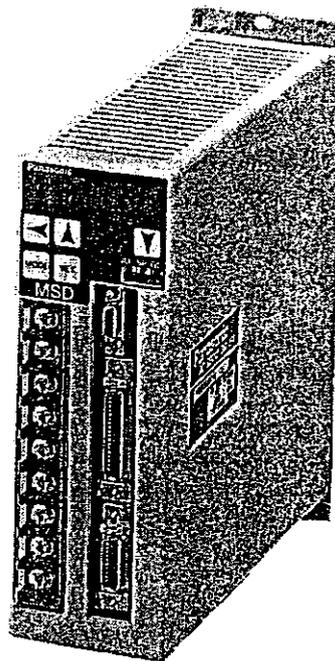


All Digital Servo

AC Servo Driver

MSD Series

Operation Manual



(Photo shows MSD023AIXE.)

- Thank you for purchasing our Panasonic All Digital AC Servo Driver, MSD Series. Wrong handling or use may result in unexpected accident, shorten the service life, or deteriorate the performance, so please read this manual carefully for correct handling.
- Please keep this manual carefully for later use.
- Please be sure to deliver this manual to an end user.
- This manual is subject to change for improvement of contents.
- This manual bears both SI unit system (international unit) and conventional unit. (The real product may bear only conventional unit in some cases.)

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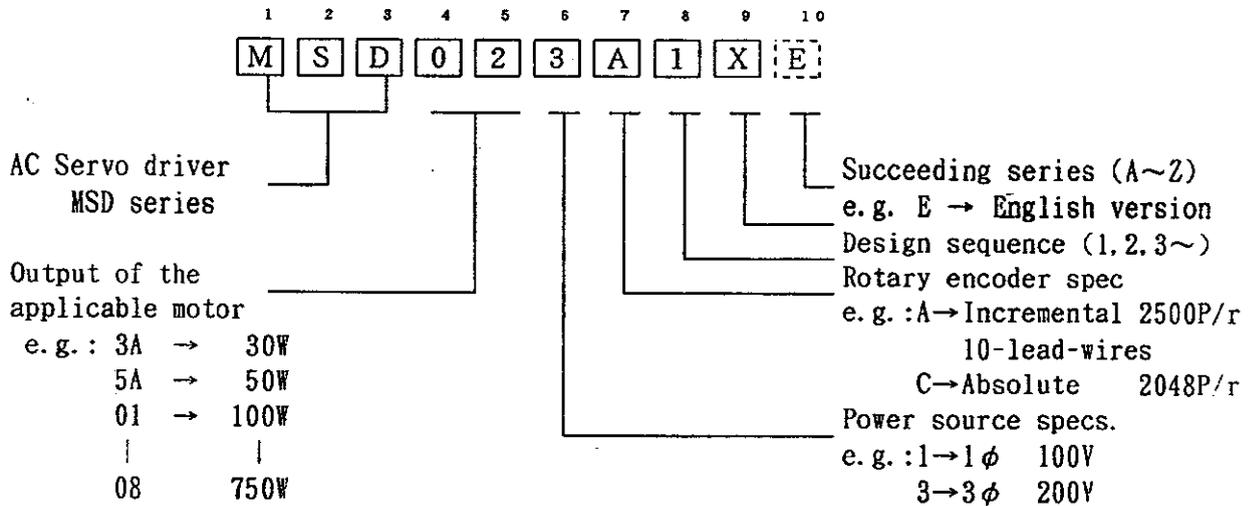
# 1. Before operation

## 1-1 After opening the package

- Please check the followings:
  - (1) Right model No.?
  - (2) Any damage during the transportation?

If you find any damage, please contact to your dealer/distributor

- Following shows how to read the model No. and its symbols:



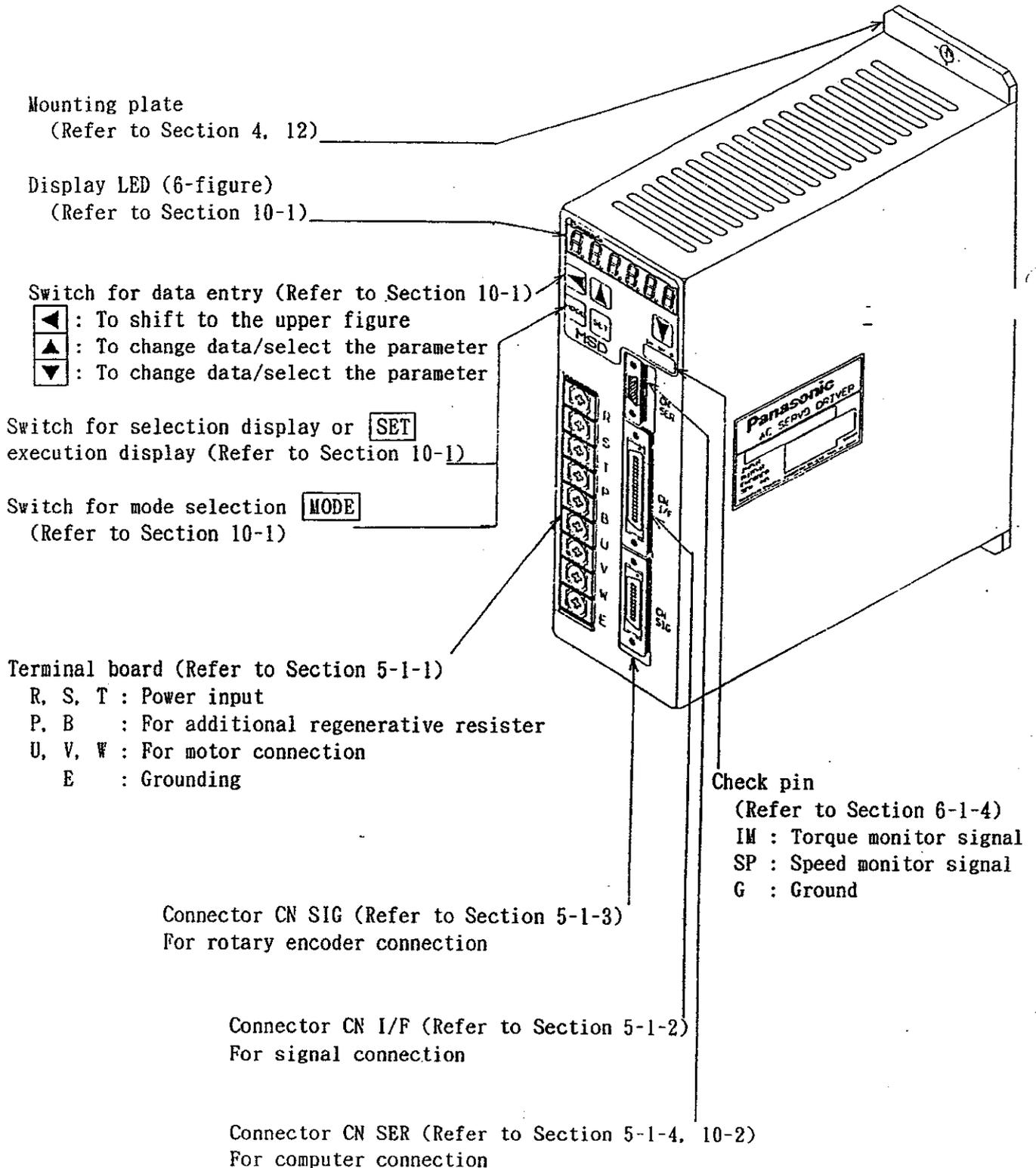
## 1-2 Confirmation of the applicable motor

This driver is designed to be used with Panasonic AC servo motor. Please refer to the following table for the correct combination of the driver and the motor, and make sure that the number of the encoder pulses matches each other.

Model No. of driver	Suffix of driver	Applicable motor				
		Series No.	Model No.	Input voltage (V)	Rated output (W)	Encoder pulses (10-lead-wires)
MSD3A1A1XE	A	MSM	MSM3AZA**	100/200	30	2500P/r
MSD5A1A1XE	A		MSM5AZA**	100/200	50	2500P/r
MSD011A1XE	A		MSM011A**	100	100	2500P/r
MSD021A1XE	B		MSM021A**	100	200	2500P/r
MSD041A1XE	C		MSM041A**	100	400	2500P/r
MSD3A3A1XE	A		MSM3AZA**	100/200	30	2500P/r
MSD5A3A1XE	A		MSM5AZA**	100/200	50	2500P/r
MSD013A1XE	A		MSM012A**	200	100	2500P/r
MSD023A1XE	A		MSM022A**	200	200	2500P/r
MSD043A1XE	C		MSM042A**	200	400	2500P/r
MSD083A1XE	C		MSM082A**	200	750	2500P/r

**Note** Please refer to section 12. "Dimensions" for the suffix.

## 2. Cosmetics and title of each part



# 3. Caution

## 3-1 Caution for safety

- (1) Even after the power is turned off, inside of the circuit is still charged with high voltage for a while. If you want to touch the terminals of the terminal board, or inside of the driver, please turn off the main power externally and wait for 5 min or more.
- (2) Even when the servo motor is off, do not touch the output terminals for motor (U, V, and W) because high voltage is applied to them while power is on or for some time after power is off.
- (3) Since a high frequency switching current runs through the servo motor, and a leakage current is relatively high, please ground together the grounding terminal (E) and the motor grounding terminal (E) without fail. Also ground the machine as well. We recommend you to ground with  $100\Omega$  or less,  $\phi 1.6\text{mm}$  or more for prevention of an electric shock and malfunction.
- (4) Please keep enough distance from the motor and the machine when you turn on the power.
- (5) While you do not use the motor and the machine for a long time, please turn off power.
- (6) Please put on the cover to the terminal board for prevention of an electric shock while using the driver.

Panasonic driver is designed and manufactured through the highest quality control however, unexpectedly higher external noise or application of high static electricity, or wrong wire connection may cause a misoperation. Please pay extra attention for the safety of your machine.

- (7) Please use a Non-Fuse Breaker as per the wiring example of section 5-1-1.

### 3-2 In order to use the driver properly

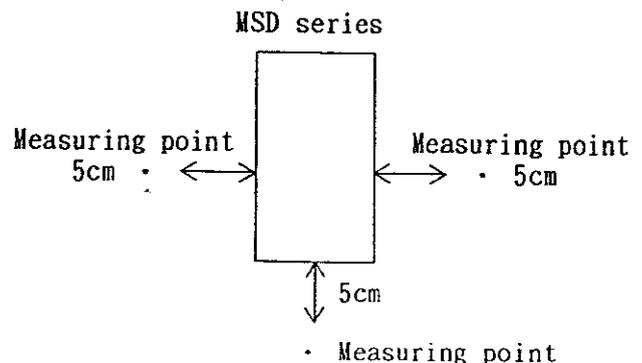
- (1) Since a misuse of the driver may leads to a wrong operation, or may damage the driver in the worst case, please carefully read the following cautions operation.
- (2) Please keep and refer to this manual anytime you encounter questions.

- ① Please do not apply a higher voltage than the rating to the power input terminals (R, S, T).  
Also please do not input the power to other terminals than the power input terminals (R, S, T) in any case. Please refer to section 5-1-1 for wiring.
- ② Please connect the output terminal for the motor (U, V, W) correctly.  
If you connect the terminal for ground, driver get damaged.
- ③ Input power side is capacitor input type. When you turn on the power, a high charge current runs and you may see the great voltage drop. We recommend you to have an independent power supply for the driver.
- ④ Refer to section 5-2 for the capacity of the power supply.
- ⑤ Please install the driver at ambient temperature of  $0^{\circ}\text{C} \sim +50^{\circ}\text{C}$ . If the temperature exceeds this, it may cause malfunction or damage to the driver.
- ⑥ When you perform a dielectric strength test, or megger test to an external circuit, please pull out all terminals of the driver so that no test voltage may be applied to the driver.
- ⑦ Please do not operate the driver under overcapacity conditions (such as continuous overcurrent operation).
- ⑧ When power is turned off, please keep an interval about 5 to 10 seconds before you turn it on again.  
If this interval is too short, the system may not start up normally because its internal circuit is not initialized.
- ⑨ If you use a leakage current breaker, please use that for the "Inverter" which withstands high frequency.

#### Caution

Life of the driver is greatly affected by ambient temperature. Please arrange the installing condition so that the temperature may not exceeds the permissible temperature range. Please check the ambient temperature at the marked point.

Max. temperature :  $+50^{\circ}\text{C}$



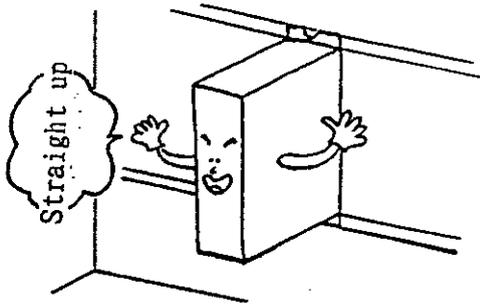
# 4. Installation

## 4-1 Notes in transportation and handling

- Please handle the unit carefully in transportation avoiding damage to the driver.
- Do not apply excessive power to the resin case of the driver in handling.

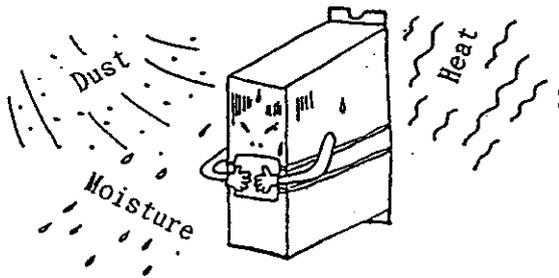
## 4-2 Installation place

- Vertical type.  
Please place the unit vertically, and keep space for ventilation around.

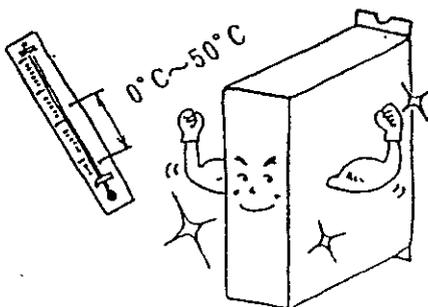


- ◇ In installing the unit, secure it tight with screws or bolts avoiding stress on the driver itself such as bend or torsion.
- ◇ Use a mounting screw or bolt sized M4 or M5.

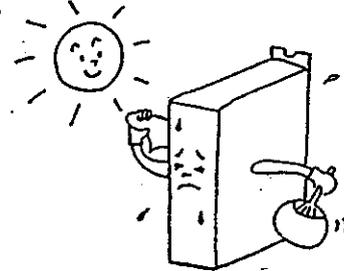
- Avoid a place of high temperature or humidity, or atmosphere containing a lot of dirt, dust, ferrous powder, or chip.



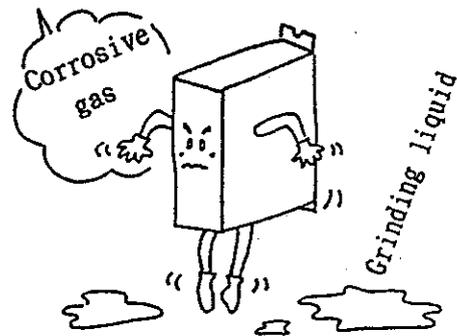
- Choose a place of ambient temperature 0°C to +50°C.



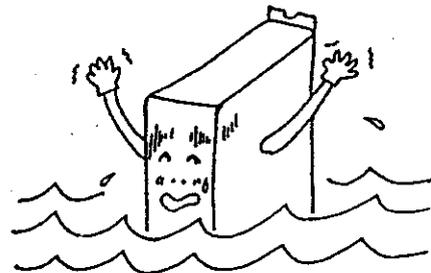
- Please avoid a place exposed to direct sunlight.



- Choose a place free from corrosive gas and grinding liquid.

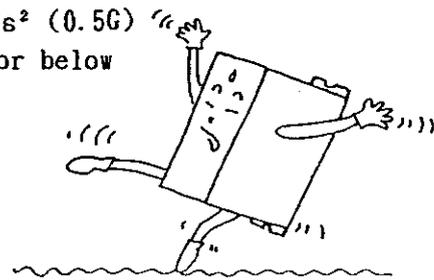


- The unit is not water-proof.  
Do not use the unit outside.



- Choose a place free from vibration.  
Do not use the unit continuously on a resonance point.

4.9m/s<sup>2</sup> (0.5G)  
or below



# 5. Wiring

## 5-1 Caution on wiring

### 5-1-1 Wiring to Terminal board

- (1) Please make wiring per Fig. 1, "Wiring example to the terminal board".
- (2) Please refer to the list of recommended wiring-related equipment in section 5-2.
- (3) Please avoid a reverse connection between the main power input terminals (R, S, T) and the motor output terminals (U, V, W).
- (4) Please avoid grounding the output terminals (U, V, W) of the motor, or shorting them each other.
- (5) Please do not connect anything to the terminals, P and B. Also do not touch these terminals since a high voltage is applied.  
For use where regenerative energy absorbing ability is insufficient provided by simple incorporated regenerative resistor, please consult the store where you purchased the unit.
- (6) Please match colors of the motor leads to the corresponding motor output terminals (U, V, W). Please note that, unlike the induction motors, you cannot reverse the rotational direction by changing 3-phase.
- (7) Please use the pre-insulated, solderless, crimp-on terminals when you connect to the terminals on the terminal board.
- (8) Please securely ground the motor's ground terminal (E) and the driver's ground terminal (E), and ground them together with the noise filter's ground terminal. We also recommend you to ground your machine itself. Please ground with ground resistance of  $100\Omega$  or less, and  $\phi 1.6\text{mm}$  or more.
- (9) After finishing wiring to the terminal board, please put on the terminal cover to avoid an accidental electrical shock.

After wiring, ensure that there is no wrong wiring again before turning on power.

- (10) If you use a magnetic contactor, relay, coil, or motor with a brake, please install a surge absorbing circuit between coils or contacts, or brake windings.
- (11) Please install a Non-Fuse Breaker and shut off the power externally in case of emergency.
- (12) Please install a noise filter to reduce a RFI and prevent any malfunction.  
(Example: LF-200 or 300 series made by Tokin Inc.)

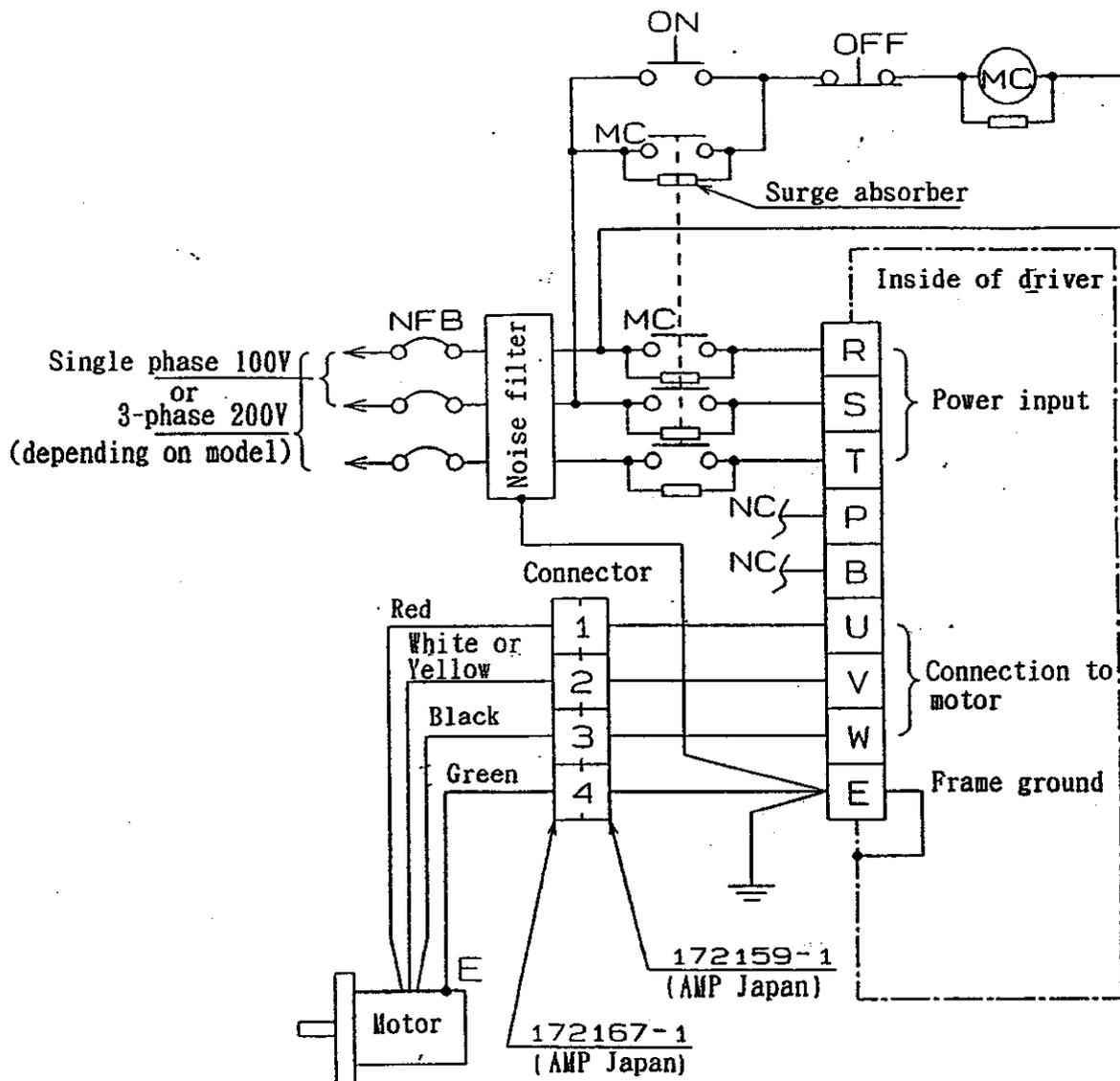


Fig. 1. Wiring example to the terminal board

5-1-2 Wiring to Connector CN I/F

- (1) Please make wiring per Fig. 2, "Wiring example to connector, CN I/F". On the pin arrangement of CN I/F, refer to section 13-1.
- (2) Please prepare a power supply for a control signal with DC12-24V, used for external control connected between COM + and COM -.
- (3) Please shorten the wiring of the driver and other equipment as much as possible (3 m or shorter).
- (4) Please separate this wiring from the power lines (R, S, T, U, V, W, E), as much as possible (30 cm or more). Please avoid passing both wires into the same duct or binding them together.
- (5) Please do not apply more than DC 24V, 50mA, to each terminal of the control output (S-RDY, ALM, COIN), or avoid applying reverse polarity. This may cause damage to the driver.
- (6) If you directly drive a relay with the control output terminals, please install a diode in parallel with the relay as Fig. 2 shows. If you do not install a diode, or install it in reverse direction, this may cause damage to the driver.
- (7) As per Fig. 2, please use shielded, twisted pair wires for a signal line of CN I/F (analog command input, command pulse input, feed-back pulse output of the encoder etc.). Please ground the shield to the signal ground (GND) of the driver. (Though the shield of other equipment normally open, in case affected by extreme noise, connect shield of both driver and other equipment to frame ground.)

