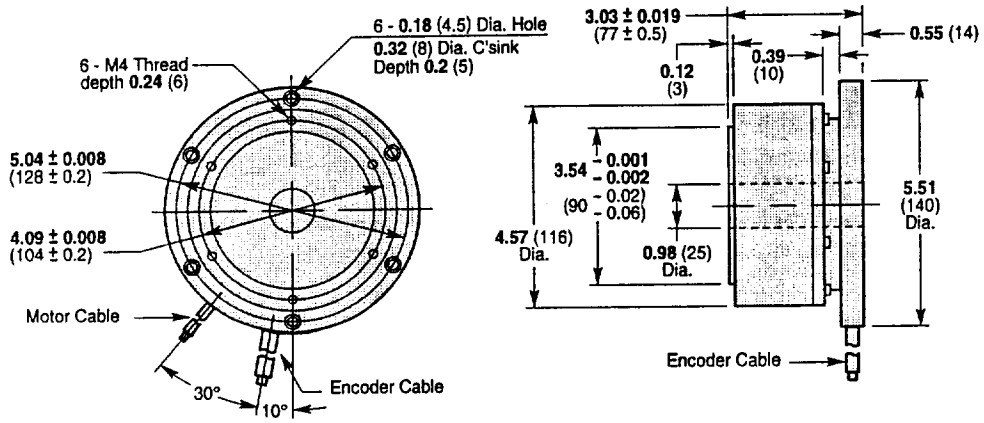
(1) Motor

(—) denotes millimeters

DM1004B

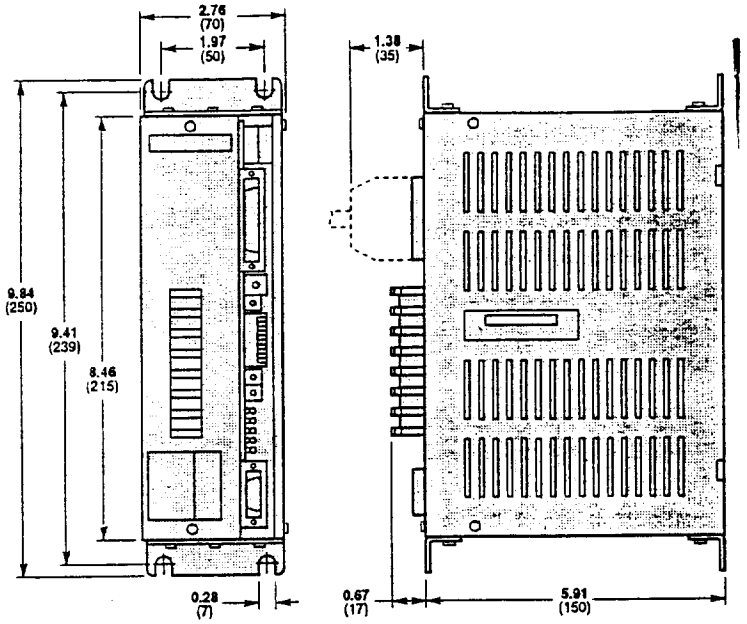
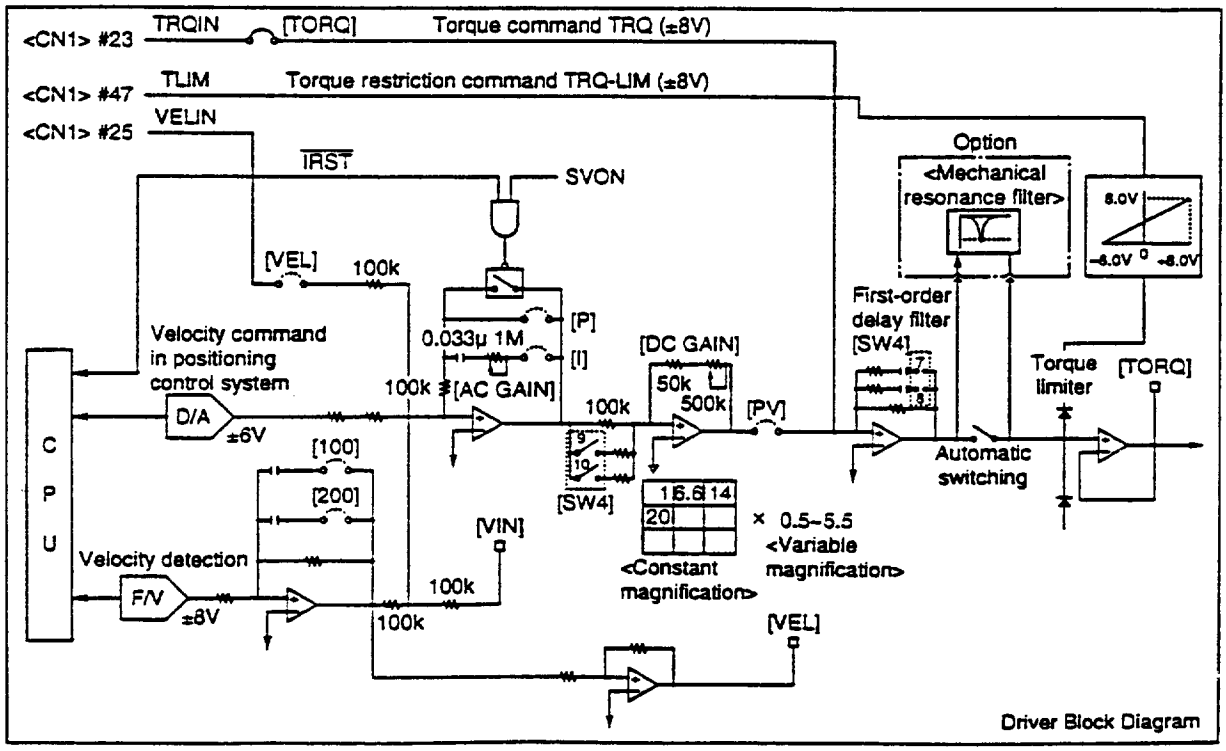


DM1004C



(2) Driver

(—) denotes millimeters



8.4 Driver Block Diagram