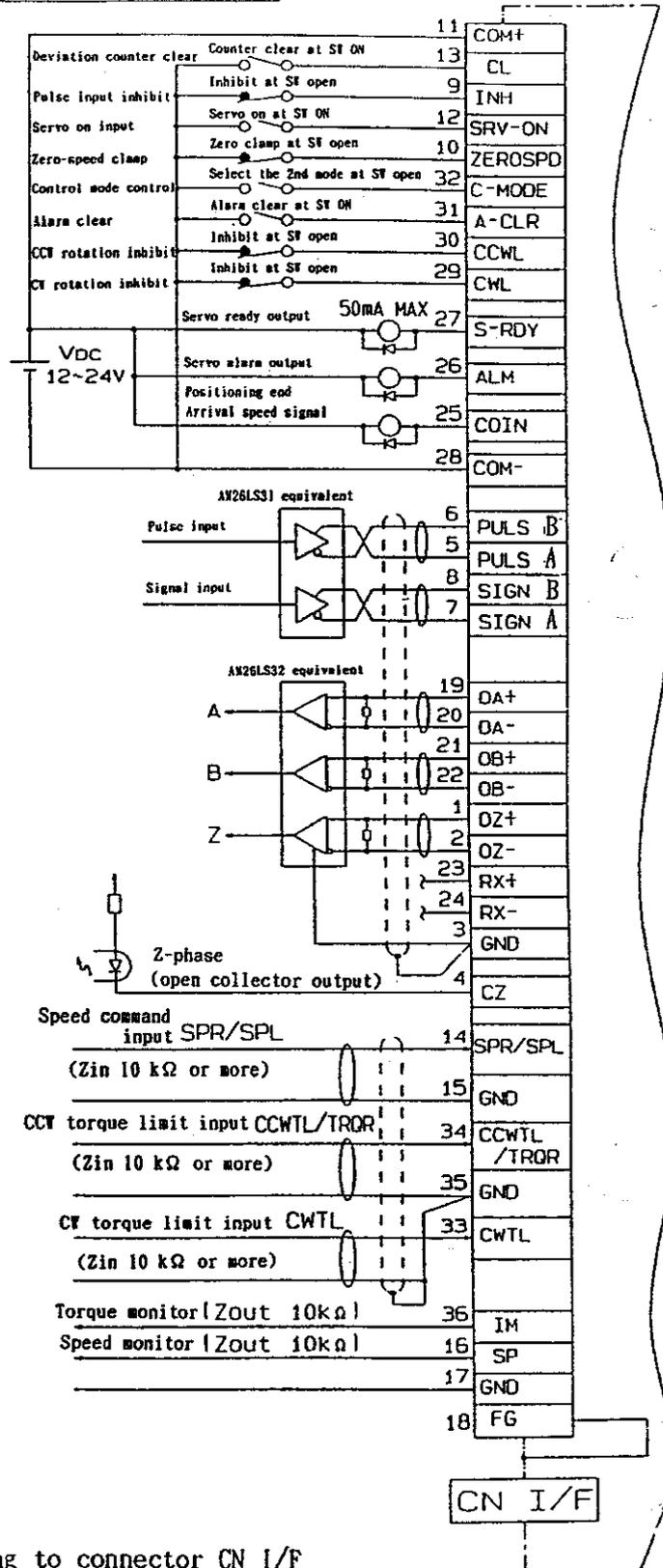


Fig. 2. Example of wiring to connector CN I/F

Receptacle on driver side		Applicable plug on user side		Manufacturer
Connector mark	Product No.	Part name	Product No.	
CN I/F	10236-52A2JL	Plug (Solder type)	10136-3000VE	Sumitomo 3M, Ltd.
		Shell	10336-52A0-008	

\* Parts equivalent to product number above made by other manufacturers may be used for receptacle and plug.

5-1-3 Wiring to Connector CN SIG

- (1) For the encoder cable, use a stranded wire having core of 0.18mm<sup>2</sup> or above, a twisted pair of wire having overall shield.
- (2) See the section 13-2 for pin arrangement of CN SIG.
- (3) The length of the cable must be within 20m max. When wiring is long, we recommend double wiring in order to reduce influence by voltage fall for 5V power supply.
- (4) Be sure to connect the shield on driver side of a relay cable to pin 20 (FG) of CN SIG. Connect the shield on motor side of a relay cable to the shield of a shielded wire coming from the encoder (pin 15 of relay connector).
- (5) Separate the wires to power line (R, S, T, U, V, W, and E) as far as possible (more than 30cm).  
Do not lead them through the same duct nor tie them together.
- (6) Do not connect anything to unused terminals of CN SIG (pins 5, 6, 13, 14, 15, 16, and 19).

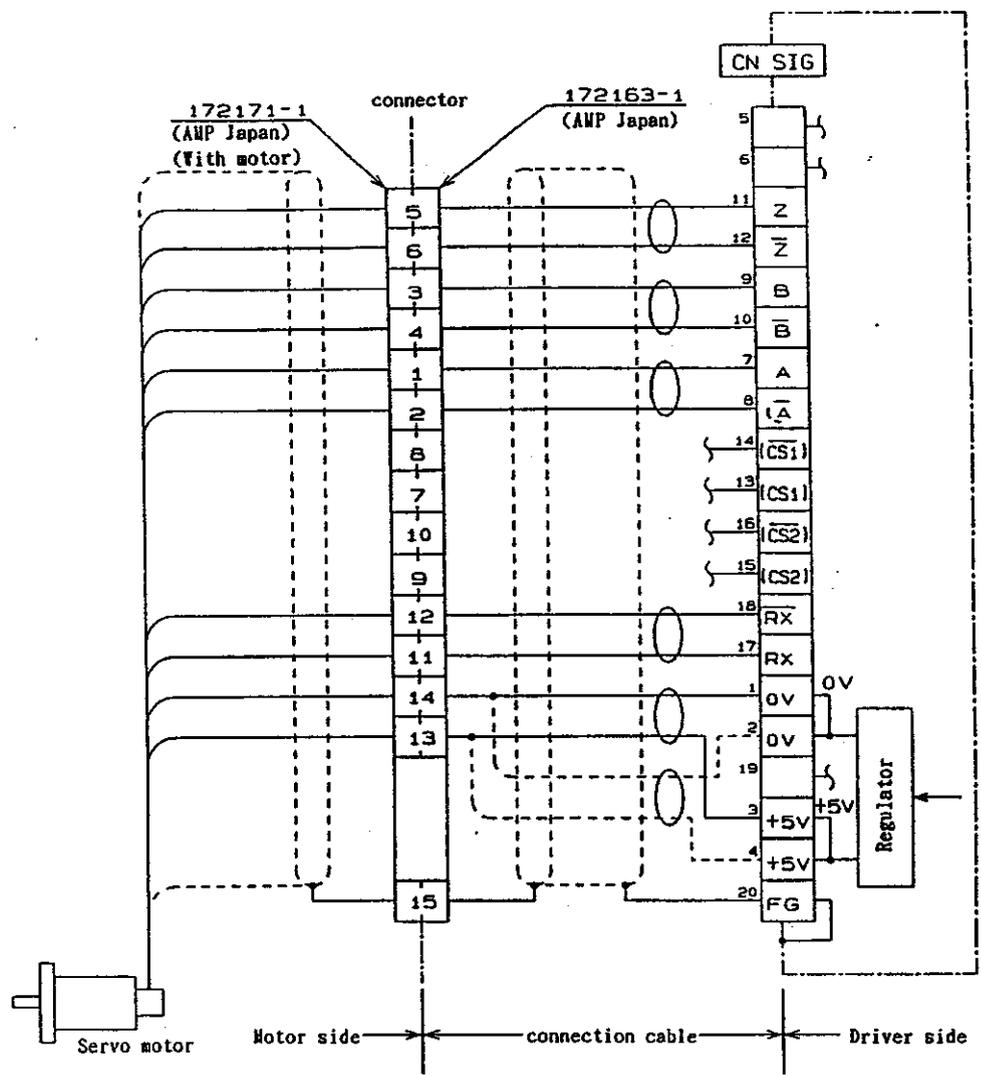


Fig. 3. Example of wiring to connector CN SIG

Receptacle on driver side		Applicable plug on user side		Manufacturer
Connector mark	Product No.	Part name	Product No.	
CN SIG	10220-52A2JL	Plug (Solder type)	10120-3000VE	Sumitomo 3M, Ltd.
		Shell	10320-52A0-008	

\* Parts equivalent to product number above made by other manufacturers may be used for receptacle and plug.

5-1-4 Wiring to Connector CN SER

(1) With a personal computer designated in section 10-2-2, you can operate this driver with the following functions;

(Please refer to section 10-2-2 for detail.)

- Setting/change of each parameter
- Control state reference
- Error condition reference
- Error record reference
- Automatic gain tuning
- Waveform graphic function
- Saving/loading of the parameter data

(2) Please use the optional connecting cable between the driver and the computer.

(refer to section 10-2, 13-4 for detail)

Please securely insert the 9-pin connector of the optional cable into the "RS-232C" connector of the back side of the computer, and insert the 10-pin connector to the "CN SER" of the driver.

Please insert or unplug these connectors after turning off the power of both the computer and the driver.

5-2 Selection of a wiring equipment

Applicable motor			Power consumption (At rated lower)	No-fuse breaker (Rated current) <span style="border: 1px solid black; padding: 1px;">Note 1</span>	Recommended noise filter <span style="border: 1px solid black; padding: 1px;">Note 2</span>	Electromagnetic switch (Composition of contact) <span style="border: 1px solid black; padding: 1px;">Note 1</span>	Main circuit wire diameter (R, S, T, U, V, W, E)
Series	Voltage	Output					
MSH	100V	~ 50W	0.3kVA	BBP2-10 (10A)	LF-210	BMF61041 (4a)	1.25mm <sup>2</sup>
		100W	0.4kVA	BBP2-15 (15A)	LF-215	BMF61041 (4a)	1.25mm <sup>2</sup>
		200W	0.5kVA	BBP2-15 (15A)	LF-215	BMF61041 (4a)	2mm <sup>2</sup>
		400W	1.0kVA	BBP2-30 (30A)	LF-230	BMF61541 (4a)	2mm <sup>2</sup>
	200V	~100W	0.3kVA	BBP3-5 (5A)	LF-305	BMF61042 (4a)	1.25mm <sup>2</sup>
		200W	0.5kVA	BBP3-10 (10A)	LF-310	BMF61042 (4a)	1.25mm <sup>2</sup>
		400W	0.9kVA	BBP3-10 (10A)	LF-310	BMF61042 (4a)	1.25mm <sup>2</sup>
		750W	1.3kVA	BBP3-15 (15A)	LF-315	BMF61542 (4a)	2mm <sup>2</sup>

Note 1. The product number of no-fuse breaker and electromagnetic switch belongs to Matsushita Electric Works, LTD.

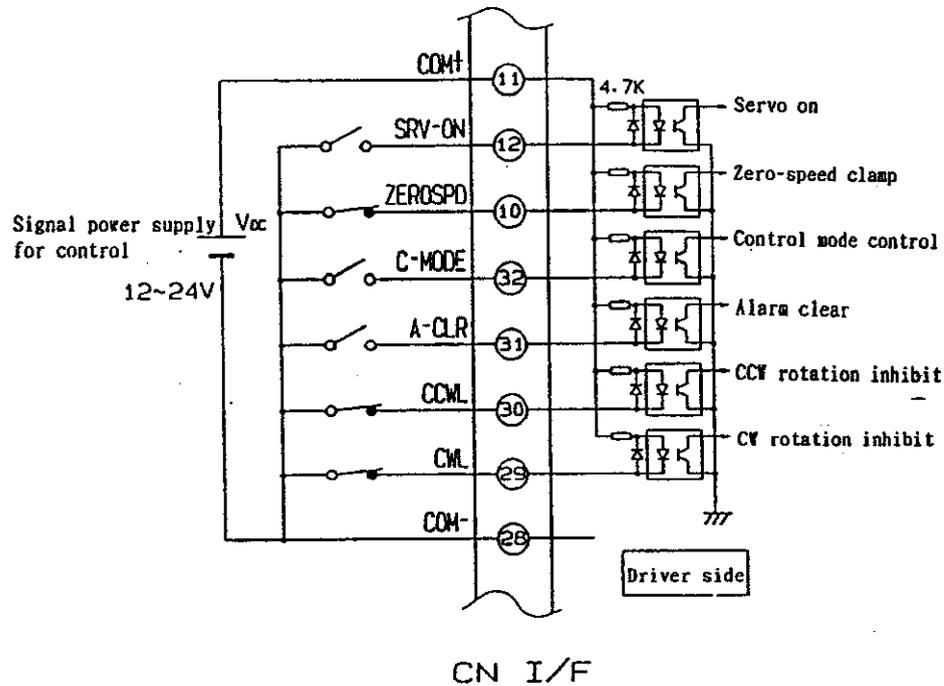
Note 2. The product number of noise filter belongs to Tokin, LTD.

# 6. Function

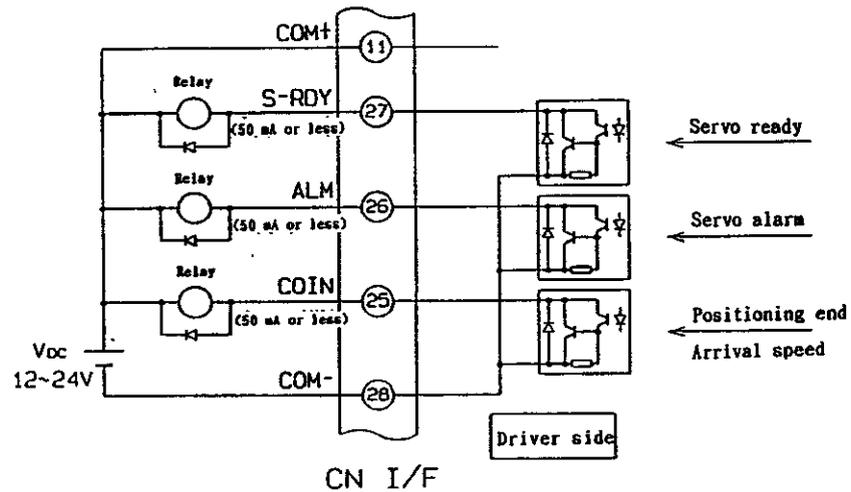
## 6-1 Configuration of input circuit

Followings show the detail of connection of connector CN I/F.  
Refer to Fig. 2 of page 8 as well.

### 6-1-1 Control input

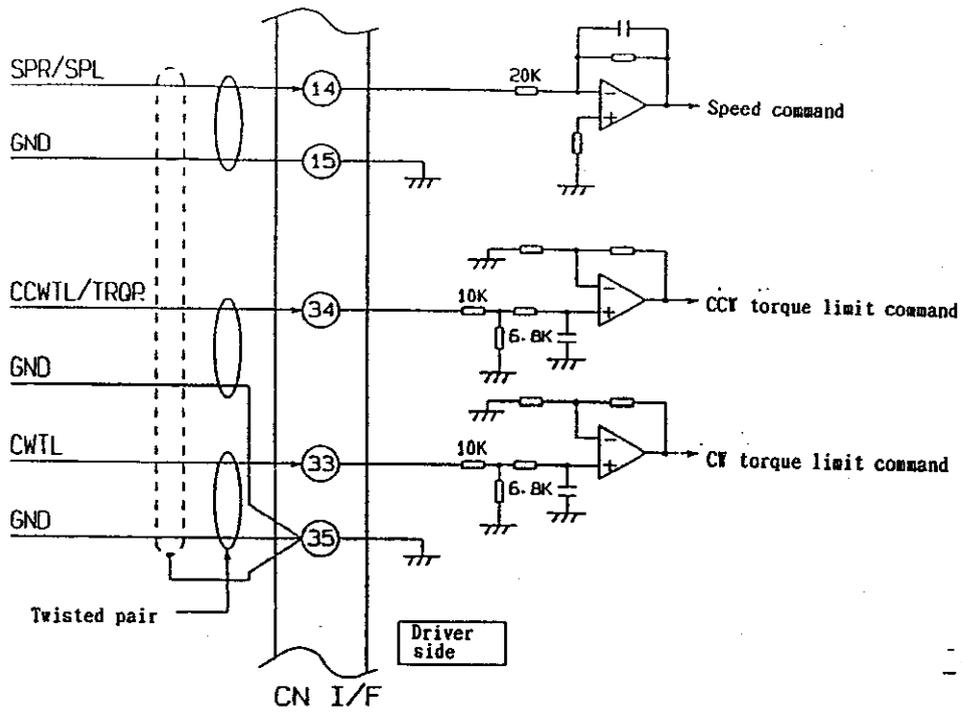


### 6-1-2 Control output



- Note** 1. Please prepare a power supply ( $V_{DC}$ ) for the control signal at your side.  
(DC12V ~ 24V, 0.5A or more)
- Note** 2. Please pay attention for the polarity of VDC. Reversed polarity of the above fig. will damage the driver.
- Note** 3. When you directly drive a relay with each output signal, please install a diode in parallel to the relay as the above fig. shows. If you do not install a diode or install it in reverse direction, the driver get damaged.
- Note** 4. When each output signal is received by logic circuit such as a gate, be sure to eliminate influence by noise.
- Note** 5. Please limit the current fed to each output to 50mA or less.

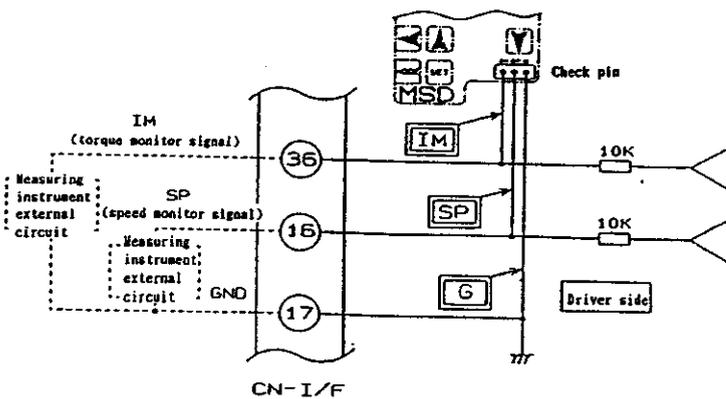
6-1-3 Analog signal input



**Note** Please use SPR/SPL and CCWTL/TRQR input separately based on the following control mode;

- SPR/SPL input
  - at speed control mode                   ..... Speed command input
  - at torque control mode                 ..... Speed limit input (in absolute value)
  - at the position control mode         ..... Inactive
- CCWTL/TRQR input
  - at speed, position control mode     ..... CCW torque limit input
  - at torque control mode               ..... Torque command input

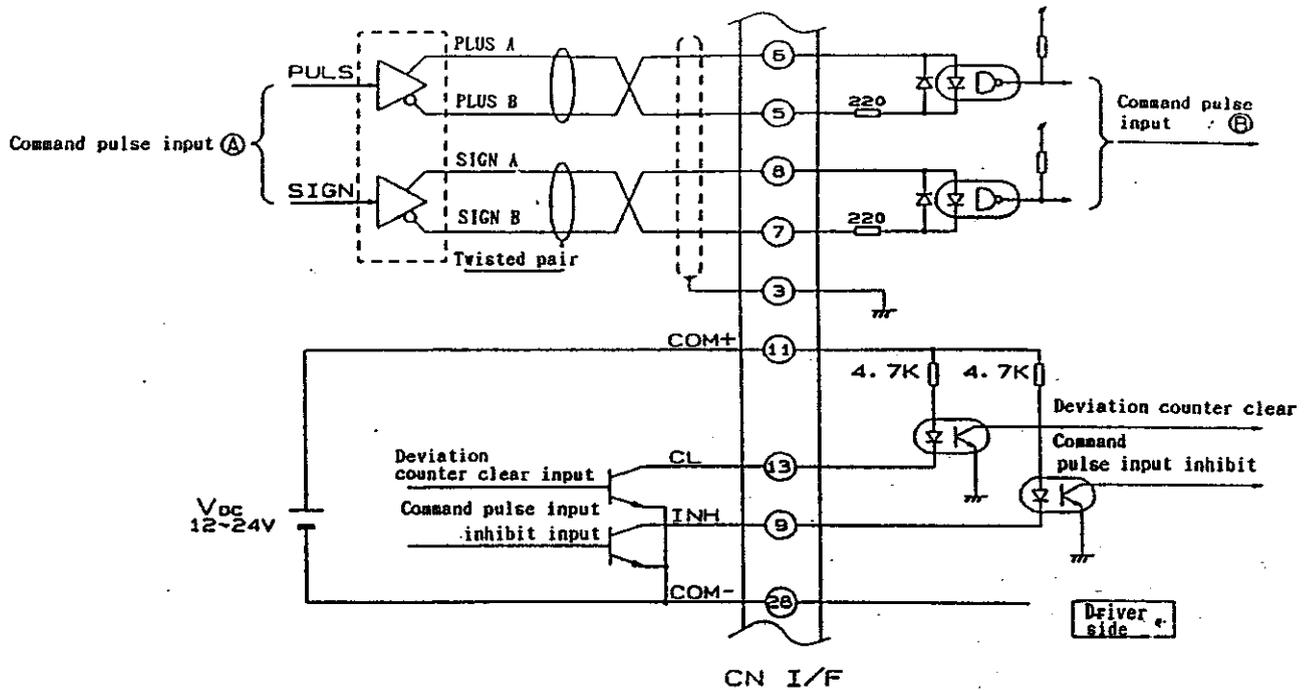
6-1-4 Analog signal output (monitor output)



**Note** 1. Output of both IM and SP has output impedance of 10KΩ. When you connect a measuring instrument or an external circuit to IM or SP output, use the ones which have high input impedance in order to minimize an error. (Such as Multimeter or Oscilloscope etc.)

**Note** 2. IM and SP are also output to check pins on the front of resin case.

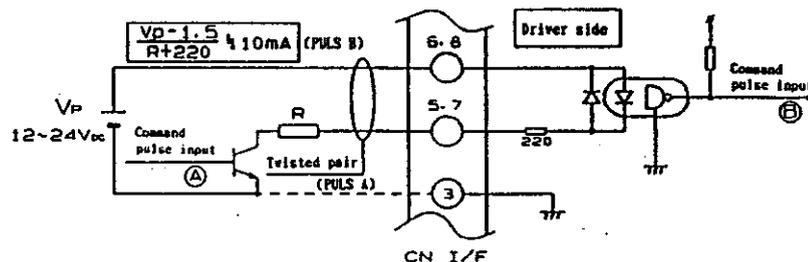
6-1-5 Pulse row command, Counter clear, Command pulse input prohibition input



**Note** 1. The command pulse input can respond to either interface of a line driver or an open collector however, we recommend you to use a line driver interface as the above Fig. shows in order to deliver a signal securely.

**Note** 2. Caution on using an open collector interface

- ① Please shorten the wiring as much as possible (1 m or shorter).
- ② Please note that the max. input pulse frequency is 200kpps at an open collector interface while that is 500kpps at a line driver interface.
- ③ When you compose a command pulse input circuit at an open collector interface, you need to install a separate power supply (12~24VDC) for pull-up. Higher the power supply voltage (less than 24VDC), higher the resistance to the noise you can expect. Please set the value of the series resistor R in the following formula so that the primary current of the photo-coupler becomes approx. 10mA depending on the power supply voltage. (Setting V<sub>p</sub> to 24V, R shows 1.8~2.0kΩ, and setting to 12V, R shows 780~820Ω.)



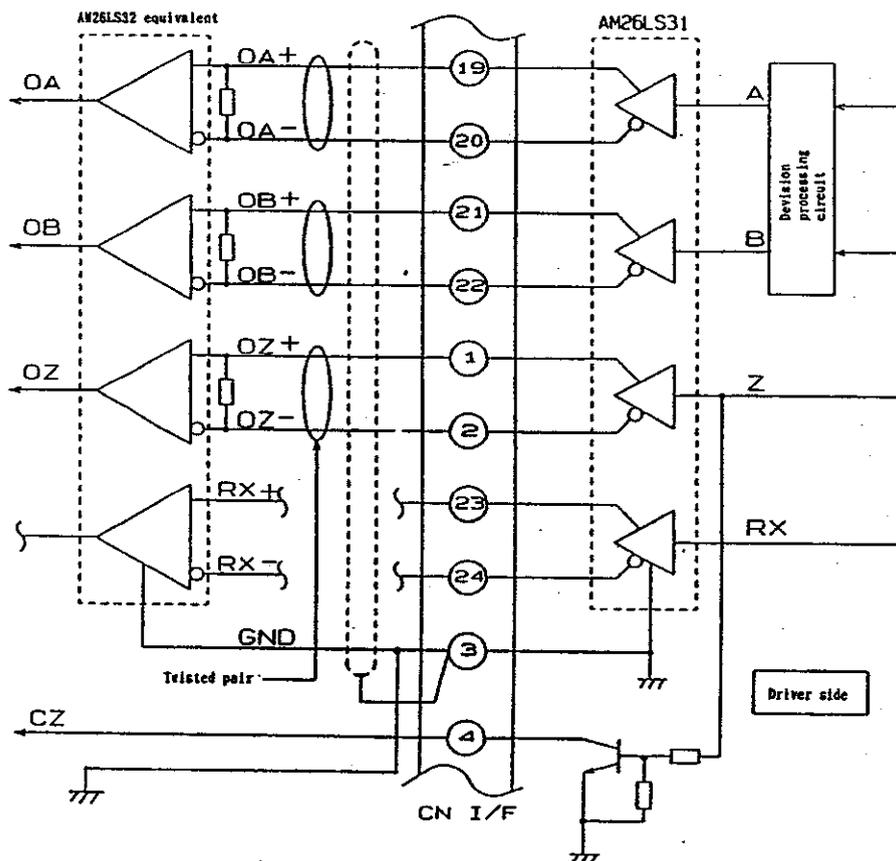
④ Note that logic relation of pulse input (relation of A and B above) is reversed as shown below respectively for line driver and open collector interface. (See 9-2 (35).)

Provision of pulse	A (Supply side)	B (Driver side)
Line driver I/F	H (L)	H (L)
Open collector I/F	H (L)	L (H)

- ⑤ If there should be any fault due to influence of noise, it may be corrected by connecting signal GND on pulse supply side and signal GND on driver side (such as pin 3 of CN I/F) (Broken line in the preceding figure).

- Note** 3. Pulse input inhibit signal (INH) inhibits the input of pulse as connection is open between pin 9 and 28. When INH input is unused, short between pin 9 and 28 outside the driver.

6-1-6 Feed back pulse output of rotary encoder



- Note** 1. The output pulse (A/B-phase) of the rotary encoder will be entered into a division processing circuit, then will be fed out through the line driver (AM26LS31) after the division processing. Z-signal alone will be fed out through the No. 4 pin (CZ) with an open collector. If using this CZ-signal, be sure to eliminate influence by noise.
- Note** 2. Please receive the output pulse with the line receiver (AM26LS32 or equivalent). In this case, please install an appropriate resistor (Approx. 330Ω) between the line receiver inputs.
- Note** 3. In Z-phase signal, note that logic is reversed respectively for line receiver output (OZ) and open collector output (CZ).
- Note** 4. When you use division function of feedback pulse, note that:
- ① Pulse width of Z-phase signal becomes relatively small, according to division ratio, compared to that of A or B phase signal after division.
  - ② When the division ratio is "1", Z-phase signal is synchronized with A-phase signal, while if it is not "1", they are unsynchronized.

6-2 Input/Output signal

Type	Title	Symbol	Pin No.	Contents/function
Control signal power supply	Control signal power supply	COM +	11	<ul style="list-style-type: none"> <li>• Connect (+) of the control signal power supply (12~24V) to the No. 11 pin, and (-) to the No. 28 pin.</li> <li>• Prepare a control signal power supply at your side.</li> </ul> Capacity varies depending on a composition of the control output circuit. Allow extra capacity.
		COM -	28	
Control input	Servo-ON input	SRV-ON	12	<ul style="list-style-type: none"> <li>• When you connect to (-) of the control signal power supply, dynamic brake will be released and the driver turns to "Servo-ON".</li> <li>• When you open the connection to (-), the driver turns to "Servo-OFF", and shuts off the current to the motor and dynamic brake will be activated, and also the deviation counter will be cleared.</li> </ul> <p><b>Note</b> 1. When you shift from "Servo-OFF" to "Servo-ON", make sure that the motor is at stop.</p> <p><b>Note</b> 2. Turn on/turn off the power at "Servo-OFF" status in order to avoid transitional trouble.</p> <p><b>Note</b> 3. Allow 50 ms or more before input the command (speed/pulse etc.) after shifting to "Servo-ON".</p>
	Zero-speed clamp input	ZEROSPD	10	<ul style="list-style-type: none"> <li>• When you open a connection to (-), the external and internal speed command input will be separated and the zero-speed command will be entered as a data value.</li> <li>• Therefore, you can eliminate varying factors, such as the off-set or the drift of the external speed command signal, or of the succeeding A/D converter.</li> </ul> You can select valid/invalid through parameter. Refer to section 9-2 (21). <p><b>Note</b> This input is active only at speed control mode.</p>
	Control mode control input	C-MODE	32	<ul style="list-style-type: none"> <li>• You can select six modes through the parameter of "Selection of control mode", in single mode, among ① Position control mode, ② Speed control mode, and ③ Torque control mode, and in addition to these in combination mode, among ④ Position (1st.) •Speed (2nd.) control mode, ⑤ Position (1st.) •Torque (2nd.) control mode, and ⑥ Speed (1st.) •Torque (2nd.) control mode.</li> <li>• In the case where any of control modes combining ④ to ⑥ above is selected, when connection to the (-) pole is open, the first mode is selected.</li> </ul>

Type	Title	Symbol	Pin No.	Contents/function
Control input	Alarm clear input	A-CLR	31	<ul style="list-style-type: none"> <li>You can clear the alarm status when you connect to (-), and you can return to the normal run. (Signal width needs to be 120ms or more.)</li> <li>At the same time, the deviation counter will be cleared.</li> </ul> <p><b>Note</b> You cannot clear the overload (OL), overcurrent (OC), encoder error (ST) and system error, parameter error, CPU error and DSP error with this input.</p> <p><u>In order to clear the above, please remove the error factor first, then turn off/on the power.</u></p>
	CCW rotation inhibit input	CCWL	30	<ul style="list-style-type: none"> <li>In case of a linear drive, connect to the limit SW in CCW direction (viewed from the motor shaft), and close this limit in case of a normal run.</li> <li>If the SW becomes open exceeding the limit, no CCW torque will be generated.</li> <li>When you do not use the limit SW, please mask this input through the parameter (refer to section 9-2 (10)), or connect between (-) at any time.</li> <li>You can activate a dynamic brake with this input. Refer to section 6-3 for a detail.</li> </ul>
	CW rotation inhibit input	CWL	29	<ul style="list-style-type: none"> <li>You can prohibit a generation of CW torque. Refer to the above "CCW rotation inhibit input" for the function and composition.</li> </ul>
Control output	Servo-ready output	S-RDY	27	<ul style="list-style-type: none"> <li>Transistor will turn ON, when the main power is on, after approx. 1 sec. of initializing time and the driver is not in "Servo-alarm" status. Please input Servo-on after outputting Servo-ready.</li> </ul> <p><b>Note</b> When you turn off the power but the main capacitor is kept charged, Servo-ready output is ON.</p>
	Servo-alarm output	ALM	26	<ul style="list-style-type: none"> <li>Transistor turns off when the driver detects the error and activates the protective function.</li> </ul>
	Positioning end signal output or Speed arrival signal output	COIN	25	<ul style="list-style-type: none"> <li>At position control mode, when the reserved pulse amount of the deviation counter gets within the positioning end range which you set through the parameter, transistor turns on.</li> <li>At speed or torque control mode, this signal becomes a speed arrival signal. Transistor turns on when the motor speed reaches the preset speed preset through the parameter.</li> </ul>

Type	Title	Symbol	Pin No.	Contents/function
Analog signal input	Speed command input	SPR/SPL	14	<p>① At speed control mode:</p> <ul style="list-style-type: none"> <li>You can input the analog speed command.</li> <li>You can set the speed command input gain (relation between the motor speed and the command input level), and the polarity of the speed command input through the parameter. (Refer to section 9-2(17), (18)).</li> </ul> <p>② At torque control mode:</p> <ul style="list-style-type: none"> <li>You can input the speed limit command. You can limit the speed responding to the external input signal level.</li> <li>A relation between the limited speed and the input level is the same as that of the commanded voltage level and the motor speed at the parameter No. [13]. Refer to section 9-2 (17).</li> </ul> <p><b>Note</b> 1. You can use both + and - polarity of the speed limit input, and you can limit both CCW and CW speed.</p> <p><b>Note</b> 2. This input becomes inactive at position control mode.</p>
		GND	15	
	CW torque limit input	CWTL	33	<ul style="list-style-type: none"> <li>You can individually limit the CW and CCW torque (current) externally at speed and position control mode, responding to the input signal level.</li> <li>Input negative command voltage to CWTL (No. 33 pin) to limit the CW torque, and positive command voltage to CCWTL (No. 34 pin) to limit the CCW torque.</li> <li>A relation between the commanded voltage and the torque limiting ratio (against the rated current) is described as follows:</li> </ul> <div style="text-align: center;"> <p>ratio against the rated current</p> <p>CW command    -3   -6   -9 (V)  CCW command    +3   +6   +9 (V)</p> </div>
		GND	35	
	CCW torque limit input	CCWTL	34	<p><b>Note</b> 1. At the factory setting, the CCW and CW torque limit function is masked through the Parameter No. [07]. When you use this function, input command voltage to CWTL or CCWTL, after releasing the mask (Refer to section 9-2 (8).)</p> <p><b>Note</b> 2. This function becomes inactive at torque control mode.</p> <p><b>Note</b> 3. Some models show saturation when the torque limit input exceeds approx. ±6V.</p>
		GND	35	

Type	Title	Symbol	Pin No.	Contents/function
Analog signal input	Torque command input	TRQR	34	<ul style="list-style-type: none"> <li>You can input the torque command at a torque control mode.</li> <li>You can set the torque command input gain (a relation between command input level and generated torque of the motor), and polarity of torque command input through the parameter. (Refer to section 9-2 (23), (24).)</li> </ul> <p><b>Note</b> 1. This input is used in common with CCW torque limit input (CCWTL).</p> <p><b>Note</b> 2. As soon as torque input equivalent to about 200% or more is given, some models may show saturation phenomenon of generated torque.</p>
		GND	35	
Analog signal output	Speed monitor signal	SP	16	<ul style="list-style-type: none"> <li>The driver outputs voltage with polarity in proportion to the motor speed. <ul style="list-style-type: none"> <li>+ : CCW rotation</li> <li>- : CW rotation</li> </ul> </li> <li>You can set 2 types of full scale value of a speed monitor signal through the parameter No. <b>08</b> "Speed monitor gain". (Refer to section 9-2 (9).)</li> </ul> <p><b>Note</b> Output impedance of the speed monitor signal is 10kΩ. Pay attention to input impedance of measuring instruments and circuits to which you connect.</p>
		GND	17	
	Torque monitor signal	IM	36	<ul style="list-style-type: none"> <li>The driver outputs voltage with polarity in proportion to the generated torque of the monitor. <ul style="list-style-type: none"> <li>+ : CCW rotation</li> <li>- : CW rotation</li> </ul> </li> <li>A relation between output voltage of the torque monitor signal and the generated torque is; <p style="text-align: center;">3V/100% torque</p> </li> </ul> <p><b>Note</b> Output impedance of the speed monitor signal is 10kΩ. Pay attention to input impedance of measuring instruments and circuits to which you connect.</p>
		GND	17	
Pulse row command input	Command pulse input	PULS A	5	<ul style="list-style-type: none"> <li>You can input command pulses through this terminal. The driver receives them with a high-speed photo-coupler IC.</li> <li>You can select input status of command pulse among the followings through the parameter; (Refer to section 9-2 (35).) <ul style="list-style-type: none"> <li>① 2-phase input (A/B-phase)</li> <li>② CW (PULS)/CCW (SIGN) pulse input</li> <li>③ Command pulse (PULS)/Symbol (SIGN) pulse input</li> </ul> </li> <li>You can set a multiplication of the 2-phase input (multiplication of 1, 2, 4), and select the polarity of the input command pulse (Refer to section 9-2 (33), (34).) through the parameter.</li> </ul>
		PULS B	6	
	Command symbol input	SIGN A	7	
		SIGN B	8	

Type	Title	Symbol	Pin No.	Contents/function
Control input (at position control mode)	Deviation counter clear input (Count clear)	CL	13	<ul style="list-style-type: none"> <li>You can clear the deviation counter inside of the driver when you turn CL to "L". You can also prohibit a command pulse input and a feed-back pulse input from the encoder.</li> <li><b>Note</b> Allow more than 30 <math>\mu</math>s of clear signal width.</li> </ul>
	Command pulse input inhibit	INH	9	<ul style="list-style-type: none"> <li>You can inhibit a command pulse (PULS, SIGN) input when you turn INH to "H".</li> </ul>
Encoder pulse output	A-phase output	OA+	19	<ul style="list-style-type: none"> <li>An output pulse from the rotary encoder built-in the driver will be entered into the division processing circuit, and be fed out through the line driver (AM26LS31) after the division processing.</li> <li>You can select a logic relation of B-phase, or Z-phase against A-phase pulse through the parameter. (Refer to section 9-2 (14).)</li> </ul>
		OA-	20	
	B-phase output	OB+	21	
		OB-	22	
	Z-phase output	OZ+	1	
		OZ-	2	
	Z-phase output	CZ	4	<ul style="list-style-type: none"> <li>Open collector output.</li> </ul>
		GND	3	

### 6-3 Dynamic brake

MSD Series have built-in dynamic brake for emergency stop. The dynamic brake will be activated in the following cases;

- (1) when you turn off the main power,
- (2) when you turn the driver to "Servo-OFF",
- (3) when a protective function is activated,
- (4) during deceleration, when the limit SW, connected to "CW rotation inhibit input (CWL)" of the Connector, CN I/F is turned to "open" while the motor is running at CW.
- (5) during deceleration, when the limit SW, connected to "CCW rotation inhibit input (CCWL)" of the Connector, CN I/F is turned to "open" while the motor is running at CCW.

**Note** 1. In case of the above (4) and (5), you can select whether or not to activate the dynamic brake through the parameter No. **OA**. (Refer to section 9-2-(11).)

Parameter No. <b>OA</b> DB deactivation at rotation inhibit	Dynamic brake
0	Brake is activated and the motor stops.
1	Brake is not activated and the motor makes free-run stop.

**Note** 2. The dynamic brake is rated for a short duration. Use this only for emergency. Avoid a frequent repetition of "Servo-ON/OFF".

## 6-4 Auto-gain tuning

### 6-4-1 Outline of auto-gain tuning

The driver selects the most proper gain automatically, by presuming the load inertia from the required torque when you drive the motor. Please refer to section 10-1-4, 10-2-5 for how to operate automatic gain tuning.

### 6-4-2 Applicable range

You can apply this function only when the following conditions are satisfied. Even if the conditions are satisfied, there may be the cases when you cannot apply this function, due to various load conditions. In these occasions, please setting manually. (Refer to section 8-2)

	Applicable conditions
Load inertia	To be more than 3 times, but less than 20 times that of the rotor inertia of the motor. Inertia to be as stable as possible.
Load	<ul style="list-style-type: none"><li>• Machine stiffness to be as high as possible, including a coupling to the motor. (No belt drive is applicable.)</li><li>• Backlash of the gear to be as small as possible.</li><li>• Eccentric load to be less than 1/4th, of the rated torque (especially in the use at vertical shift axis).</li><li>• Viscous load torque to be less than 1/4th of the rated torque.</li><li>• No safety problem nor machine damage to be expected, even when an oscillation occurs.</li><li>• Machine to allow two revolutions of the motor for CCW and CW in both forward and reverse direction.</li></ul>

### 6-4-3 Cautions

- (1) During the automatic gain tuning operation, you can expect the motor output torque up to the max. set through the parameter No. **06** and CW & CCW rotation inhibit input becomes inactive.
- (2) The driver may enter into an oscillation depending on the load condition. Please pay extra attention for the safety. when the oscillation occurs, turn to "Servo-OFF" immediately, and initialize to the factory setting of the gain through the parameter.
- (3) When any malfunctions occur during the automatic gain tuning operation, turn off the power or turn to "Servo-Off" immediately.
- (4) When load inertia cannot be estimated although automatic gain tuning is performed, gain remains unchanged as a value before tuning.

### 6-4-4 Auto-gain tuning operation

When you set the machine stiffness No. (higher the setting No., stiffer the tuning you can set) and execute, you can start the automatic gain tuning operation.

Rotate 2 revolutions to CCW and 2 revolutions to CW 2 times. Take this process as one cycle, and repeat max. 5 cycles.

Operation acceleration will be increased by double from the 3rd. cycle onward.

Depending on the state of load, there may be some cases when the auto-tuning will be completed before 5 cycles, or the operation acceleration will not change. These are not malfunctions.

Regarding the machine stiffness No.

- This No. represents the stiffness of the machine, and ranges from 1 to 9. You can set a higher value and higher gain with a higher stiffness machine.
- Normally you start setting with smaller No.; and repeat the automatic gain tuning until you encounter the oscillation, abnormal noise or vibration.

6-4-5 How to operate

- (1) Shift the load where no problem to be seen when the motor rotates 2 revolutions.
- (2) Inhibit the command.
- (3) Turn to "Servo-ON".
- (4) Start up the automatic gain tuning. (Refer to section 10-1-4 (4).)
- (5) Write into EEPROM if no problem to be seen.

**Note** If "Alarm", "Servo-OFF" or "Deviation counter clear" occur during the automatic gain tuning operation, this leads to "Automatic gain tuning error". Please refer to section 10-1-4 (4).)

6-5 Protective functions

6-5-1 Outline

- MSD Series have various protective functions, and the driver trips while an alarm output signal (ALM) is turned "off" from "on" when these functions are activated.
- When the driver trips:
  - (1) All digits of 7-segment LED will flash, if you operate with the front panel. Please refer to section 10-1-4 (1), in order to check the error code which represents the error factor.
  - (2) You can monitor on the monitor screen as described in the section of [Control state reference] or [Error condition reference], if you use a computer.

6-5-2 Detail of protective functions

Protective function	Error code No.	Content	Corrective action
Overvoltage protection	12	Voltage at converter exceeds 400V (for 200V model), or 200V (for 100V model), due to regenerative energy.	<ul style="list-style-type: none"> <li>• Extend deceleration time. Or reduce load inertia.</li> </ul> <b>Note</b> This cannot be applied to use regenerative brake continuously.
Undervoltage protection	13	Power supply voltage drops due to instantaneous power shut off or lack of power capacity.	<ul style="list-style-type: none"> <li>• Check if power supply voltage is within permissible range or not.</li> </ul> <b>Note</b> Check voltage drop due to lack of power capacity, or rush current at Power-ON. Also check open phase of power supply.
Overcurrent protection	14	Output current of converter increases extraordinarily.	<ul style="list-style-type: none"> <li>• Check short of each of motor leads (U, V, W), after shutting off power.</li> <li>• Verify insulation resistance between motor leads (U, V, W) and motor ground (E), and check any deterioration of insulation resistance.</li> <li>• If this protection recurs, even after checking and turning on power again, it represents malfunction. Shut off power immediately.</li> </ul>

Protective function	Error code No.	Content	Corrective action
Overload protection	16	Driver is used continuously with current which exceeds ratings.	<ul style="list-style-type: none"> <li>• Extend accel./decel. time or reduce load. Or extend capacity motor/driver.</li> </ul>
Encoder error protection	22	<ul style="list-style-type: none"> <li>• Some errors on encoder wiring occur. (such as broke wire)</li> <li>• Encoder malfunction</li> </ul>	<ul style="list-style-type: none"> <li>• Check wiring or connection between driver and encoder, or connection of Connector, CN SIG.</li> <li>• Check power supply voltage at encoder side (5V <math>\pm</math>5%) (especially when you use longer cables).</li> <li>• See <b>Note</b> 2 on the next page.</li> </ul>
Position error limit protection	24	Position error pulse exceeds permissible range set through the parameter No. <b>23</b> (Position error limit setting).	<ul style="list-style-type: none"> <li>• Check if motor runs per position command pulse or not.</li> <li>• Check saturation of output torque at torque monitor.</li> <li>• Set value of parameter No. <b>06</b> "Torque limit" to the max. (300% normally)</li> <li>• Verify gain adjustment.</li> <li>• Extend accel./decel. time or reduce load, if above check does not show any error.</li> </ul>
Deviation counter overflow protection	29	Position error pulse exceeds $2^{27}$ (134217728).	<ul style="list-style-type: none"> <li>• Check as same as above.</li> </ul>
Overspeed protection	26	Motor speed exceeds a limit set through the parameter.	<ul style="list-style-type: none"> <li>• Check if you input excess speed command or not. Or check input frequency of command pulse and division/multiplication ratio of command pulse.</li> <li>• Check if overshoot occurs at acceleration due to mis-adjustment of gain.</li> </ul>
Rotation inhibit input error protection	38	Driver trips when both CCW and CW rotation inhibit input turns to off, interpreting this as an error.	<ul style="list-style-type: none"> <li>• Check any errors of SW, wire, or power supply connected to CCW/CW rotation inhibit input.</li> <li>• Especially, check start-up delay of power supply for control signal (12~24VDC).</li> </ul>
Command pulse division error protection	27	Driver trips when division/multiplication ratio which you set through parameter No. <b>25</b> , <b>26</b> is not proper. (too high).	Set division/multiplication ratio so that command pulse frequency after division/multiplication becomes less than the max. input pulse frequency (500kpps).
EEPROM parameter error protection	36	Shows EEPROM parameter error if the data is damaged, when you read it from EEPROM upon the power on.	Set all the parameter again and write into EEPROM.

Protective function	Error code No.	Content	Corrective action
Receiving parameter error protection	84	Driver trips by judging some possible error by self-diagnosis function.	Turn off power once, then turn on again. If driver still trips, showing the left display, this may represent some malfunction. Shut off power immediately.
System error protection	98		
DSP error protection	23		
CPU error protection	30		
Other error protection	99		

**Note**

1. In order to restart the driver after the trip, please remove the trip factor by turning off the power. Then turn on the power gain, or enter an alarm clear signal (A-CLR).

Please note that you cannot reset when the following protective functions are activated, and please reset by turning on the power again;

- Overcurrent protection
- Overload protection
- Encoder error protection
- Self-diagnosis trips (Error code No. 36, 84, 98, 23, 30)

Turn on power again for resetting.

When EEPROM parameter error protection (No. 36) has worked, turn on power again, then check all parameters and reset them.

**Note**

2. When encoder error protection (error code No. 22) works as soon as system is started up, mostly the cause is wrong wiring and connection between driver and encoder.

See the section 5-1-3, and check it again.

# 7. Running

## 7-1 Before running

■ After you finish installation and wiring, please check the followings before running;

(1) Any wrong wiring?

Especially wrong wiring of the power input R, S, T and the motor output U, V, W, E, and loose connection.

(2) Is the input power correct?

(3) Any short portion with wire refuse?

(4) Any loose screw or connector? Is the connector inserted securely?

(5) Is the motor connecting cable shorted or grounded?

## 7-2 Trial run

(1) Please make a trial run per below:

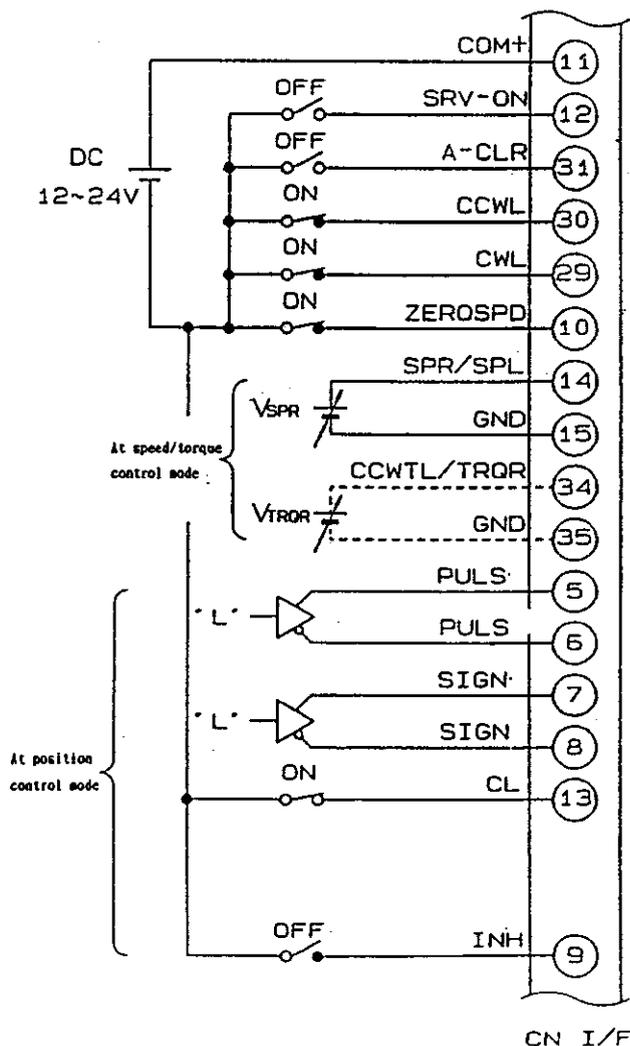
• Run the motor with no load (no load connected to the motor shaft).

• Fix the motor to avoid any movement due to the quick accel/decel. operation.

(2) Release a brake if you use the motor with a brake.

(3) Set polarity of signals, or switches connected to the input signal pins of CN I/F per the right Fig., and apply a signal power supply (DC12~24V).

(Do not turn on the main power of the main power to the driver yet.)



(4) Turn on the power to the driver

① 7-segment LED of the front panel displays shows one of the followings depending on the setting value at the Parameter No. **01**. "Selection of initial display".

P					0	.....	Position deviation	}	Refer to Section 10-1-4 (1)
r					0	.....	Motor speed		
t					0	.....	Output torque		

② Confirm that the parameter value is in accord with the factory setting by referring to Section 9, "Parameter", and Section 10, "Operation". Also confirm again the following parameter settings;

- Parameter No. **07** "Torque limit inhibit" : Check if the setting is "1" or not.  
(Refer to Section 9-2 (8))
- Parameter No. **29** "Pulse input mode" : (Refer to Section 9-2 (35))  
(running at only position control)  
Check if the input status of the command pulse is  
PULS + and SIGN -  
PULS - SIGN -

(5) Input a Servo-ON signal. The motor is now ready to be run.

① At speed control mode;

By increasing a speed command input (SPR) from 0V gradually, the motor runs at the speed in proportion to the input voltage.

② At torque command mode;

By increasing a torque command input (TRQR) from 0V gradually after applying about 1V to speed limit input (SPL) to make a speed limit state, the motor starts running.

③ At position control mode;

- Make a deviation counter clear signal (CL) to clear release (L→H), and make a command pulse input inhibit signal (INH) to inhibit release (H→L). Now the motor becomes the Servo-Lock state.
- Input a command pulse, responding to the setting value of Parameter No. **29** "Pulse input mode", to the terminal of PULS/SIGN. The motor runs at a speed in proportion to an input pulse frequency.

**Note** A relation between an input pulse frequency and a motor speed can be calculated per the following formula; (when the input pulse status is CW, CCW pulse row, or pulse row plus sign input)

$$\begin{aligned} & (\text{Input pulse frequency [pps]} \times (\text{Input pulse division} \cdot \text{multiplication ratio})) \\ & = (\text{Number of encoder pulses [P/r]} \times \frac{\text{speed [r/min]}}{60}) \times 4 \end{aligned}$$

**e.g.** where

Number of encoder pulses	: 2500[p/r]	}
Division · Multiplication ratio	: 1	
Input pulse frequency	: 300[kpps]	

$$\text{Motor speed N [r/min]} = \frac{300 \times 10^3 \text{ [pps]} \times 1 \times 60}{4 \times 2500 \text{ [P/r]}} = 1800 \text{ [r/min]}$$

(6) Please try other functions such as parameter change or gain adjustment.

# 8. Adjustment

## 8-1 Voltage confirmation of the rotary encoder

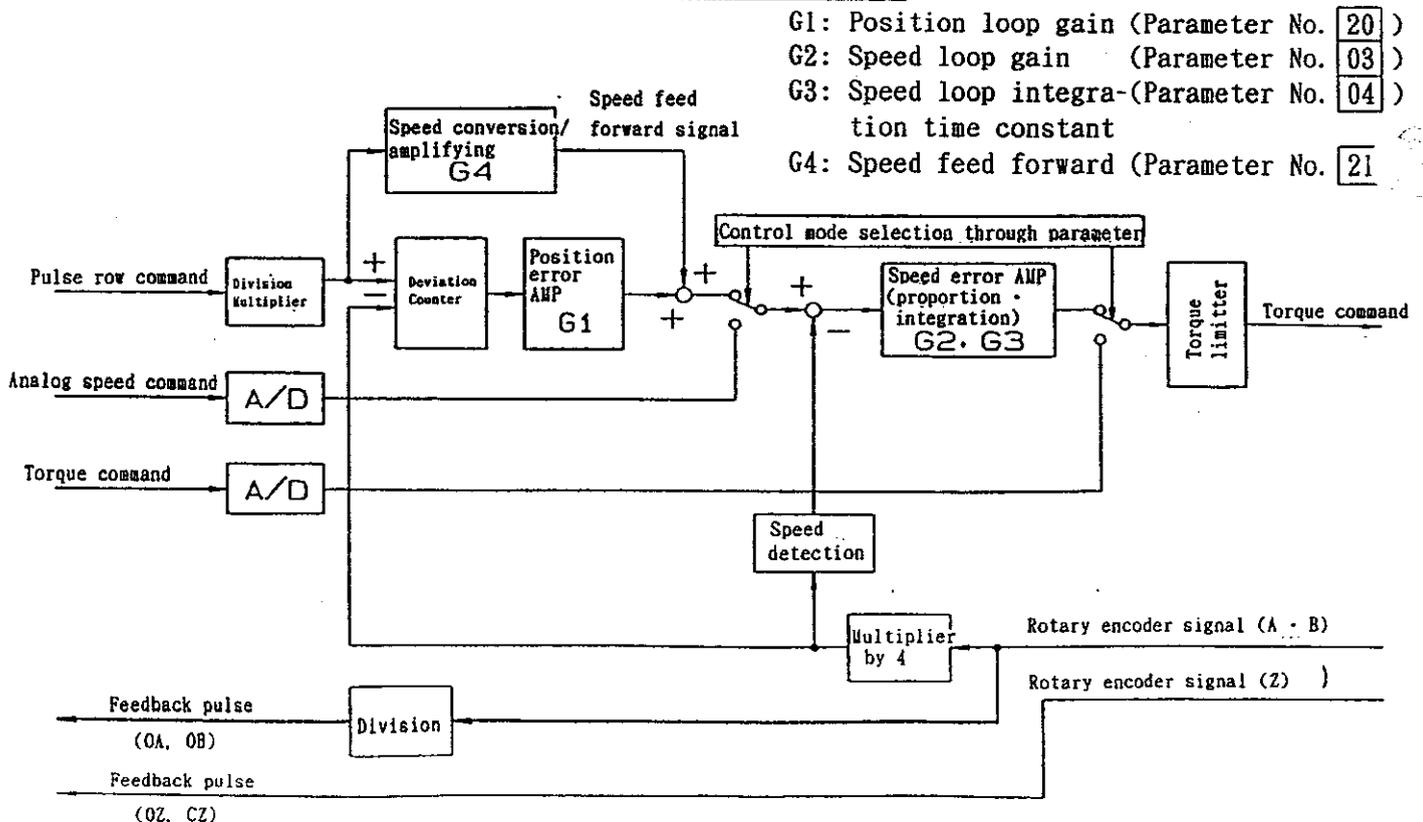
- This driver has a built-in power supply for the rotary encoder. In order to operate this encoder properly, the power supply voltage should be maintained  $5V \pm 5\%$ . If you use longer connecting cables for the rotary encoder, the voltage may be maintained with the above range due to the voltage drop. In this case, please confirm the rotary encoder voltage near the motor and in the state of connection to the encoder (between the 13-pin (+5V) and the 14-pin (0V) of the connector for encoder) is within  $4.75 \sim 5.25V$ . If this becomes below  $4.75V$ , refer to Section 5-1-3 and make the double wiring for the power supply.

## 8-2 Gain adjustment

As explained in section 6-4, some models of MSD Series have the automatic gain tuning function. If you encounter the case when the automatic gain tuning cannot be performed well due to the load condition, or when the vibration or noise is generated at the stopping or running while using non-auto-type, or when you want to obtain the most proper response or stability matching to the various load conditions, you may need the re-adjustment. In this case, please refer to section 8-2-1, "Basics of gain adjustment", and readjust.

- Though MSD Series consist of the digital AC Servo, you can make an analog adjustment for the servo gain adjustment. Following chart illustrates the image of making an equivalent conversion of the servo control to the analog servo control:

Equivalent block diagram



(1) In case of the position control mode;

- ① Set a speed feed forward gain to the minimum (0%) through the Parameter No. **[21]** (Refer to section 9, "Parameter" and section 10, "Operation").
- ② Set a larger value of the speed loop gain (within the range that no oscillation occurs) through the Parameter No. **[03]**.
- ③ Set the larger value of the position loop gain through the Parameter No. **[20]** within the range that no oscillation occurs.

**Note** If you set the larger position loop gain, the machine stiffness (at Servo-lock) becomes high.

Higher stiffness may cause the oscillation.

- ④ Set the smaller value of the speed loop integration time constant through the Parameter No. **[04]**. Smaller the value you set, faster the speed you can obtain to make the position deviation toward 0.
- ⑤ When you want to obtain an extremely fast response speed, increase the speed feed forward gain gradually through the Parameter No. **[21]**. If you set too large, it may cause the overshoot.

(2) In case of the speed control mode;

- ① Adjust the speed loop gain and speed loop integration time constant to the most proper value, by referring to the above mentioned ② and ④.
- ② If you use an oscilloscope, measure the check pins, SP (speed monitor signal) and IM (torque monitor) of the front panel. Then adjust the speed loop gain and the integration time constant so that you can obtain the minimum overshoot of the speed monitor a signal at the accel/deceleration, against the stepped speed command, or the minimum ripple of the torque monitor signal.

## 8-2-2 Caution on the gain adjustment

- (1) The most proper value of the gain setting varies depending on the load. Please make re-adjustment when the load is changed.
- (2) When you set the maximum value of the speed loop integration time constant (1000[ms]) at the position control mode, the position-finish may not reach within the range set through the Parameter No. **[22]** and the positioning end signal (COIN) may not be fed out. Please set this value to "100[ms]" or less at normal condition.
- (3) If you compose a Servo Drive System in combination with this driver set at the speed control mode and an external positioning unit, the position loop gain of the servo system may vary due to the setting value of the input gain in speed control mode (Parameter No. **[13]**).
- (4) If you set too high value of the gain setting, it may cause the oscillation. In this case, lower the gain setting to stop the oscillation. If you cannot stop the oscillation, turn the Servo-ON command to OFF by turning off the main power then turn on again to reset the gain from the lower value.

# 9. Parameter

## 9-1 Outline of parameter

- (1) MSD Series have parameters through which you can set/adjust various features and functions. And you can refer, set or adjust, ① with the operation panel · display in the front of the driver, or ② with a computer.
- (2) Parameters are classified as follows;
- ① User parameter which you can set and change the data
  - ② System parameter which you can refer but cannot set nor change the data
- Each parameter consists of 4 pages, and each page is divided by max. 16.
- (3) Following is the list of parameters; Please refer to section 9-2 for the detail.

Type	Parameter No.	Parameter	Related control mode	Adjustable range	Standard factory setting
User parameter	0 0	Name of axis	T.S.P	0~9	0
	0 1	Selection of initial display	T.S.P	0~2	1
	0 2	Selection of control mode	T.S.P	0~5	1
	0 3	Speed loop gain	T.S.P	25~3500	*
	0 4	Speed loop integration time constant	T.S.P	1~1000[ms]	*
	0 5	Speed detection filter	T.S.P	0~4	4
	0 6	Torque limit	T.S.P	0~400[%]	*
	0 7	Torque limit inhibit	S.P	0, 1	1
	0 8	Speed monitor gain	T.S.P	0, 1	0
	0 9	Inactive drive inhibit input	T.S.P	0, 1	1
	0 A	Dynamic brake	T.S.P	0, 1	0
	0 B	Numerator of pulse frequency division (feed back)	T.S.P	1~10000	10000
	0 C	Denominator of pulse frequency division (feed back)	T.S.P	1~10000	10000
	0 D	Pulse inversion	T.S.P	0~3	0
	0 E	(not in use)	—	—	—
	0 F	(internal use)	—	—	—
User parameter	1 0	Acceleration/Deceleration time period	S	0~5000	0
	1 1	(not in use)	—	—	—
	1 2	Arrival speed	T.S	0~10000[r/min]	1000
	1 3	Input gain in speed control mode	T.S	10~2600	225
	1 4	Input reversal in speed control mode	T.S	0, 1	0
	1 5	Offset voltage in speed control mode	T.S	-127~127	0
	1 6	Internal/external speed selection	T.S	0, 1	0
	1 7	Zero-speed clamp cancel	T.S	0, 1	1
	1 8	First internal speed	T.S	-7000~7000	0
	1 9	(not in use)	—	—	—
	1 A	Input gain in torque control mode	T	25~2500	250
	1 B	Input reversal in torque control mode	T	0, 1	0
	1 C	Offset voltage in torque control mode	T	-127~127	0
	1 D	(not in use)	—	—	—
	1 E	(not in use)	—	—	—
	1 F	(internal use)	—	—	—

Type	Parameter No.	Parameter	Related control mode	Adjustable range	Standard factory setting
User parameter	2 0	Position loop gain	P	10~1000[1/s]	*
	2 1	Speed feed forward	P	0~100[%]	0
	2 2	Positioning end range	P	0~32766[P]	10
	2 3	Position error limit setting	P	1~32766	30000
	2 4	Cancel of position error limit	P	0, 1	0
	2 5	Numerator of pulse frequency division	P	1~10000	10000
	2 6	Denominator of pulse frequency division	P	1~10000	10000
	2 7	Multiplier setting	P	1~4	4
	2 8	Logical inversion	P	0~3	0
	2 9	Pulse input mode	P	0~3	1
	2 A	(not in use)	—	—	—
	2 B	(not in use)	—	—	—
	2 C	(not in use)	—	—	—
	2 D	(not in use)	—	—	—
	2 E	(internal use)	—	—	—
	2 F	(internal use)	—	—	—
System parameter	3 0	Motor pole	<ul style="list-style-type: none"> <li>• These parameters are set by factory corresponding to the applicable motor and driver.</li> <li>• You cannot change the value of these parameters.</li> </ul>		
	3 1	Encoder pulse			
	3 2	J/T ratio			
	3 3	Current proportional gain			
	3 4	Current integration gain			
	3 5	Overspeed level			
	3 6	Max. output torque			
	3 7	Overload time constant			
	3 8	Overload criteria			
	3 9	(internal use)		—	
	3 A	(internal use)		—	
	3 B	(internal use)		—	
	3 C	(internal use)		—	
	3 D	(internal use)		—	
	3 E	(internal use)		—	
	3 F	(internal use)		—	

**Note** 1. Please note that "Standard factory setting" may vary from the above values depending on the applicable motor specifications.

**Note** 2. Factory setting value differs of parameters with \* depending on the driver model.

**Note** 3. Symbols used in this column stand as follows:  
T : Torque control mode  
S : Speed control mode  
P : Position control mode

## 9-2 Detail of user parameter

- (1) Parameter No. **[00]** : Name of axis (adjustable range: 0~9)
- When you use a computer to refer or monitor the parameter setting, you can monitor which axis the computer is accessing, while you control multi-axis.
  - Setting value of this parameter becomes the part of prompt, displayed on the initial screen at a serial communication. ( of Prompt AXIS%).
  - This setting does not affect any servo operation.
- (2) Parameter No. **[01]** : Selection of initial display (adjustable range: 0, 1, 2)
- You can select the type of data displayed at 7 segment LED, among the followings when you first turn on the power.
  - "0" : Displays the reserved pulse amount of position error counter. unit : [PULSE]
    - ① Range of display is -32767~+32767. If the reserved pulse amount exceeds this range, the display saturates at the upper or lower limit of this range.
    - ② Polarity display (+) : generates CCW torque  
- : generates CW torque
  - "1" : Displays the motor speed. unit : [r/m]
    - Polarity display (+) : rotates at CCW  
- : rotates at CW
  - "2" : Displays the motor torque.
    - ① Range of display is 0~±1500  
(Displayed value)×0.2 represents the actual generated torque (in % against the rated torque).  
**e.g.** If the displayed value is "+1500", the motor generates 300% of the rated torque at CCW.
    - ② Polarity display (+) : generates CCW torque  
- : generates CW torque
- Note** This parameter becomes inactive when you operate with computer.  
When the polarity is +, + will not be displayed.
- (3) Parameter No. **[02]** : Selection of control mode (adjustable range: 0~5)
- You can select the control mode with which you use this driver among the followings:
    - "0" : Position (pulse row) control mode
    - "1" : Speed (analog) control mode
    - "2" : Torque (analog) control mode
    - "3" : Position (1st.) • Speed (2nd.) control mode
    - "4" : Position (1st.) • Torque (2nd.) control mode
    - "5" : Speed (1st.) • Torque (2nd.) control mode
  - You can select either a 1st. or a 2nd. mode with a control mode control input (C-MODE), when you choose one of the above "3", "4" or "5" as follows:
    - When you select "H" of C-MODE, you can select the 1st. mode.
    - When you select "L" of C-MODE, you can select the 2nd. mode.
- Note** Please input C-MODE when the command signal to the shifting control mode is "0", or the motor is at complete stop, since this driver has not interlocking function between the receiving of the control mode control input and the existence or nonexistence of the command (pulse row command, speed/torque command), or the reserved pulse amount of the deviation counter.

- (4) Parameter No. **[03]** : Speed loop gain (adjustable range: 25~3500)
  - Proportional gain of the speed amplifier. Larger the value you set, larger the gain you can obtain.
  - Most appropriate value of the speed loop gain depends on the load inertia and the motor model.
 Please refer to section 8-2, "Gain adjustment" for detail.

- (5) Parameter No. **[04]** : Speed loop integration time constant (adjustable range: 1~1000ms)
  - Integration time constant of the speed amplifier. Smaller the value you set, faster the integration is made.
 Please refer to section 8-2, "Gain adjustment" for detail.

**Note** If you set this to the max. (1000), the integration time constant becomes infinite (no integration).

- (6) Parameter No. **[05]** : Speed detection filter (adjustable range: 0~4)
  - You can select the type (time constant) of the digital filter for speed detection signal. Larger the value you set, quieter the noise you can expect from the motor.
  - We recommend you to set this to "4" unless you need excessive speed response.

- (7) Parameter No. **[06]** : Torque limit (adjustable range: 0~400%)
  - This driver is designed to accept the max. torque of 300% of the rated torque for a short duration. You can limit this max. torque when you expect any mechanical problem with the motor load or the machine.
  - You set the value in percentage of the rated torque (100%).

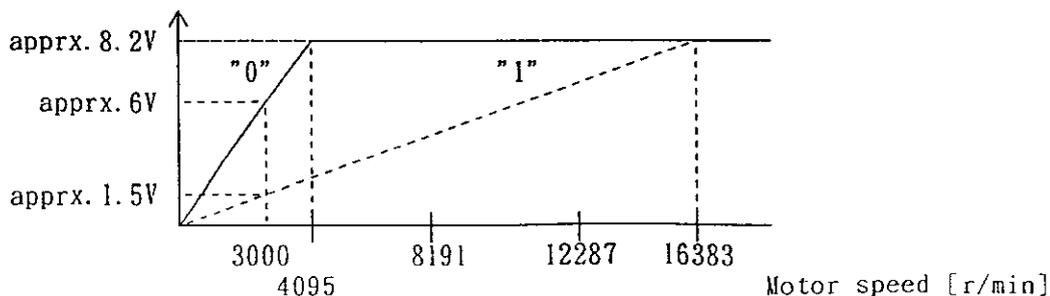
**e.g.** When the setting is "200". : Permissible output torque is 200% (2 times) of the rated torque

**Note** You cannot set a higher value than the factory setting value of the system parameter No. **[36]** (Max. output torque setting). Even if you set a higher value, the max. output torque will be automatically adjusted to the max. output torque of the factory setting.

- (8) Parameter No. **[07]** : Torque limit inhibit (adjustable range: 0, 1)
  - You can ignore the analog torque limit input (CWTl, CCWTl) by setting this to "1".

**Note** No torque will be generated when you set this to "0", and the torque limit input (CWTl, CCWTl) is open.

- (9) Parameter No. **[08]** : Speed monitor gain (adjustable range: 0, 1)
  - You can set the full scale value of the speed monitor signal (SP).
    - "0" : 4095 r/min full scale
    - "1" : 16383 r/min full scale
  - It is set to "0" (4095 [r/min] full scale) in normal specifications. If it is insufficient, set the parameter to "1".
  - Relation between the motor speed and the monitor voltage is described as below;



- (10) Parameter No. **09** : Inactive drive inhibit input (adjustable range: 0, 1)  
 • You can ignore the CW rotation inhibit input (CWL) and CCW rotation inhibition input (CCWL) by setting this to "1", and the driver runs normally judging this as "non-inhibit".

**Note** No torque of CW will be generated if you set this to "0" and the CW rotation inhibit input (CWL) is open. Same is applied to CCW. If both CWL and CCWL is open, the driver trips due to "Drive inhibit input error".

- (11) Parameter No. **0A** : Dynamic brake (adjustable range: 0, 1)  
 • You can select among the below, while the CW rotation inhibit input (CWL) or the CCW rotation inhibit input (CCWL) is working, and the motor is decelerating:  
 "0" : Dynamic brake is activated and the motor stops.  
 "1" : Dynamic brake is not activated and the motor makes free run stop.

- (12) Parameter No. **0B** : Numerator of pulse frequency division (feed back) (adjustable range: 1~100)  
 • You can set the numerator of the division of the feed back pulse from the encoder.

- (13) Parameter No. **0C** : Denominator of pulse frequency division (feed back) (adjustable range: 1~10000)  
 • You can set the denominator of the division of the feed back pulse from the encoder.

**Note** 1. Please make a division ratio lower than 1 after reducing to a common denominator.

$$\text{Division ratio} = \frac{\text{Numerator}}{\text{Denominator}} \leq 1$$

**Note** 2. Please do not set a extreme ratio (such as 1/10000). We recommend you to set a ratio between 1/32 and 1.

**Note** 3. This driver is designed for the motor with 2500 [P/r] encoder as a standard. Following table gives you example when you need to adjust to the necessary pulse number based on the system;

	Necessary feed back pulses at the system [P/r]				
	500	1000	1500	2000	2500
Setting value of numerator	500	1000	1500	2000	2500 (10000)
Setting value of denominator	2500	2500	2500	2500	2500 (10000)

**Note** 4. When you use division function of feedback pulse, Z-phase pulse is synchronized with A-phase pulse when division ratio is "1", while note that they are unsynchronized if it is not "1".

(14) Parameter No. **0D** : Pulse inversion (adjustable range: 0~3)

- Phase relation of the output pulse from the rotary encoder;
  - B-phase pulse is behind of A-phase at CW
  - B-phase pulse is ahead of A-phase at CW
- You can inverse the phase relation between the above A and B phase through this parameter by inverse the logic of B-phase. You can do the same to Z-phase.
- The table below represents each relation (at CW)

Value of parameter <b>0D</b>	A-phase			
0	B-phase		logic non-inversion	
	Z-phase		logic non-inversion	
1	B-phase		logic inversion	
	Z-phase		logic - non-inversion	
2	B-phase		logic non-inversion	
	Z-phase		logic inversion	
3	B-phase		logic inversion	
	Z-phase		logic inversion	

(15) Parameter No. **10** : Acceleration/Deceleration time period (adjustable range: 0~5000)

- You can set the acceleration and deceleration time through this parameter.
- Relation between the setting value and the accel./decel. time is described as follows:

$$\text{Setting value} = \left. \begin{array}{l} \text{Acceleration time from } 0[\text{r/min}] \text{ to } 1000[\text{r/min}][\text{s}] \\ \text{or} \\ \text{Deceleration time from } 1000[\text{r/min}] \text{ to } 0[\text{r/min}][\text{s}] \end{array} \right\} \times 500$$

e.g. When you want to start up from 0[r/min] to 3000[r/min] in 6s,  
 0[r/min]  $\rightleftharpoons$  1000[r/min] in 2s

↓  
 Setting value = 2 × 500 = 1000

- Note** 1. Acceleration/Deceleration limit function is not valid at the position control mode and torque control mode. Also do not use the accel./decel. limit function at the speed control mode while you compose a position control loop externally. (Set this parameter to "0".) This may cause an oscillation.
- Note** 2. Please note that you cannot set the acceleration and deceleration time individually.

(16) Parameter No. **12** : Arrival speed (adjustable range: 0~10000)

- You can directly set the detection level of the speed arrival signal (COIN) at the speed control or torque control mode, in motor speed [r/min].
- COIN signal will be turned on when the motor speed exceeds the setting value.

**Note** Please use the output COIN differently per the following control mode:  
 At the speed, torque control mode ... Speed arrival signal  
 At the position control mode ..... Positioning end signal  
 Therefore, this parameter is invalid at the position control mode.

- (17) Parameter No. **13** : Input gain in speed control mode (adjustable range: 10~2600)
- You can set the analog speed command (SPR) input gain (relation between the necessary motor speed and the speed command voltage value).
  - Please calculate the setting value per the following formula;

Setting value =  $0.00003 \times \text{number of encoder pulses} \times \text{necessary motor speed at 6V input [r/min]}$

e.g. Number of encoder pulses ..... 2500 [P/r]  
 Necessary motor speed at 6V input ..... 3000 [r/min]  
 Setting value =  $0.00003 \times 2500 \times 3000 = 225$

**Note** Please pay attention to the possible oscillation caused by the change of the position gain of the servo system, which is set through the parameter, when you compose the position control loop and use this driver at the speed control mode.

- (18) Parameter No. **14** : Input reversal in speed control mode (adjustable range: 0, 1)
- You can reverse the polarity (rotational direction) of the analog speed command signal (SPR),

"0" : Rotates at CW with the speed command of (+)  
 "1" : Rotates at CCW with the speed command of (+)

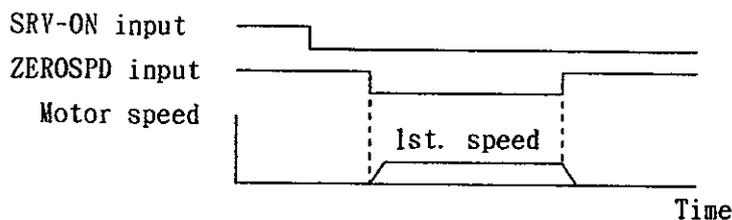
**Note** In case of position loop setting outside the driver, servo system is uncontrollable unless the polarity matches.

- (19) Parameter No. **15** : Offset voltage in speed control mode (adjustable range: -127~127)
- You can make an offset adjustment of the analog speed command input circuit.
  - Please proceed as follows when you make the offset adjustment with the driver alone;

- Enter exactly "0" V to the speed command input (or connect SPR to the signal GND).
- Set the value so that the motor does not rotate.

- (20) Parameter No. **16** : Internal/External speed selection (adjustable range: 0, 1)

- You can separate the analog speed command input (SPR) by setting this parameter to "1", and the internal speed command which you set through the parameter No. **18** (First internal speed, described later) becomes valid.
- Select between the motor stop and the 1st. speed with the zero-speed clamp input (ZEROSPD).
- Fig. below shows the example of variable speed running when you select the internal speed command;



- (21) Parameter No. **17** : Zero-speed clamp cancel (adjustable range: 0, 1)
- You can invalidate the zero-speed clamp input (ZEROSPD), by setting this parameter to "1", and the driver runs normally.

**Note** Zero-speed clamp input (ZEROSPD, No. 10 pin of CN I/F) which is described in section 6-2, becomes valid when you open this and (-) of the control signal power supply (COM No. 28 pin). If you set this parameter to "0" and open the ZEROSPD input, the driver becomes to "Zero-speed clamp" at any time, and the motor does not run.

- (22) Parameter No. **18** : First internal speed (adjustable range: -7000~7000)
- Set the first internal speed [r/min] with the following formula, when the internal speed command becomes valid. (Refer to parameter No. **16**.)
- $$\text{Setting value} = \frac{\text{Necessary 1st. speed [r/min]} \times \text{Number of encoder pulses [P/r]}}{7140}$$
- e.g.** Number of encoder pulses ..... 2500 [P/r]  
Necessary 1st. speed ..... 1500 [r/min]
- $$\text{Setting value} = \frac{1500 \text{ [r/min]} \times 2500 \text{ [P/r]}}{7140} = 525$$
- Note** Polarity of the setting value represents the polarity of the internal speed command.
- (+) : Rotates at CCW
  - : Rotates at CW
- (23) Parameter No. **1A** : Input gain in torque control mode (adjustable range: 25~2500)
- You can set the torque command (TRQR) input gain (relation between the generated motor torque and the torque command input voltage) at the torque control mode.
  - Set the value with the following formula;
- $$\text{Torque command input gain [V/100\%]} \approx \frac{3 \times 250}{\text{Setting value}}$$
- e.g.** When you want to obtain the rated torque with the torque command input of 1.5V;
- $$\text{Setting value} \approx \frac{3 \times 250}{1.5 \text{ [V/100\%]}} = 500$$
- Note** If you enter the torque command input which corresponds to 200% or more of the rated torque, this may cause a saturation despite of the above formula.
- (24) Parameter No. **1B** : Input reversal in torque control mode (adjustable range: 0, 1)
- You can reverse the polarity (direction of the generated torque) of the analog torque command signal (TRQR) with this parameter.
- "0" : Generates CW torque with the torque command of (+)
  - "1" : Generates CCW torque with the torque command of (+)
- (25) Parameter No. **1C** : Offset voltage in torque control mode (adjustable range: -127~127)
- You can make an offset adjustment of the analog torque command input circuit.
  - Please proceed as follows when you make the offset adjustment with the driver alone;
    - Input exactly "0" V to the torque command input (TRQR), (or connect TRQR to the signal GND) after setting to the torque control mode.
    - Set the value so that the motor does not rotates.
- (26) Parameter No. **20** : Position loop gain (adjustable range: 10~1000)
- You can set the position gain at the position control mode with the unit of [1/s].
  - Larger the value you set, larger the gain, and higher the servo stiffness (stiffness at servo-lock) you can obtain.
- Note** Too large setting may cause an oscillation.
- (27) Parameter No. **21** : Speed feed forward (adjustable range: 0~100)
- You can add a speed feed forward function at the position control mode when you need high speed response. (Refer to section 8-2 "Gain adjustment".)
  - Set the speed feed forward volume in percentage against the commanded volume.
- Note** Too large setting may cause an oscillation. We recommend you to set this parameter to "0" unless you need excessive speed response.

- (28) Parameter No. [22] : Positioning end range (adjustable range: 0~32766)
- You can set the detection level of judging the positioning end, with the number of pulses.
  - The driver will judge the positioning end when the number of reserved pulses of the deviation counter becomes within the preset range, the driver outputs the positioning end signal (COIN). (turns on the output transistor.)

**Note** Feedback pulse of rotary encoder is multiplied 4 times and input to deviation counter, so the positioning end range is converted into motor rotation angle as:

$$\frac{\text{Positioning end range}}{4 \times (\text{Pulse count of rotary encoder})}$$

- (29) Parameter No. [23] : Position error limit (adjustable range: 1~32766)
- Set the detection level of judging the position error, with the number of reserved pulses of the deviation counter.
  - Calculate the setting value with the following formula;

$$\text{Setting value} = \frac{\text{Judging level of position error [PULSE]}}{16}$$

- The driver trips when the number of reserved pulses of the deviation counter exceeds the above setting value, judging as an error.

- (30) Parameter No. [24] : Cancel of position error limit (adjustable range: 0.1)
- You can mask the protective function of the position error limit with this parameter.
  - You can cancel the detection of the position error limit, and the driver keeps operating even when the number of reserved pulses of the deviation counter exceeds the detection level, set through the parameter No. [23] (Position error limit).

- (31) Parameter No. [25] : Numerator of pulse frequency division (adjustable range: 1~10000)
- You can set the numerator of command pulse frequency division • multiplication.

- (32) Parameter No. [26] : Denominator of pulse frequency division • multiplication (adjustable range: 1~10000)
- You can set the denominator of command pulse frequency division • multiplication.

**Note** 1. Like the above section, you set any value of the denominator between 1 and 10000, but we recommend you to use with the range per the below;

$$\frac{1}{50} \leq \frac{\text{Setting value of numerator}}{\text{Setting value of denominator}} \leq 20$$

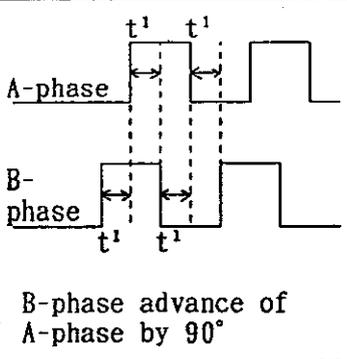
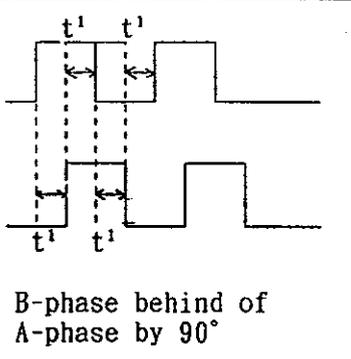
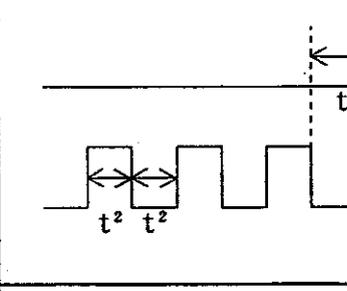
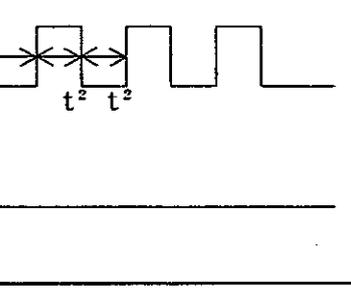
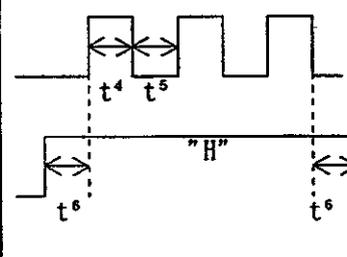
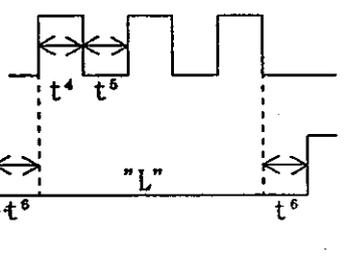
**Note** 2. Please set the multiplication ratio so that the command pulse frequency after the multiplication may not exceed the max. command pulse frequency. (500kpps in case of the line driver output, 200kpps in case of the open collector output.)

**Note** 3. See the section 7-2 "Trial run" for the relation between command pulse frequency, division/multiplication ratio, and motor revolutions.

- (33) Parameter No. [27] : Multiplier setting (adjustable range: 1~4)
- You can set the multiplication when you select "2-phase pulse input mode" at the parameter No. [29] (Pulse input mode) described later.
  - Relation between the setting value and the multiplication becomes as below;

"1" ..... Multiplication of 1  
 "2" ..... Multiplication of 2  
 "3" and "4" ..... Multiplication of 4

- (34) Parameter No. **28** : Logic inversion (adjustable range: 0~3)  
 • You can set the logic of the command input of 2 systems (PULS, SIGN) individually as below:  
 "0" ... "PULS" signal logic non-inversion, "SIGN" signal logic non-inversion  
 "1" ... "PULS" signal logic inversion, "SIGN" signal logic non-inversion  
 "2" ... "PULS" signal logic non-inversion, "SIGN" signal logic inversion  
 "3" ... "PULS" signal logic inversion, "SIGN" signal logic inversion
- (35) Parameter No. **29** : Pulse input mode (adjustable range: 0~3)  
 • Input status of command pulse may be selected from 3 types shown below by setting this parameter.

Setting	Input status	Signal of CN I/F	CCW command	CW command
"0" or "2"	2-phase pulse with 90° difference (A-phase+B-phase)	PULS  SIGN	 <p>B-phase advance of A-phase by 90°</p>	 <p>B-phase behind of A-phase by 90°</p>
"1"	CW pulse row + CCW pulse row	PLUS  SIGN		
"3"	Pulse row + Sign	PLUS  SIGN		

**Note** 1. The table above shows the logic relation on pulse input **ⓑ** side (driver side) illustrated in section 6-1-5. When the logic is considered on pulse input **Ⓐ** side (supply side), note that logic is inversed when pulse is supplied by line driver and by open collector. (See **Note** 2 of 6-1-5.)

**Note** 2. When logic relation of PULS, SIGN signal has to be changed for convenience of signal polarity on command pulse supply side (**Ⓐ**), use the function of parameter No. **28**.

• Minimum required time width

	Line driver interface	Open collector interface
t <sub>1</sub>	2 μs or longer	5 μs or longer
t <sub>2</sub>	1 μs or longer	2.5 μs or longer
t <sub>3</sub>	1 μs or longer	2.5 μs or longer
t <sub>4</sub>	1 μs or longer	2.5 μs or longer
t <sub>5</sub>	1 μs or longer	2.5 μs or longer
t <sub>6</sub>	1 μs or longer	2.5 μs or longer

# 10. Operation

(1) MSD Series have various parameters through which you can adjust/set the performance or functions.

Please use these parameters so that you can operate the driver at the most appropriate condition.

(2) Among various functions of MSD Series are;

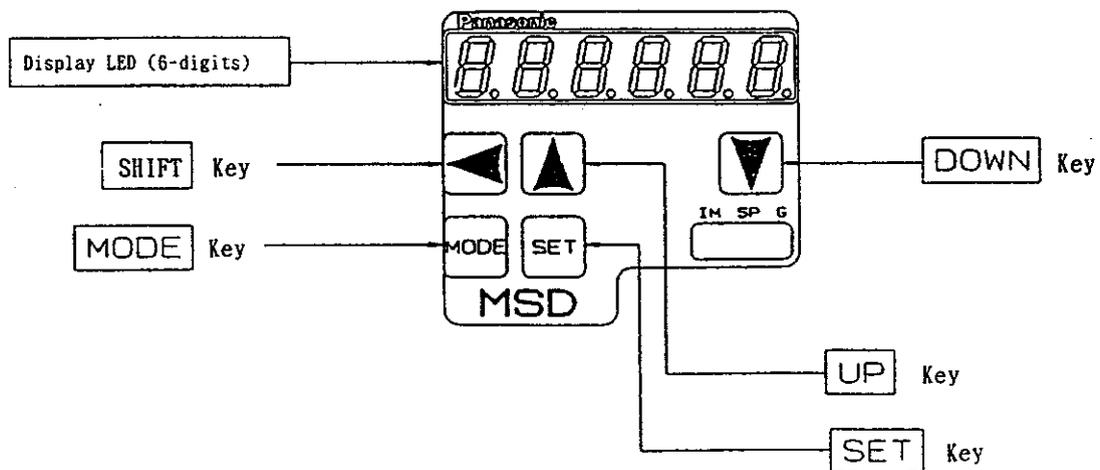
- Monitoring functions of such as the number of reserved pulses of the deviation counter (position error), motor speed and generated torque.
- Display of the status of the control input/output signals connected to the connector, CN I/F.
- Display of the error factors and the record.

(3) There are 2 ways of operating the above functions as below;

- Key operation and the display of the front panel or,
- Computer display

## 10-1 Key operation of the front panel and display

### 10-1-1 Composition of the front panel/display



■ There are 4 modes which you can work with, when you operate through the key SW or LED on the front panel. These are, "Monitor mode", "Parameter setting mode", "EEPROM writing mode" and "Automatic gain tuning mode". Please use **MODE** key to select these modes. Each mode consists of **Selection display** and **Execution display**, and use **SET** key to select these displays. Use **▲** **▼** **◀** keys to select or execute each mode.

■ You can only change the data at the figure which decimal point is flashing.

**▲** **▼** **◀** keys are not valid unless the flashing of the decimal point is displayed.

SW	Valid condition	Function
<b>MODE</b>	At the selection display	Select the mode.
<b>SET</b>	At any time	Select the selection display or execution display.
<b>▲</b> <b>▼</b>	When the flashing decimal point is displayed.	Change the data. Select the parameter. Execute the operation.
<b>◀</b>		Shift to upper figure for data changing.

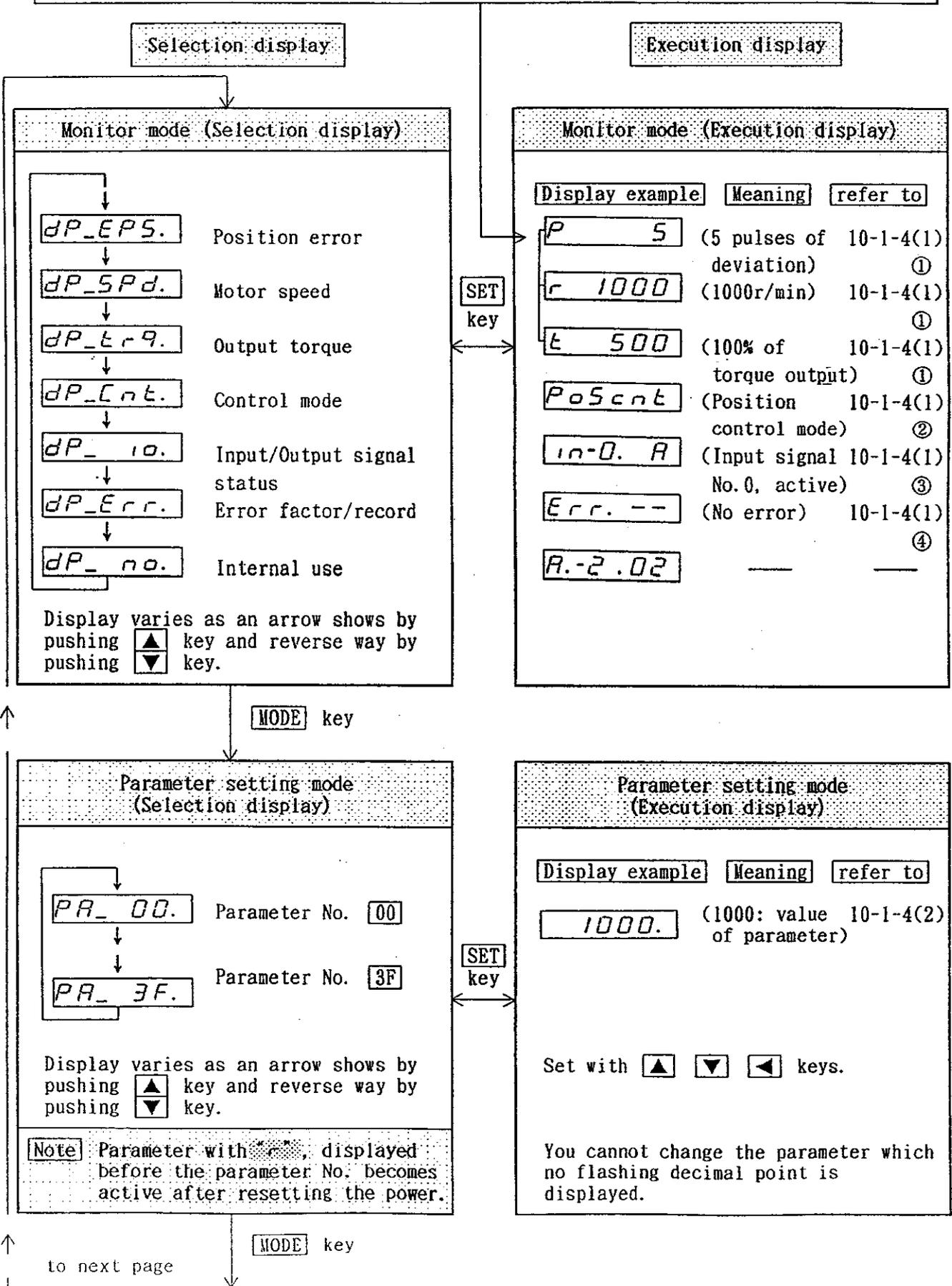
■ At the selection display of each mode, upper figures consist of 2 alphabets + under bar.

Mode	Upper figures at the selection display
Monitor mode	<i>dP_</i>
Parameter setting mode	<i>PA_</i>
EEPROM writing mode	<i>EE_</i>
Automatic gain tuning mode	<i>At_</i>

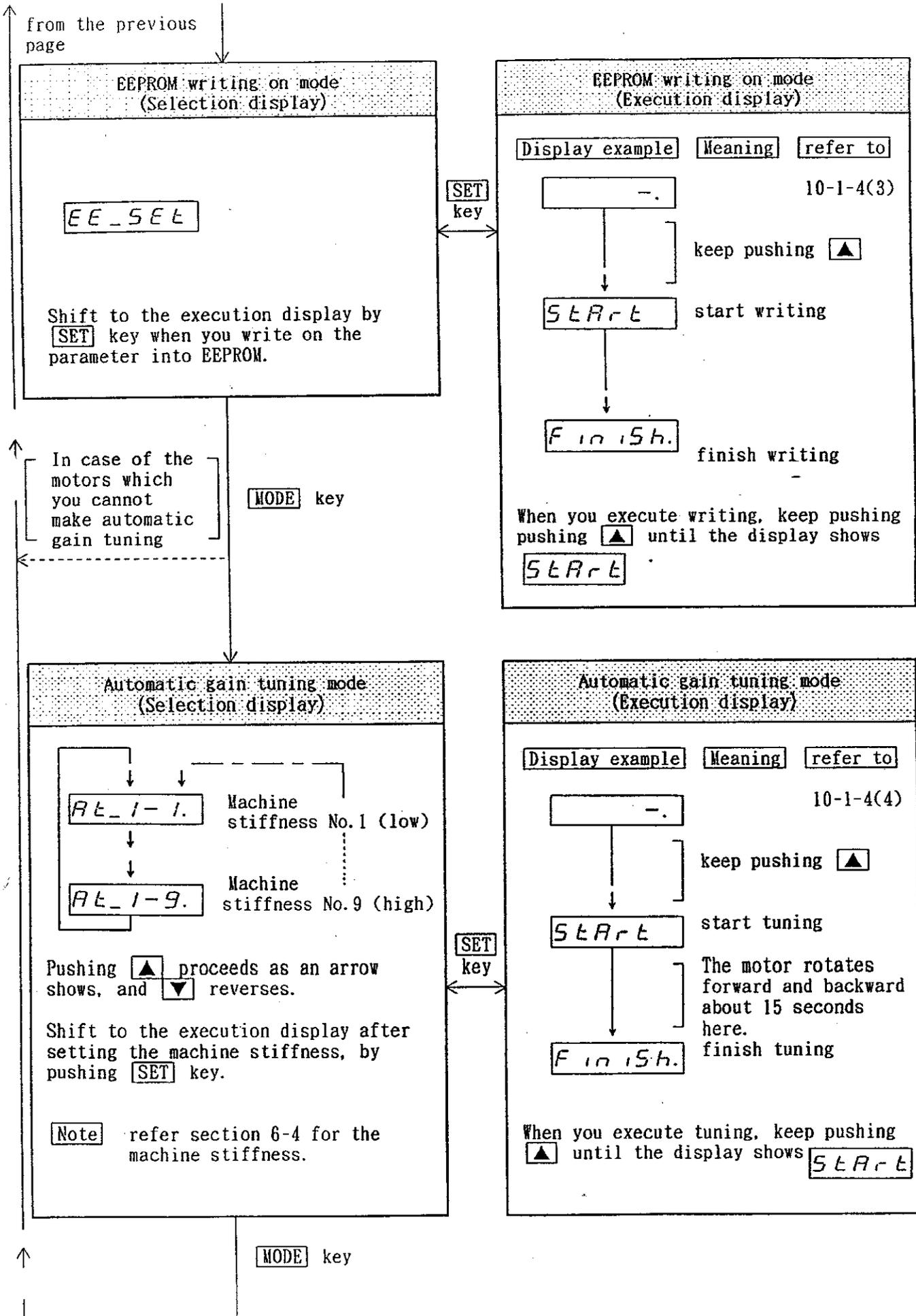
■ When all the figures flash, this represents the trip.

Display	Motor status
All the figures flash	Trip
Normal display	Normal operation

When you turn on the power, LED display shows the execution display (either one of the position error, motor speed, or torque output), following the setting of the parameter No. **01** ("Selection of initial display", after displaying the LED check (about 2s).

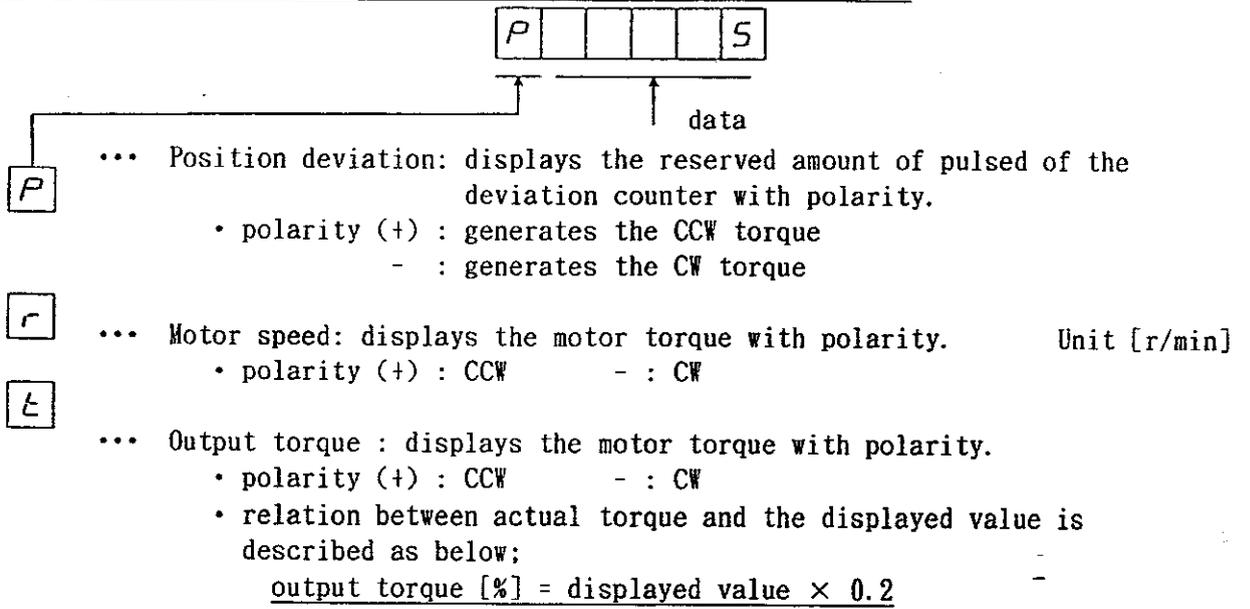


to next page



(1) Detail of monitor mode

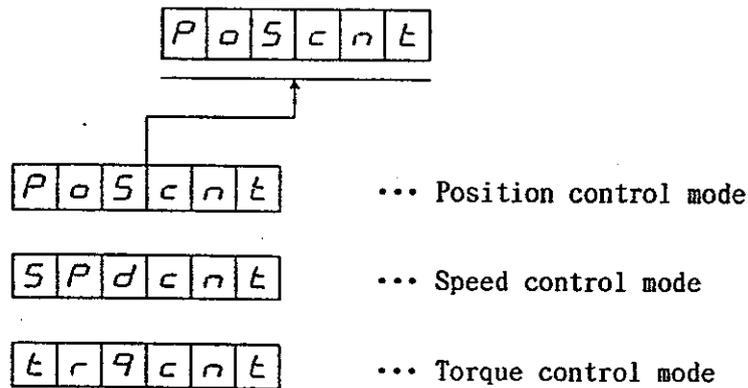
① Display of the position error, motor speed and output torque



**Note** when the polarity is +, + will not be displayed.

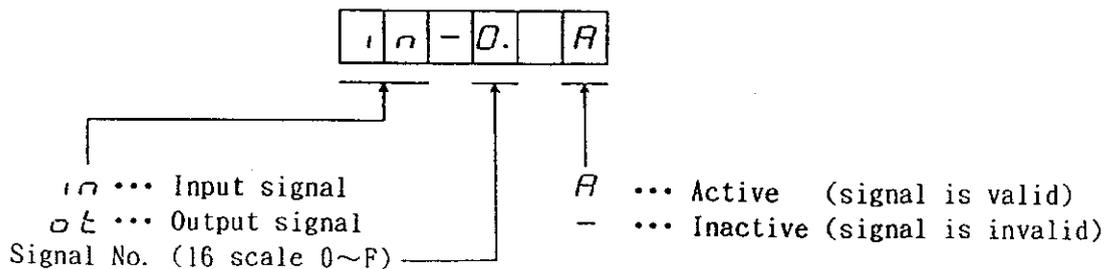
② Display of control mode

Displays the current control mode.



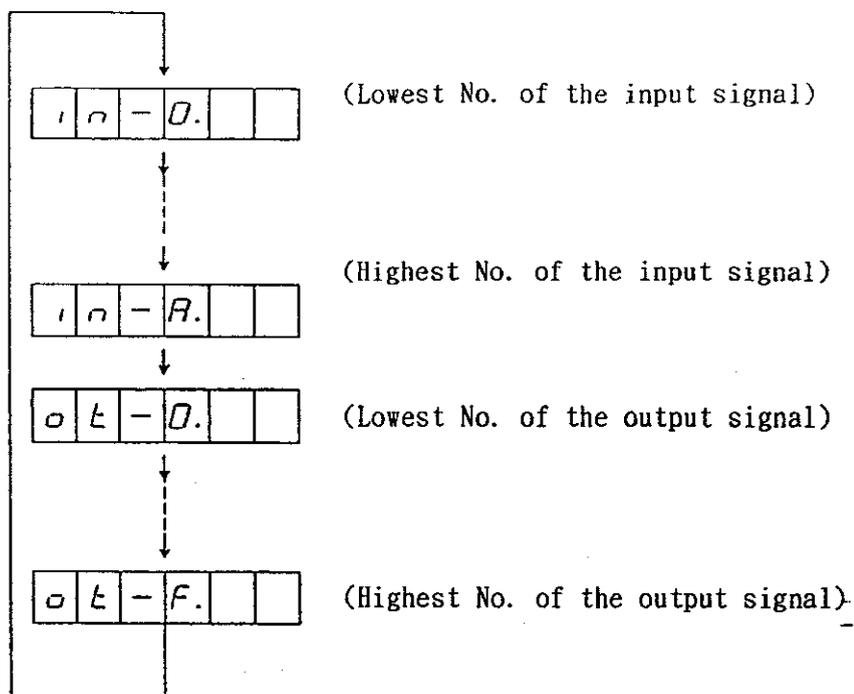
③ Display of input/output signal

■ Displays the status of the control input and output signal to the connector CN I/F. You can use for checking the right connection.



■ Push ▲ ▼ to select the desired signal No.

Example of shifting when pushing ▲

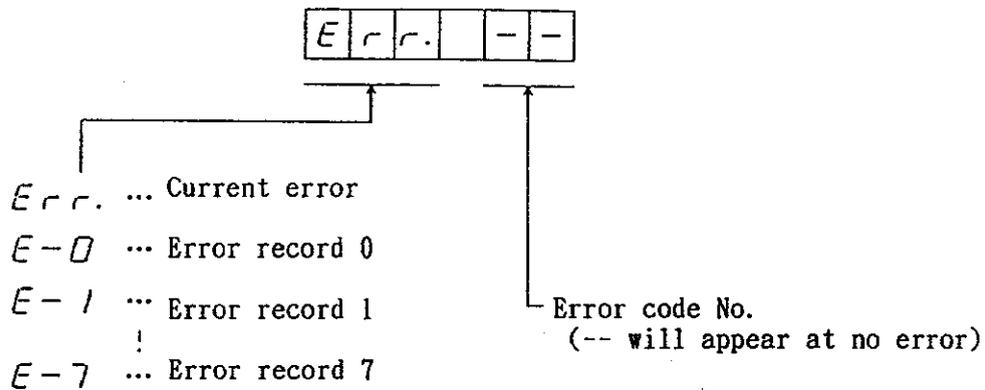


■ Signal No. and its title

Input signal				Output signal			
Signal No.	Title	Symbol	Pin No.	Signal No.	Title	Symbol	Pin No.
0	Servo-ON	SRV-ON	12	0	Servo-ready	S-RDY	27
1	Alarm clear	A-CLR	31	1	Servo-alarm	ALM	26
2	CW rotation inhibit	CWL	29	2	(not in use)	-	-
3	CCW rotation inhibit	CCWL	30	3	(not in use)	-	-
4	Control mode control	C-MODE	32	4	(not in use)	-	-
5	Zero-speed clamp	ZEROSPD	10	5	(not in use)	-	-
6	(not in use)	-	-	6	Positioning end Arrival speed	COIN	25
7	(not in use)	-	-	7	(not in use)	-	-
8	Pulse input inhibit	INH	9	8	(not in use)	-	-
9	(not in use)	-	-	9	(not in use)	-	-
A	Deviation counter clear	CL	13	A	(not in use)	-	-
B	(not in use)	-	-	B	(not in use)	-	-
C	(not in use)	-	-	C	(not in use)	-	-
D	(not in use)	-	-	D	(not in use)	-	-
E	(not in use)	-	-	E	(not in use)	-	-
F	(not in use)	-	-	F	Internal use	-	-

④ Error factor and its record

■ You can trace the error factor back to its past 8 errors including present one.



■ You can trace by pushing

(By pushing , you can select older record.)

**Note** If the error occurred which was stored as a record, same error No. will be displayed for the current and the error record 0.

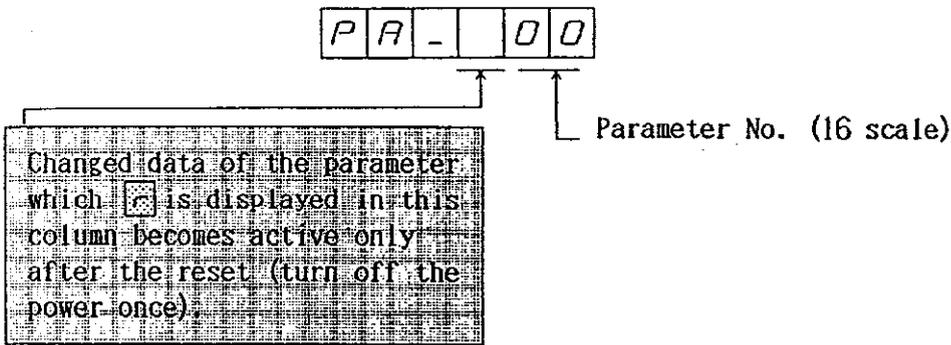
■ Relation of error code No. and its content

Error code No.	Content	Error code No.	Content
12	Overvoltage error	38	Drive inhibit input error
13	Undervoltage error		
14	Overcurrent error	41	ABS0 counter overflow error
		40	ABS0 system down
16	Overload error	46	ABS0 breakage error
22	Encoder signal error	23	DSP problem
24	Error caused by POS. error	30	CPU problem
26	Overspeed error	36	EEPROM parameter error
27	Pulse frequency division error	84	Received parameter error
29	POS. error counter overflow	98	System error
		99	Other error

**Note** Error protection function of error code No. 41, 40, and 46 is provided only for drivers applicable with absolute encoder.

(2) Parameter setting

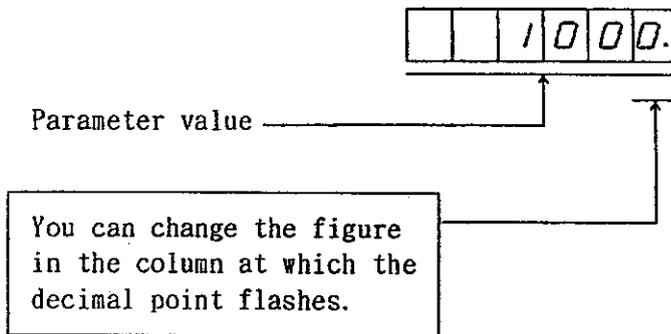
[Selection display]



- Push ▲ ▼ to select the parameter which you want to refer or set.

**Note** Please refer to section 9-1, "Outline of parameter" for the relation of the Parameter No. and its content.

[Execution display]



- Set the parameter value by pushing ▲ ▼.

With ▲, the value increases and decreases with ▼.

- Shift the flashing decimal point with ◀ to the upper digit.

**Note** Each parameter has a limit for the shift to the upper digit.

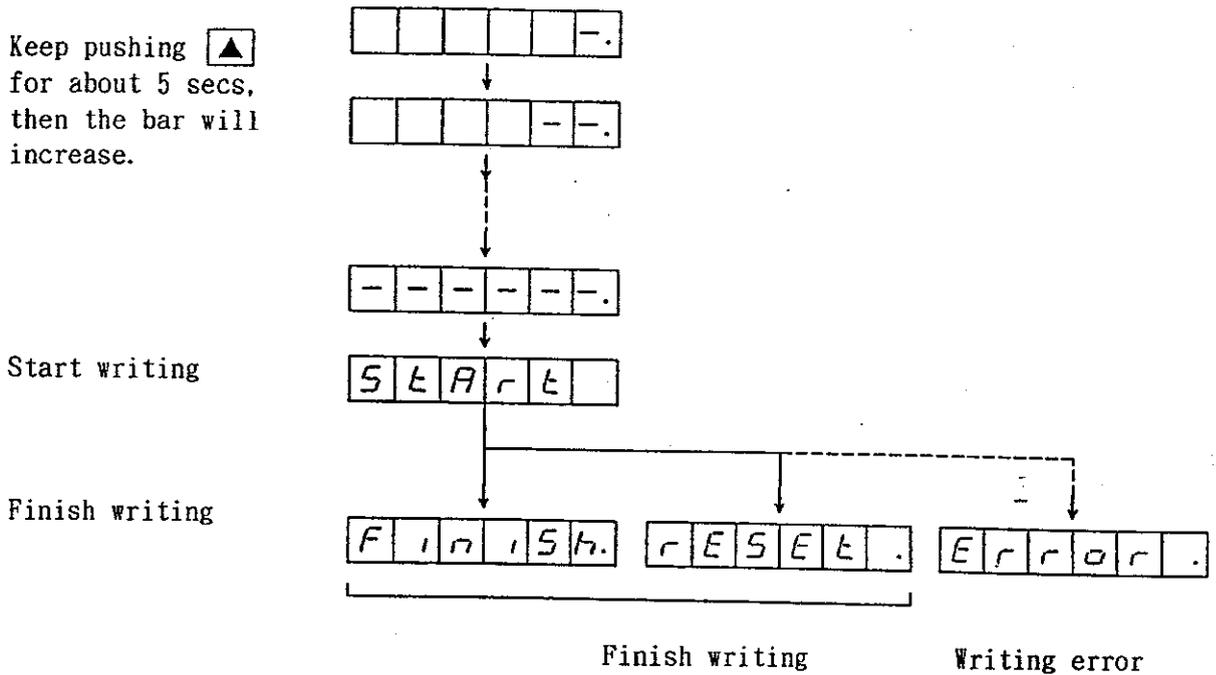
- Upon changing the parameter value, the content will be reflected to the control.

**Note** 1. Please change the data little by little, instead of changing drastically if you change the parameters which affect the motor movement (such as the speed loop gain or position loop gain). Some parameters inhibits to use ◀.

**Note** 2. Some parameters substantially change the motion of motor because of their function (e.g. parameter No. 02 "Selection of control mode", No. 14 "Input reversal in speed control mode.", No. 25/26 "Numerator/Dominator of pulse frequency division.", etc.). In changing these parameters, be sure to be state of Servo-off.

(3) Detail of EEPROM writing on mode

- Keep pushing  until the display shows `StArL`.



- When you change the parameter setting which becomes active after the reset, the display shows `rESEt.` at the finish of writing. Please turn off the power to reset.

- If you keep pushing  after the end of writing, you can re-write in the parameter.

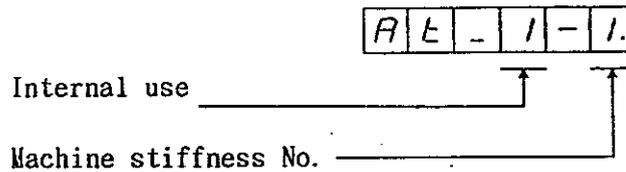
**Note** 1. When you encounter the error at writing, please re-write. If you still encounter the error, this may be the driver's malfunction. Please contact the shop purchased this driver.

**Note** 2. Please do not turn off the power while writing. Wrong data may be written. If this happens, please set all the parameters and write-in again after the complete check.

(4) Detail of automatic gain tuning

Note	1. Please refer to section 6-4 for the detail of the automatic gain tuning function. Especially read and understand the applicable range and notes described in section 6-4 before you use this function.
Note	2. At the automatic gain tuning mode, the motor turns 2 revolutions each to CW and CCW. Please allow your mechanism to accept such movement.

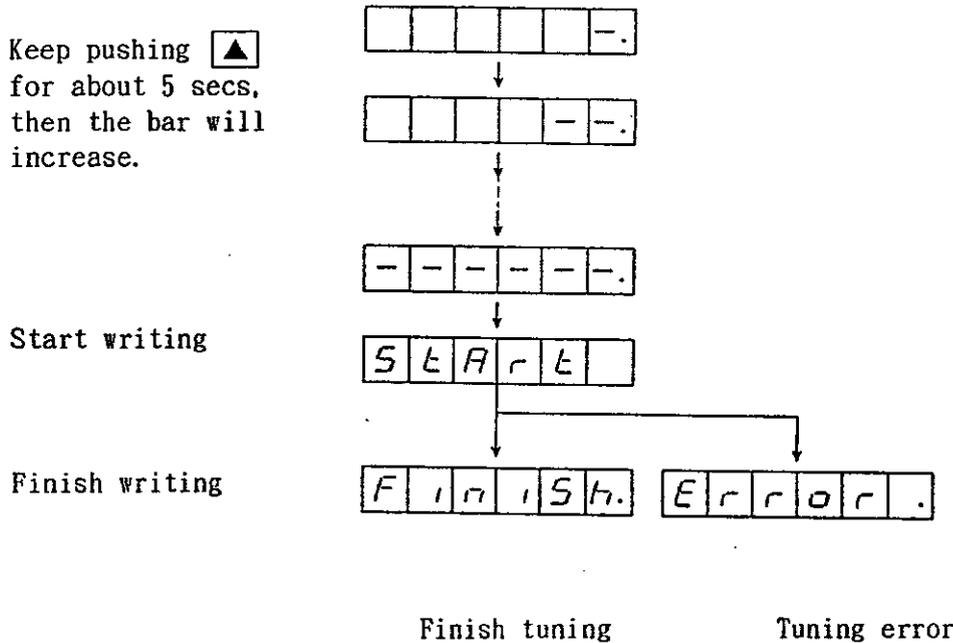
[Selection display]



- Push   to select the machine stiffness No. (refer to section 6-4 for the machine stiffness No.)

[Execution display]

- When you execute the auto-gain tuning, turn to Servo-ON and keep pushing  until the display shows: `S E A r t`



- You can restart by keep pushing  after the end.

**Note** 1. When automatic gain tuning is executed and normally terminated, if the gain is out of "application range" described in section 6-4-2, the machine operation may not be improved. (Gain remains unchanged before and after automatic gain tuning.) In this case, adjust the gain manually according to the section 8-2.

**Note** 2. When auto gain tuning error has occurred:  
A tuning error occurs when the following condition occurs during tuning operation.

- ① During tuning operation,
  - Error has occurred.
  - Servo-on is inactive.
  - Deviation counter is cleared.
- ② Inertia or load is too large, causing saturation of output torque.
- ③ Tuning is not executed successfully because of resonance, etc.

When any tuning error has occurred, each gain returns to a value before tuning. The system does not trip except when an error has occurred, so fully note the safety especially when resonance occurs.

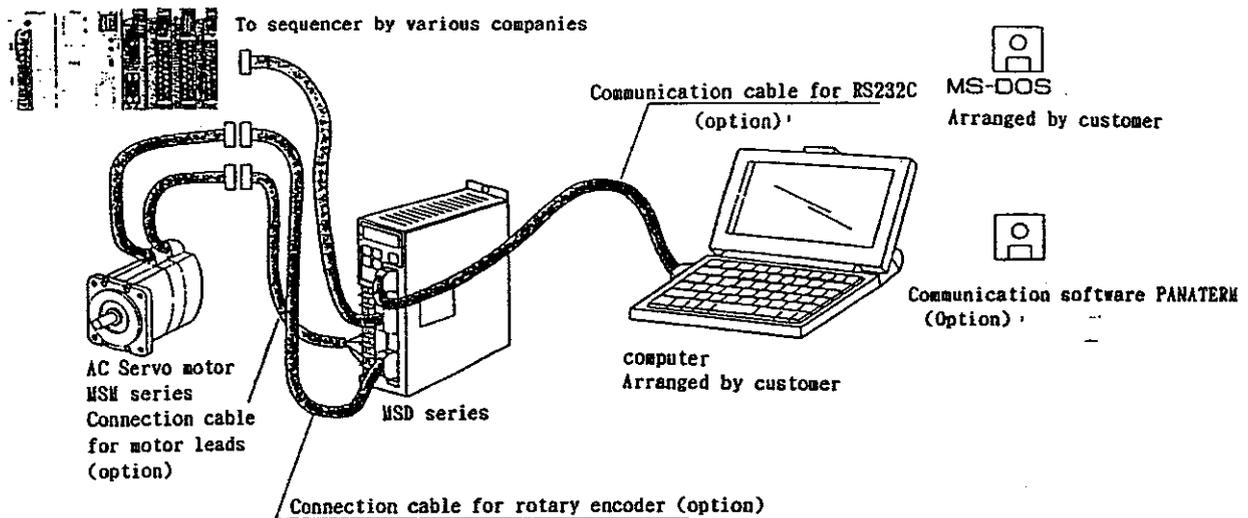
**Note** 3. Parameter data after automatic gain tuning is not written in EEPROM. When power is off, it returns to former data before execution. If you want to reflect the result of automatic gain tuning here and after, write the parameter in EEPROM before cutting off power according to section 10-1-4 (3).

## 10-2 Operation with computer

### 10-2-1 Outline

MSD series have the function which you can make serial communication with the computer via RS232C, and you can use this computer as a console. You can set, change the parameter, or monitor the control state on the CRT screen of the computer.

Composition of using the computer is described as below:



### 10-2-2 Computer and software

#### (1) Applicable Computer

- IBM PC/AT or compatible machine

#### (2) Software

- OS
  - Please prepare MS-DOS\*<sup>1</sup> ver. 4.0 or higher.
- Software for communication (PANATERM\*<sup>2</sup>)
  - We prepare as an option. (2DD • 3.5 inch FDD)
  - Part No. for this PANATERM\*<sup>2</sup> is DVOP0460E.

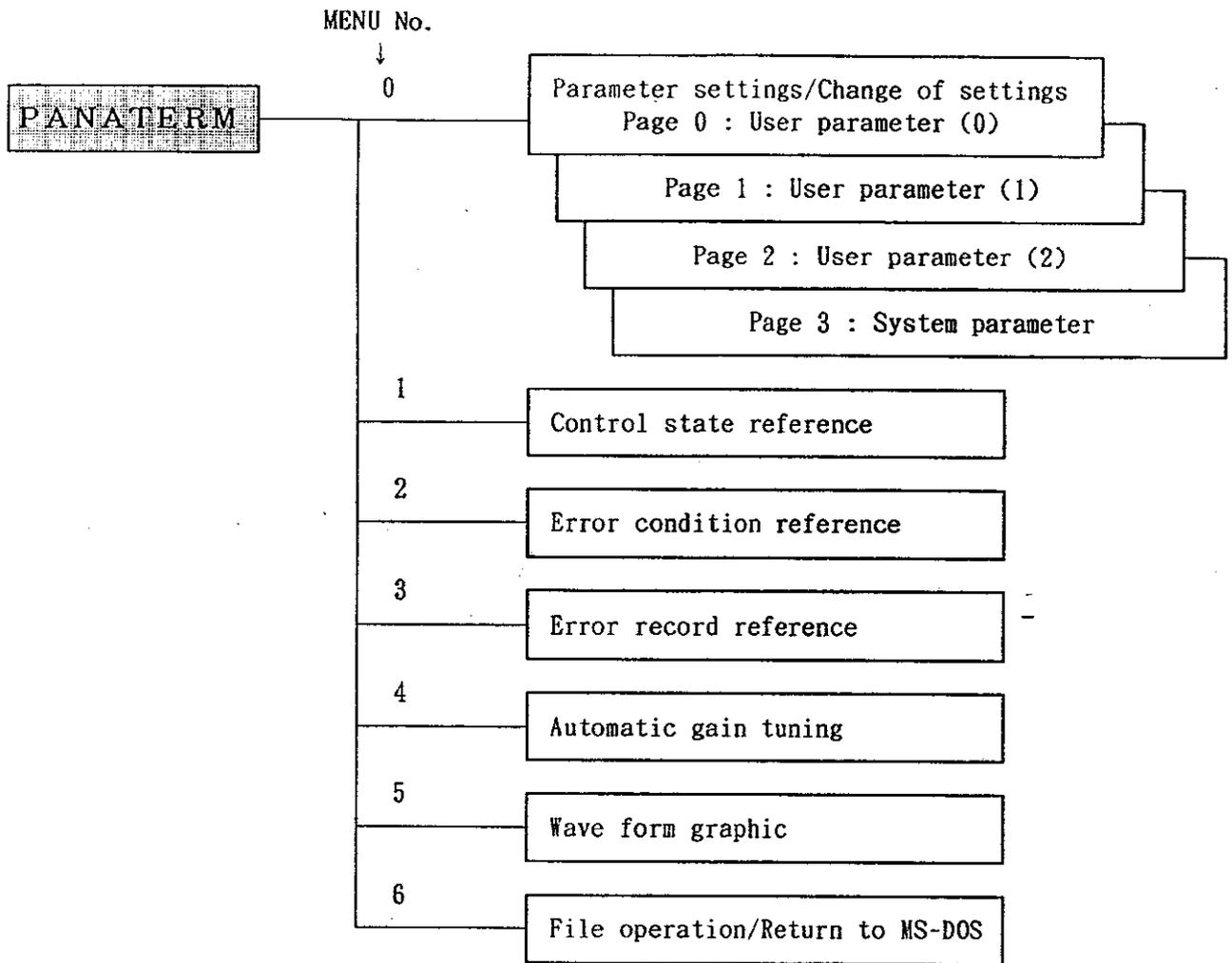
\*1. MS-DOS is a trademark of Microsoft Incorporation USA.

\*2. PANATERM is a trademark of Matsushita Electric Industries, Co.,Ltd.

#### (3) Connecting Cable for RS232C

- We prepare the connecting cable between connector (CN SER : 10 pin) on the front panel of the driver and the connector for RS232C (25 pin) as an option.
- Part No. of this connecting cable is DVOP0630 for RS232C.

**Note** You cannot use this cable to other application.



10-2-4 How to load

- (1) Connection of the connecting cable
  - Please make sure that all the power supply to the driver and to the computer is turned off.
  - Insert the plug of 10 pin of the cable to the connector, CN SER, and plug of 25 pin to the RS-232C connector securely.
- (2) Setting the communication mode of the driver
  - You can select the parameter setting and control state referring among the following ways:
    - ① Through the computer via communication.
    - ② Key operation of the front panel. (Refer to 10-1)

Selection of the above can be made by the connection or non-connection of the connecting cable plug (10 pin) to the connector of the drive; CN SER.

① Connection : Communication mode with the computer.  
In this case, LED is fixed to display of H-232C and key operation is disabled.

② No-connection : Key operation of the front panel

(3) Loading

- Turn on the power of the computer to load MS-DOS.  
Make sure that the screen shows prompt A > of MS-DOS.
- Turn on power for the driver.
- Load FDD of "PANATERM" to the computer and enter  
A > PANATERM .
- Now "PANATERM" is loaded and the following will appear on the computer CRT;

```
-----+-----  
| Communication software ---- PANATERM(ver. 3. 11b) |  
|           for IBM PC/AT MS-DOS Ver 4. 00           |  
| Copyright (c) 1992 by Industrial Motor Div.       |  
|   Matsushita Electric Industrial Co., LTD.        |  
-----+-----  
| The communication began.                          |  
-----+-----
```

- Prompt of "AXIS\*%" will appear when you push the return key of the computer.

Now you are ready to operate.

1 0 - 2 - 5    O p e r a t i o n

- When you enter AXIS\*%MENU  while prompt of "AXIS\*%" is on the screen, following menu screen will be displayed on CRT.

```
-----+-----  
| ALL DIGITAL SERVED DRIVER                          |  
|                                                     |  
| Copyright (c) by                                   |  
|   Matsushita Electric Industrial Co., LTD.        |  
|   Motor Division                                   |  
-----+-----
```

<<< select\_MENU >>>

```
-----+-----  
MENU No. 0 ----- Parameter Settings/Change of settings  
MENU No. 1 ----- Control state reference  
MENU No. 2 ----- Error condition reference  
MENU No. 3 ----- Error record reference  
MENU No. 4 ----- Automatic gain tuning  
MENU No. 5 ----- Waveform graphic  
MENU No. 6 ----- File operation/Return to MS-DOS  
=====+=====
```

Select Menu No.  
( Select 'Q' to quit a menu )  
MENU No. ( 0 - 6 ) =

- Enter MENU No. corresponds to the mode you want to refer.

(1) [Parameter setting/change mode]

- By entering  of MENU No. on the above menu screen, you can select "Parameter setting/change" mode, and the CRT shifts to the following screen (Parameter setting/change screen).
- Parameter setting/change screen has total 4 pages. In order to change the page, enter   or .

**Note** Please refer to section 9, "Parameter" for the detail of each parameter.

[Page 0]

<<< PARAMETER set >>>			ALL DIGITAL SERVO DRIVER
* No. 0	Name of axis	-- 0	Copyright (c) by Matsushita Electric Industrial Co.LTD Motor Division.
No. 1	Selection of initial disp.	-- 1	
No. 2	Selection of control mode.	-- 1	
No. 3	Speed loop gain	-- 100	
No. 4	Speed loop integration ti.	-- 50	
No. 5	Speed detection filter	-- 4	
No. 6	Torque limit	-- 300	
No. 7	Torque limit inhibit	-- 1	
No. 8	Speed monitor gain	-- 0	
No. 9	Inactive drive inhibit in.	-- 1	
No. a	Dynamic brake	-- 0	
No. b	Numerator of pulse freque.	-- 10000	
No. c	Dominator of pulse freque.	-- 10000	
No. d	Pulse inversion	-- 0	
No. e			
No. f	System management paramet.	-- 16384	

[Page 1]

<<< PARAMETER set >>>			ALL DIGITAL SERVO DRIVER
* No. 10	Acceleration/Deceleration.	-- 0	Copyright (c) by Matsushita Electric Industrial Co.LTD Motor Division.
No. 11			
No. 12	Arrival Speed	-- 1000	
No. 13	Input gain in speed contr.	-- 225	
No. 14	Input reversal in speed c.	-- 0	
No. 15	Offset voltage in speed c.	-- 0	
No. 16	Internal/External speed s.	-- 0	
No. 17	Zero-speed clamp cancel	-- 1	
No. 18	First internal speed	-- 0	
No. 19			
No. 1a	Input gain in torque cont.	-- 250	
No. 1b	Input reversal in torque	-- 0	
No. 1c	Offset voltage in torque	-- 0	
No. 1d			
No. 1e			
No. 1f	System management paramet.	-- 25090	

[Page 2]

<<< PARAMETER set >>>			ALL DIGITAL SERVO DRIVER
* No. 20	Position loop gain	-- 20	Copyright (c) by Matsushita Electric Industrial Co.LTD Motor Division.
No. 21	Speed feedforward	-- 0	
No. 22	Positioning end range	-- 10	
No. 23	Position error limit sett.	-- 30000	
No. 24	Cancel of position error	-- 0	
No. 25	Numerator of pulse freque.	-- 10000	
No. 26	Dominator of pulse freque.	-- 10000	
No. 27	Multiplier setting	-- 4	
No. 28	Logical inversion	-- 0	
No. 29	Pulse input mode	-- 1	
No. 2a			
No. 2b			
No. 2c			
No. 2d			
No. 2e			
No. 2f	System management paramet.	-- 31744	

[Page 3]

<<< PARAMETER set >>>			ALL DIGITAL SERVO DRIVER
* No. 30	Motor pole	-- 4	Copyright (c) by Matsushita Electric Industrial Co.LTD Motor Division.
No. 31	Encoder pulse	-- 10	
No. 32	I/T ratio	-- 20	
No. 33	Current propotional gain	-- 50	
No. 34	current integration gain	-- 6	
No. 35	Overspeed level	-- 6000	
No. 36	Maximum output torque	-- 300	
No. 37	Overload time constant	-- 500	
No. 38	Overload criteria	-- 115	
No. 39			
No. 3a			
No. 3b			
No. 3c			
No. 3d			
No. 3e			
No. 3f	System management paramet.	-- 24576	

■ How to set/change the parameter

- ① Shift the cursor \* next to the parameter of which you want to change the setting with   or   key of the computer, then press the SPACE key.
- ② A message relating to the parameter which you want change will be displayed below the parameter set, and the procedure message will be displayed at the right side of the screen.

**Note** 1. There are some parameters which you cannot change, such as "System management parameter" of each page, or System parameters including "Motor pole setting" etc. When you happen to select one of these parameters, enter the RETURN key .

**Note** 2. Some parameters substantially change the motion of motor because of their function (e.g. parameter No. 02 "Selection of control mode", No. 14 "Input reversal in speed control mode", No. 25, 26 "Numerator/Dominator of pulse freque division.", etc.).

In changing these parameters, be sure to be state of Servo-off.

- ③ Following shows the example when you want to change the data of Parameter No. , "Numerator of pulse freque division." from the current 10000 to 500.

<< PARAMETER set >>				ALL DIGITAL SERVO DRIVER
No. 0	Name of axis	--	0	Copyright (c) by
No. 1	Selection of initial disp.	--	1	Matsushita Electric
No. 2	Selection of control mode.	--	1	Industrial Co.LTD
No. 3	Speed loop gain	--	100	Motor Division.
No. 4	Speed loop integration ti.	--	50	-----
No. 5	Speed detection filter	--	4	
No. 6	Torque limit	--	300	
No. 7	Torque limit inhibit	--	1	
No. 8	Speed monitor gain	--	0	No. b = 10000
No. 9	Inactive drive inhibit in.	--	1	Please input --- 500
No. a	Dynamic brake	--	0	New-Parameter = 500
No. b	Numerator of pulse freque.	--	10000	OK?(y/n/q) ---
No. c	Dominator of pulse freque.	--	10000	
No. d	Pulse inversion	--	0	
No. e				
No. f	System management paramet.	--	16384	
-----				
No. b	Numerator of pulse frequency division (MIN = 1, MAX = 10000)			
	Set a numerator of frequency division of pulse from a rotary encoder.			

- Push the return key  after setting the new data.
- Next enter one of , , .
- : When you enter the correct data.
- : When you enter the wrong data, enter N and enter the correct data.
- : When you want to interrupt or end the setting/change of the data.

- ④ When you end the parameter setting/changing and want to write data into EEPROM.
  - Enter .
  - Then a message asking whether you want to write new data into EEPROM or not will be displayed below the parameter set as the following fig. shows. Enter  if you want to write.

"Writing task into EEPROM in progress" will be displayed and it starts writing into EEPROM. When the writing is finished, "Writing task into EEPROM is complete" will be displayed.

<<< PARAMETER set >>>			ALL DIGITAL SERVO DRIVER
No. 0	Name of axis	-- 0	Copyright (c) by Matsushita Electric Industrial Co. LTD Motor Division.
No. 1	Selection of initial disp.	-- 1	
No. 2	Selection of control mode.	-- 1	
No. 3	Speed loop gain	-- 100	
No. 4	Speed loop integration ti.	-- 50	
No. 5	Speed detection filter	-- 4	
No. 6	Torque limit	-- 300	
No. 7	Torque limit inhibit	-- 1	
No. 8	Speed monitor gain	-- 0	
No. 9	Inactive drive inhibit in.	-- 1	
No. a	Dynamic brake	-- 0	
* No. b	Numerator of pulse freque.	-- 10000	
No. c	Dominator of pulse freque.	-- 10000	
No. d	Pulse inversion	-- 0	
No. e			
No. f	System management paramet.	-- 16384	

Select 'Y' to write data into EEPROM or select 'N' to quit. Y  
Writing task into EEPROM in progress

- Note** 1. After entering **[Y]**, do not turn off the power of the driver and the computer before "Writing task into EEPROM is complete" is displayed. If you turn off the power while writing, the data cannot be secured.
- Note** 2. If you select **[N]** and do not write the data into EEPROM, old data prior to the parameter change will be maintained after you reset the power.
- Note** 3. There are some parameters of which the changed data becomes valid only after you reset the power, such as Parameter No. **[29]** "Pulse input mode".  
• If you change the data for these parameters, following message will be displayed at the right side of the screen;

Change of this parameter  
becomes effective  
after it is reset.  
Press RETURN key

- Then press the return key **[↵]** and change the data. Enter **[Q]** to finish the parameter setting/changing mode. Then the following message will be displayed at the bottom of the screen before shifting to the writing mode;

Changed data of parameter requires it's reset.  
After writing data into EEPROM, reset the data.

Press RETURN key

There are following 3 User Parameters of this kind:

Parameter No. **[27]** Multiplier setting

Parameter No. **[28]** Logical inversion

Parameter No. **[29]** Pulse input mode

(2) [Control state reference] mode

- When you enter [1] as the menu No. on the menu screen, you can obtain the "Control state reference" mode, and the following screen will be displayed;

```

    <<< display STATUS >>>  ( Select 'Q' to quit a menu )
-----
|  INPUT_bits                |  OUTPUT_bits                |
-----
Servo on signal              -- +A  Servo ready                    -- +A
Alarm clear signal           -- -   Servo alarm                    -- -
CW rotation inhibit signal   -- -
CCW rotation inhibit signal  -- -
Control mode control signal  -- -
Zero-speed clamp signal      -- +A
                               Positioning end                    -- -

Pulse input inhibit signal   -- -

Count clear signal           -- -

                               Dynamic brake release                -- +A
-----
Position error = 0 ( pulse )  Speed control mode
Revolutions    = 0 ( r/min )  No Error
Output torque  = 0 X 0.2 ( % )  +A ACTIVE

```

- Monitor of input/output signal state

- You can monitor the state of the control input/output signal which is fed into the driver connector, CN I/F. This is useful for checking the wiring to the connector CN I/F.
- Signal marked with "+A" represents active, and with "-" inactive.

- Monitor of control state

You can monitor following 5 kinds of state;

- ① Position error : Displays the number of currently reserved pulses of the POS. error counter. Unit [Pulse]
    - Polarity (+) : Generates CCW torque, (-) : Generates CW torque
  - ② Revolutions : Display current motor speed Unit [r/min]
    - Polarity (+) : Rotates at CCW, (-) : Rotates at CW
  - ③ Output torque : Displays the torque which the motor currently generates.
    - Displayed figure times 0.2 represents the percentage against the rated torque.
    - Polarity (+) : Generates CCW torque, (-) : Generates CW torque
- [e.g.] If the displayed value is -1000, this represents that the motor generates 200% of the rated torque. ( $-1000 \times 0.2 = -200$ )
- ④ Control mode : Displays in which control mode is set
  - ⑤ Error : Displays the error factor if any error occurs
    - At normal condition, "non" will be displayed.

[Note] 1. Communication between the driver and the computer is a serial communication via RS232C.

Due to the communication speed limit, displayed value of position error, revolutions and output torque has some delay from the actual value.

[Note] 2. If the polarity is +, + will not be displayed.

- Enter [Q] if you want to return to the menu screen, after finishing the control state reference mode.

(3) [Error condition reference] mode

- You can select the "Error condition reference" by entering [2] as a menu No. and the following screen will be displayed. You can monitor the current error and its factor.

+A : Error  
- : Normal

ERROR_FLAGS		ERROR_FLAGS	
Undervoltage error	-- +A		
External trip input	-- -	ABS0 over speed error	-- -
Error caused by POS. error	-- -	ABS0 counter overflow error	-- -
POS. error counter overflow	-- -	ABS0 system down	-- -
Overspeed error	-- -	ABS0 breakage error	-- -
Overload error	-- -		
Overheat error	-- -		
Overvoltage error	-- -		
Regenerative resistance error	-- -		
Overcurrent error	-- -	EEPROM parameter error	-- -
Encoder trouble	-- +A	Received parameter error	-- -
Drive inhibit input error	-- -	System error	-- -
Pulse frequency division error	-- -	DSP problem	-- -
		CPU problem	-- -
=====			
Position error =	0 ( pulse )	Speed control mode	
Revolutions =	0 ( r/min )	Error =22=	Encoder trouble
Output torque =	0 X 0.2 ( % )		+A ACTIVE

**Note** When more than one error has occurred as shown above, the factor of the higher priority error (The lower an error is located on the screen, the higher priority it has.) and its code No. will be displayed at the right bottom of the screen, and registered in the error record.

- Enter [Q] if you want to return to the menu screen after finishing the error condition reference mode.

(4) [Error record reference] mode

- You can trace the record of past 8 errors by entering **3** as a menu No. at the menu screen to enter the "Error record reference", displaying the following:

<<< display back\_ERROR >>>

Serial No.	Condition	Error code	3bits-code
-0	Encoder trouble	22	3
-1	Encoder trouble	22	3
-2			
-3			
-4			
-5			
-6			
-7			

Note: Undervoltage error, Drive inhibit input error and external trip input are not included in error record.

( Select 'Q' to quit a menu )

- "0" represents the factor of the latest error and higher the number, older the record.

**Note** "Undervoltage error" and "Drive inhibit input error" will not be stored as an error record, even though the driver trips. Therefore when these error occur, current error does not match to the content of error record 0.

- Enter **Q** in order to get back to the menu screen after ending the error record monitor mode.

(5) [Automatic gain tuning] mode

Note: Please also refer to Section 6-4 for the detail of this function. Especially please carefully read and understand the applicable ranges and notes described in Section 6-4, before using this function.

- Enter [4] of the menu No. to enter the "Automatic gain tuning" mode. Following note message will be displayed at the bottom of the screen as well as:
  - Information of command key, ([G]), start and ([Q]) end of the automatic gain tuning mode,
  - Setting value of the current parameters related servo gain.

<<< auto GAIN tuning >>>

- 
- Note: 1. Some type of motors has no automatic gain tuning function.  
Please refer to instruction manual.
2. During automatic gain tuning, set value of maximum output torque will be valid while clockwise and counterclockwise rotation inhibit input will be ignored.
3. Automatic gain tuning may cause an oscillation under a certain load. When the oscillation occurs, turn off servomechanism immediately and change setting on gain to initial settings as follows.
4. Please refer to instruction manual.

=====  
Algorithm [ 1 ] | Position loop gain --- 20  
\*Start ---> 'G' | Speed loop gain --- 100  
\*Quit ---> 'Q' | Integration time const. --- 50  
Press 'G' or 'Q' | Speed feedforward --- 0

- At the automatic gain tuning mode, the motor makes each 2 (two) revolutions both CW and CCW. Please move the load so that it may not cause any problem.
- Make sure that the applicable range and notes stated in section 6-4 are cleared before Servo-ON.
- Enter [G] to start the automatic gain tuning mode. At the left bottom corner of the screen is a message asking for the "Machine stiffness No." Please select the machine stiffness No. depending on total machine stiffness.

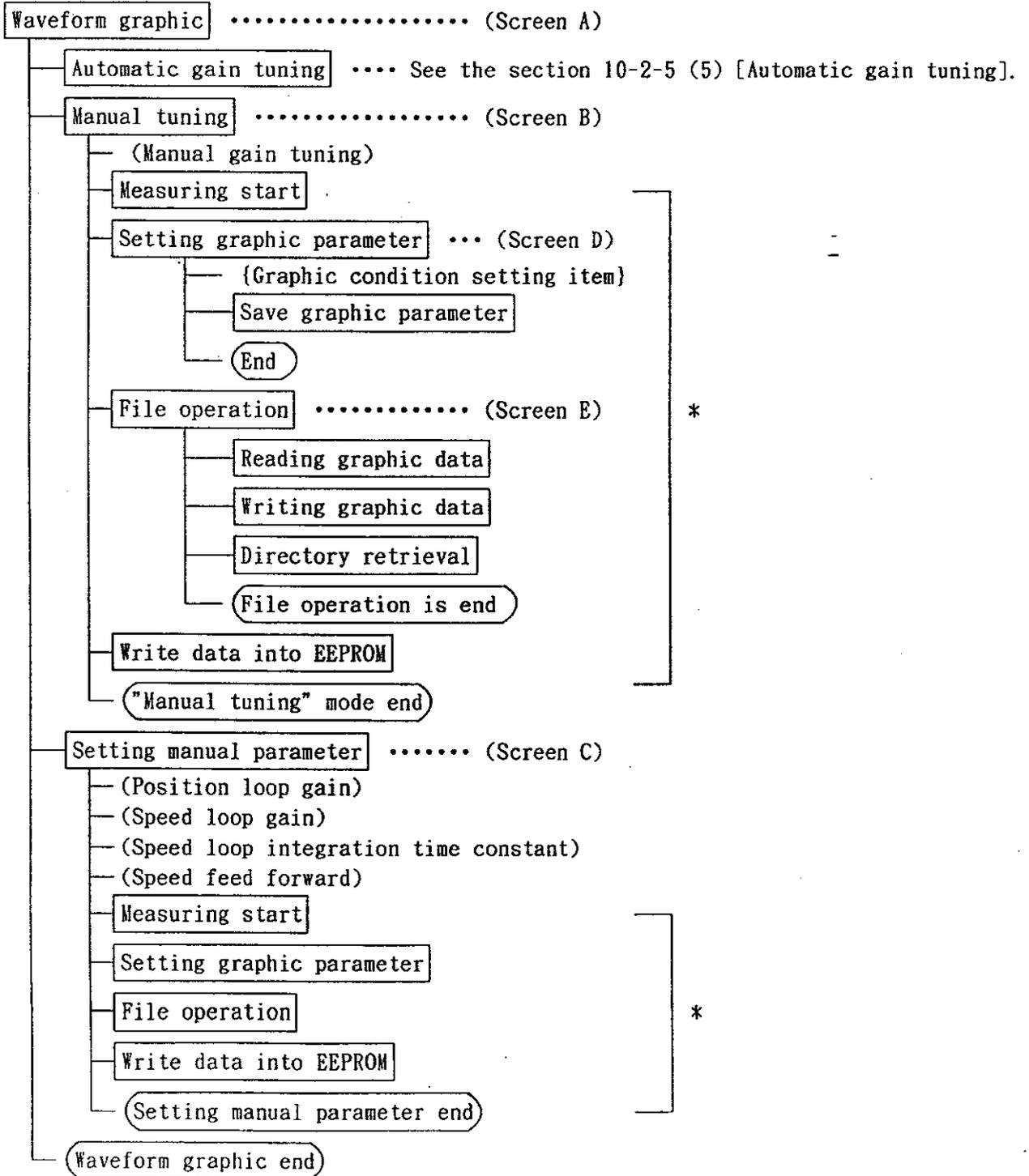
lower <- machine stiffness -> higher  
[ 1, 2, 3, 4, 5, 6, 7, 8, 9 ]

Note Refer to section 6-4 for the "Machine stiffness No."

- Upon entering the machine stiffness No., the motor starts and activates the auto-gain tuning.
- On completing the tuning operation, a message asking if you write into EEPROM, or not will appear at the left bottom corner of the screen. Also a new servo gain related data will be displayed at the right bottom corner of the screen. If no problem can be seen with this tuning result, enter [Y] to write into EEPROM.

(6) [Waveform graphic] mode

- When [5] is entered as a menu No. on PANATERM menu screen, "Waveform graphic" is established, enabling display of waveform of position error, actual motor speed, speed command, and torque command on CRT of personal computer.
- "Waveform graphic" includes operation functions of "Manual tuning" mode and "Setting manual parameter", in addition to "automatic gain tuning" described in the section 6-4 and 10-2-5 (5). When you combine these operation functions and waveform display function in use, you will make servo gain adjustment easier.
- Constitution of waveform graphic

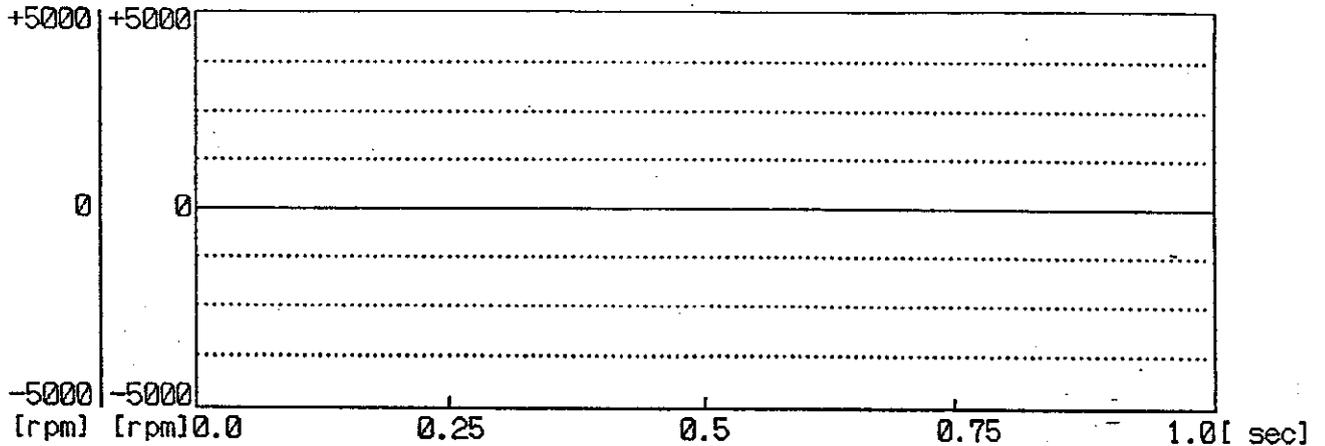


The mark \* means the identical function.

■ Operation procedure

- ① When you enter menu No. **5** on the menu screen, CRT displays the screen below. On the upper part of the screen displayed is a graphic screen for showing motor motion waveform, and on the lower part displayed is a message screen for operation and setting in waveform graphic.

Screen A



"Auto tuning mode"  
 "Manual tuning" mode  
 Setting manual parameter

Waveform graphic end

- ② In waveform graphic, place the cursor (reversed character) on the message screen at the item to be executed using **↑** and **↓** keys, and press the return key **↵** for selection. As for the items having a setting displayed on the right side, place the cursor at an item you want to change or set, then press the keys **←** and **→**, and the value can be incremented or decremented by 1 (by 10 with **SHIFT** key + **←**, **→** keys) and setting can be changed.

■ Monitoring motion waveform

- ① On the waveform graphic screen (screen A), select 'Manual tuning' mode (screen B ... described later) or **Setting manual parameter** (screen C ... described later), then select **Measuring start** displayed on each message screen, and the message below is displayed waiting for trigger.

Waiting for trigger input  
[Interrupted by ESC key]

- ② As soon as the established trigger condition is satisfied, measurement/display of waveform data is started, and the message changes into the following:

Transferring data  
[Interrupted by ESC key]

When display of waveform is terminated, the screen before selecting **Measuring start** is recovered.

■ Setting of graphic screen

- ① If the measured motion waveform should exceed the scale, or no display appear, change the setting condition on the graphic screen for normal display.
- ② Select **Setting graphic parameter** in the message screen of screen B or C, then the message screen displays the following:  
Select an item you want to change using **↑** and **↓** keys, and change the contents using **←** and **→** keys.

**Screen D**

Measuring item	: Motor speed, Instruction speed	Display mode	: Mono
Revolutions	: +5000 - -5000 [rpm]		
Output torque	: +500 - -500 [%]		
Position error	: +200 - -200 [pulse]		
Quadrature axis	: 0 - 1.0[sec] Sample 2msec		
Trigger slope	: Rising edge (absolute)		
Trigger level	: 1/8 of Full range		
Trigger position	: 1/4 of Full range		
		End	

- **Measuring item** : Select an motion waveform to be monitored. (2 channels)
- **(Revolutions/Output torque/Position error) Ordinate axis** :  
Set a display range of motion waveform along ordinate axis.  
  
**Note** When automatic scaling is set, display range of measured data is automatically set.
- **Quadrature axis** : Set a display range of motion waveform along quadrature axis (time axis).
- **Trigger slope** **Trigger level** **Trigger position** : Set a trigger condition.  
  
**Note** Object of trigger is an actual speed of motor.
- **Display mode** : Change over monochrome/color depending on the type of personal computer display.
- **Save graphic parameter** : Used for saving setting conditions above on graphic screen. Place the cursor on **Save graphic parameter**, and press **↵** for saving each setting condition in file name "Panaterm. grp".
- ③ **End** : Place the cursor on this item and press **↵**, then control returns to the screen before selecting **Setting graphic parameter**.

■ Save/Callout of waveform data

- ① If you want to save measured motion waveform or call out saved waveform to be displayed, select **File operation**.  
The message screen appears as follows:

**Screen E**

Reading graphic data  
Writing graphic data  
Directory retrieval

File operation is end.

- ② When you select **Reading graphic data**, saved waveform data can be called out and displayed. In this case, it is required to enter a file name of waveform data you want to see. You can also change display range of waveform data along ordinate axis and quadrature axis using **Change graphic mode**. Select **Reading graphic data is end** in order to terminate display.
- ③ When you select **Writing graphic data**, waveform currently displayed is saved. At this time, enter a file name to be saved, and a comment as necessary.
- ④ When you select **Directory retrieval**, a file name can be displayed on the screen by executing MS-DOS DIR command. Normally, when you press **↵** without entering any directory name, all file names are displayed.
- ⑤ When save/callout of waveform data is finished, place the cursor on **File operation is end** and press **↵**, then control returns to the screen before selecting **File operation**.

#### ■ Adjusting servo gain

In waveform graphic, servo gain can be adjusted in addition to monitor display of operation waveform.

- ① When you select **'Auto tuning' mode**, 'Automatic gain tuning' function described in 10-2-5 (5) can be implemented in waveform graphic. See the item 10-2-5 (5) for display and operation procedure.
- ② When you select **Setting manual parameter**, 4 types of parameter relating to servo gain and their current setting are displayed at the top of message screen as shown on screen C below. In order to change settings, follow the procedure below:
  - Place the cursor on a parameter you want to change.
  - There are two ways available, to increment or decrement the setting using **←** and **→** (or **SHIFT** key + **←** and **→**), and to enter a value directly using numeric key and **↵** key.

#### **Screen C**

```

Position loop gain [10 - 1000] : 20
Speed loop gain [25 - 3500] : 100
Integration time [1 - 1000] : 50
Speed feedforward [0 - 100] : 0
Measuring start
Setting graphic parameter
File operation
Write data into EEPROM
manual setting is end

```

**Note** See the item 9-2 and 8-2 for the meaning of parameters relating to servo gain and their adjustment.

- ③ When you select **'Manual tuning' mode**, the current setting of 'Manual tuning gain' (= Setting of speed loop gain) is displayed at the right top of the message screen as shown in screen B below. This value can be incremented or decremented only by use of **←** and **→** (or **SHIFT** key + **←** and **→**). (Numeric input is disabled.)
- When setting of 'Manual tuning' mode is changed, position/speed loop gain displayed on the left on message screen and speed loop integration time constant also change in an interlocked way.
  - The larger the value is, the higher becomes servo rigidity.

**Screen B**

[ Now paramter value ]	:	'Manual tuning' : 100
Positin loop gain : 20	:	Measurement beginning
Speed loop gain : 100	:	Setting graphic parameter
Integration time : 50	:	File operation
	:	Write data into EEPROM
	:	'Manual tuning' is end

**Note** **'Manual tuning' mode** function is intended for fine adjustment after adjustment by **'Auto tuning' mode** or **Setting manual parameter**.  
 Note that servo rigidity cannot be made high if setting before 'Manual tuning' mode is improper.

■ **Write data into EEPROM**

When **Write data into EEPROM** is selected, parameters relating to servo gain changed in 'Waveform graphic' can be written in EEPROM and saved. If you turn off power without writing in EEPROM, parameters return to the value before change. Take care.

■ **Return to menu screen**

When all operations described are finished, return to waveform graphic screen (screen A) and place the cursor on **Return to menu screen** and press **☒**, then control returns to menu screen of PANATERM.

**Notes in using waveform graphic**

1. In waveform graphic, waveform data is taken in by sampling by 2ms cycle approx., so that when a waveform containing especially high frequency component (such as torque waveform) is displayed, note that it looks like a waveform different from real one.
2. When 'Speed control' in position control mode is displayed, if setting of position loop gain is low making position error large, display of speed control may be chipped.
3. In executing 'Waveform graphic', if power for the driver is newly turned on and system is reset, be sure to terminate 'Waveform graphic' once to recover display of PANATERM prompt (AXIS\*%).

(7) [File operation/Return to MS-DOS] mode

- You can enter "File operation/Return to MS-DOS" mode by entering **6** of the menu No. at the menu screen, and the following display will appear;

Menu screen of file operation

```
-----
<<< FILE operation >>>
-----
No.0 ----- Return to MS-DOS.
No.1 ----- Return to menu screen.
No.2 ----- Parameter is saved to the disk.
No.3 ----- Parameter is loaded into the DRIVER.
-----
Please input No..
No. (0 - 3) -
```

- You can save the parameter data to external FDD, or load the data from FDD to the driver.

- ① How to save the parameter data to FDD
  - Load FDD to the computer.
  - Enter **2** of the parameter No. at the menu screen.
  - Following message appear at the bottom of the screen after each operation;

• Enter **2** at the menu screen for the file operation  
• Start receiving

```
-----
<< No.2 Parameter save >>
-----
The parameter is being received.
-----
```



• End receiving  
• Next message by pressing **Y**  
• Return to the menu screen for the file operation by pressing **N**

```
-----
<< No.2 Parameter save >>
-----
Parameter reception end
Is the received parameter written in the file ?
[y/n] ---
-----
```



• Enter file name with 8 letters ( or less ) and press **X**  
• Next message by pressing **Y**  
• Reenter a file name by pressing **N**  
• Return to the menu screen for the file operation by pressing **Q**

```
-----
<< No.2 Parameter save >>
-----
Please input the file name.
(8 letters or less is valid for file name)
[TEST.TXT ]
OK ? [y/n/q] ---
-----
```

- End writing
- Return to the menu menu screen for the file operation by pressing **[↵]**



```

<< No.2 Parameter save >>
Parameter file name
(8 letters or less is valid for file name)
[TEST.TXT]
The file is written.
Please push RETURN key.
  
```

② When you load the parameter data to the driver.

- Load FDD to the computer.
- Enter **[3]** of the menu No. at the menu screen for the file operation.
- Following messages appear at the bottom of the screen after each operation:

- Enter **[3]** at the menu screen for the file operation

```

<< No.3 Parameter load >>
Please input the file name.
(8 letters or less is valid for file name)
{
  }
  
```



- Enter file name with 8 letters ( or less ) and press **[↵]**
- Next message by pressing **[Y]**
- Reenter a file name by pressing **[N]**
- Return to the menu screen for the file operation by pressing **[Q]**

```

<< No.3 Parameter load >>
Please input the file name.
(8 letters or less is valid for file name)
[TEST.TXT]
OK ? [y/n/q] ---
  
```



• Start transmitting

```

  << No. 3 Parameter load >>
  Parameter file name
  (8 letters or less is valid for file name)
  [TEST.TXT]
  The parameter is being transmitted.

```



• End writing  
• Return to the menu screen for the file operation by pressing

```

  << No. 3 Parameter load >>
  Parameter file name
  (8 letters or less is valid for file name)
  [TEST.TXT]
  Parameter transmission end
  Please push RETURN key.

```

**Note**

Above procedure only loads the parameter data from FDD to the memory (RAM) of the driver. If you turn off the power of the driver at this moment, parameter data will be erased.

Please make write-in procedure to EEPROM after the data loading as per below;

- ① Return to the normal menu screen by entering  of the menu No. at the file operation screen.
  - ② Confirm the loaded parameter data by selecting the parameter setting/change mode by entering  of the parameter No. at the menu screen.
  - ③ Enter  if the loaded parameter data is correct. Then a message is displayed asking whether or not you want to write in to EEPROM, and enter .
- ③ Return to MS-DOS
- Enter  at the menu screen for the file operation if you want to return to MS-DOS, interrupting the communication between the driver and the computer.
- ④ Return to the menu screen
- Enter  at the menu screen for the file operation if you want to return to other mode from the file operation/return to MS-DOS mode. Normal menu screen is displayed.

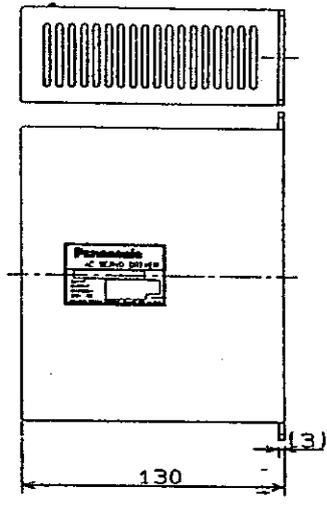
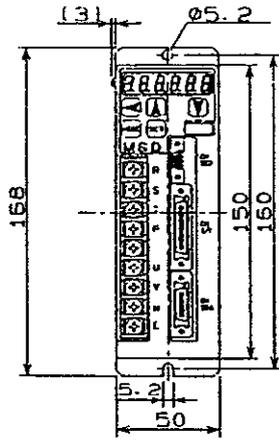
# 11. Specifications

Model		MSD**□○△▽	MSD**□○△▽	MSD**□○△▽	
B a s i c	Applicable motor/ output (W)	MSM 100V type 200V type	30, 50, 100 30, 50, 100, 200	200 400	
	Input power source	100V type 200V type	Single phase 100~115V +10%/-15%, 50/60Hz 3-phase 200~230V +10%/-15%, 50/60Hz	400 750	
S p e c	Control method	Transistor PWM (Sine-wave form)			
	Feed back	Incremental encoder (2,500P/r)			
A m b i e n t	Ambient condition	Temperature	Working : 0~50°C, Storage : -20~+80°C		
		Humidity	Working/storage : 90%RH or less (no condensation)		
		Vibration	4.9m/s <sup>2</sup> (0.5G) or less, 10~60Hz (no continuous operation at resonance point is permissible)		
Control mode		① Analog speed control, ② Position control, ③ Torque control, ④ Position-Speed control, ⑤ Position-Torque control, ⑥ Speed-Torque control			
I n p u t	Control input		① Servo-ON input, ② Alarm clear input, ③ CW rotation inhibit input, ④ CCW rotation inhibit input, ⑤ Zero-speed clamp input, ⑥ Control mode control input		
	A n a l o g	Speed command	2[V/Kr/min] scale setting and command polarity through parameter		
		Torque command	Used with CCW torque limit, 3V/rated torque (effective at torque command mode)		
		Torque limit command	Individually settable of CW/CCW torque limit. 3V/rated torque		
	P u l s e	Pulse row command input	Input pulse row status	Differential input. Selectable through parameter. (① Forward/Reverse run, ② A/B phase, ③ Command/Direction)	
Control input			Open collector input. ① Deviation counter clear input, ② Command pulse prohibition input		
C o n t r o l	Control output		① Servo-alarm, ② Servo-ready, ③ Arrive speed (Speed-Torque control mode)/Position-finish (Position control mode)		
	Encoder feed back signal		Line driver output of encoder pulse (A, B, Z) after division, Opencollector output of Z-phase pulse		
	Monitor output		① Speed monitor 2V/Kr/min ② Torque monitor 3V/rated torque		
D y n a m i c	Regenerative		Built-in resistor		
	Dynamic brake		① At Servo-OFF, ② At alarm occurs, ③ At main power OFF, ④ At deceleration while CW or CCW rotation inhibit input becomes valid (able to invalidate through parameter)		
	Automatic gain tuning		Built-in (applicable to certain motor models)		
	Masking of unnecessary input wiring		① Drive inhibit input (CW/CCW), ② Torque limit command input, ③ Zero-speed clamp input		
	Soft-start/down		0~10sec/1000r/min (setting through parameter)		
	Zero-speed clamp		Enter to Servo-lock with zero-speed clamp input (in case of speed control mode)		
	Dvsn/Mltplctn of cmdnd pulse		1~10000/1~10000		
	Dvsn of RE feed back pulse		1~10000/1~10000 (Numerator ≤ Denominator)		
	P r o t e c t i v e	function	Hard error	OV, LV, OS, OL, OC, ST	
			Soft error	CPU error, DSP error, System error etc.	
Trace back of alarm data		Traceable back to the past 8 error data (including current error)			
Setting key, LED display		① 5 keys (MODE, SET, UP, DOWN, SHIFT), ② 6-DIGIT LED			
Communication with RS232C		Parameter setting and monitoring of the status with IBM (PC/AT) series			
P e r f o r m a n c e	Applicable load inertia		Less than 30 times the inertia of motor (400W or less)	Less than 20 times (750W)	
	Max. command pulse frequency		500[Kpps] (200[Kpps], in case of opencollector input)		
Frequency characteristics		200[Hz] or more (at J <sub>M</sub> =J <sub>L</sub> ) (depends on motor model)			
Weight		1.0 [kg]	1.2 [kg]	1.5 [kg]	
Dimensions (refer to section 12)		suffix A	suffix B	suffix C	

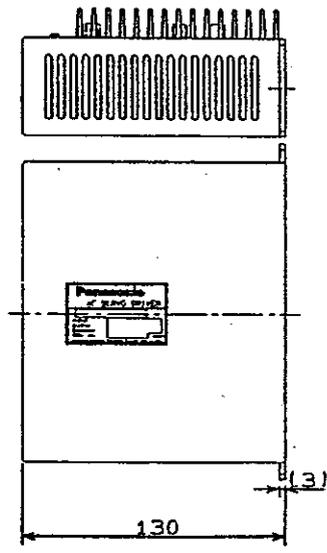
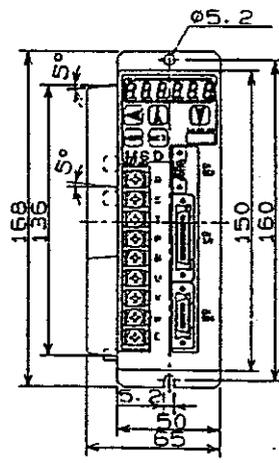
[Note] Regarding the \*\*\* or □○△▽ refer to section 1-1.

# 12. Dimensions

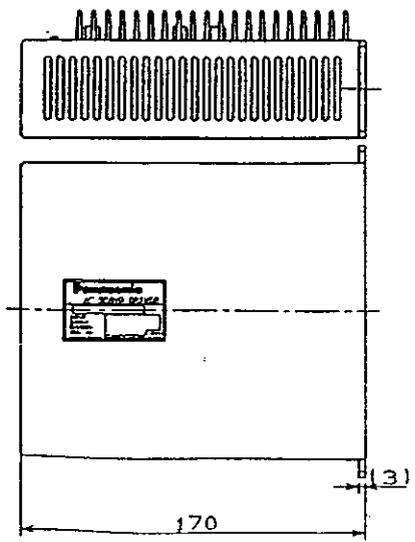
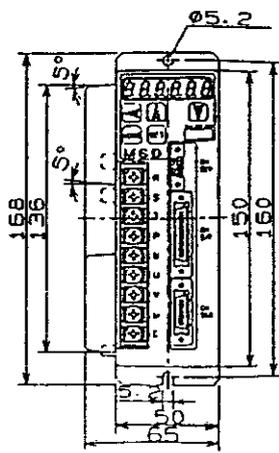
Dimension suffix A



Dimension suffix B



Dimension suffix C



# 13. Option parts

## 13-1. Connector kit for connecting external equipment

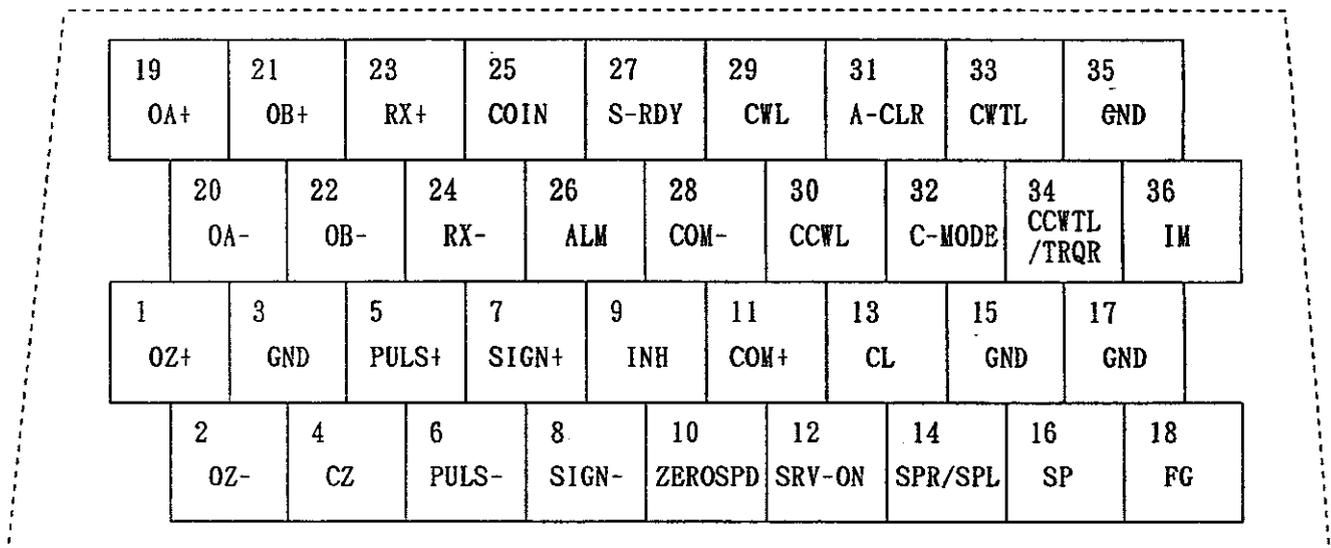
(1) Product No. DV0P0480

(2) Constituents

Name	Manufacturer's product No.	Quantity	Manufacturer's name	Remarks
Plug	10136-3000VE	1	Sumitomo 3M, Ltd.	For CN I/F (36 pins)
Shell kit	10336-52A0-008	1		

\* Parts equivalent to product number above made by another manufacturer may be adopted for plug and shell kit.

(3) Pin arrangement of plug for CN I/F



**Note** 1. The table above shows the arrangement as viewed from solder side. Also confirm the pin number stamped on plug itself to ensure correct wiring.

**Note** 2. See the item 6-2 for symbols indicating the signal name above, or function of signals.

## 13-2. Connector kit for connecting motor encoder

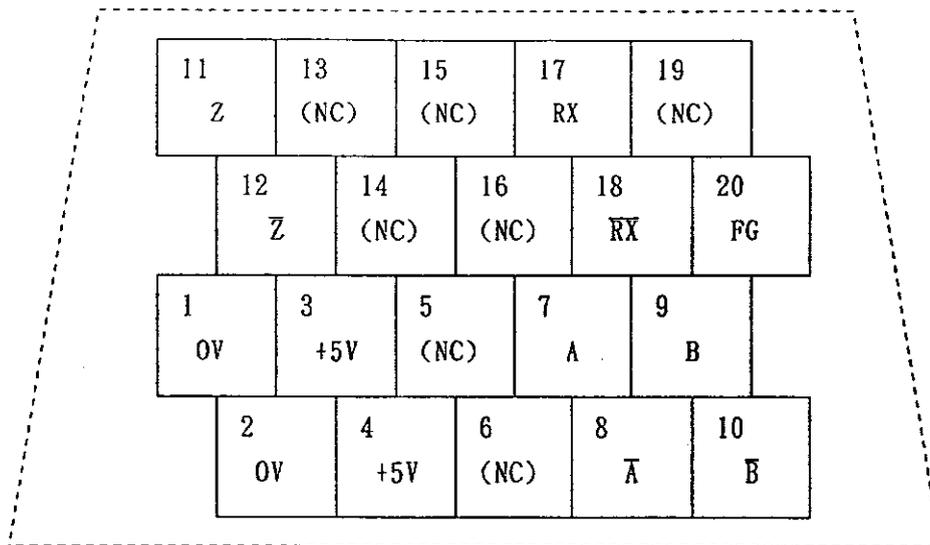
(1) Product No. DV0P0490

(2) Constituents

Name	Manufacturer's product No.	Quantity	Manufacturer's name	Remarks
Plug	10120-3000VE	1	Sumitomo 3M, Ltd.	For CN SIG (20 pins)
Shell kit	10320-52A0-008	1		
Cap	172159-1	1	AMP (Japan), Ltd.	Motor power line For relay (4 pins)
Socket	170366-1	4		
Cap	172163-1	1	AMP (Japan), Ltd.	Encoder cable For relay (15 pins)
Socket	170365-1	15		

\* Parts equivalent to product number above made by another manufacturer may be adopted for plug and shell kit.

(3) Pin arrangement of plug for CN SIG



- Note 1. The table above shows the arrangement as viewed from solder side. Also confirm the pin number stamped on plug itself to ensure correct wiring.
- Note 2. Be sure to connect shield of shielded wire to be used to pin 20 (FG). Do not connect anything to the pin marked with (NC) in the table above.
- Note 3. See the section 5-1-3 in wiring and connecting.

13-3. Communication control software PANATERM

(1) Product No. DV0P0460E

(2) Operation environment

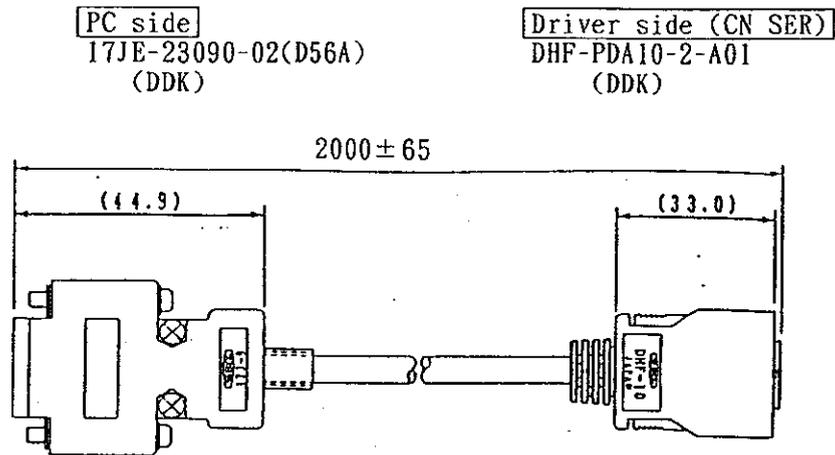
Supplying media	2DD 3.5" floppy disk
Compatible PC model	Compatible machine of PC/AT
Compatible OS	MS-DOS, Ver. 4.00 or above

Note This software is subject to change in specifications without notice for improvement of version.

### 13-4. RS232C Connection Cable

(1) Product No. DV0P0630

(2) Outer dimension

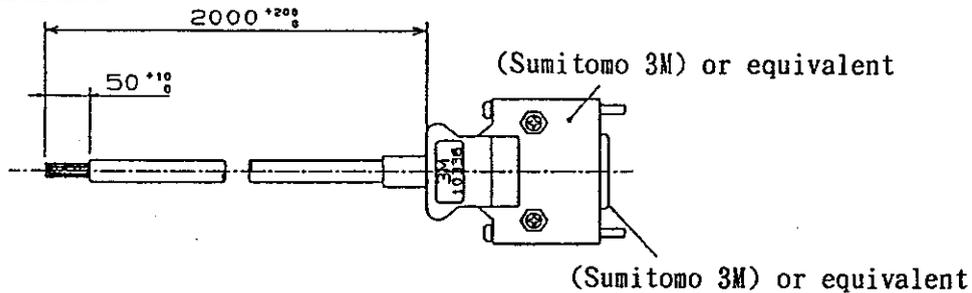


**Note** This connection cable cannot be used for other equipment.

### 13-5. Cable for interface

(1) Product No. DV0P0520

(2) Outer dimension



(3) Wiring table

Pin No.	Signal name	Core color	Pin No.	Signal name	Core color	Pin No.	Signal name	Core color
1	OZ+	Orange(Red 1)	13	CL	White (Red 2)	25	COIN	White (Red 3)
2	OZ-	Orange(Black 1)	14	SPR/SPL	Gray (Black 2)	26	ALM	White (Black 3)
3	GND	Gray (Red 1)	15	GND	Gray (Red 2)	27	S-RDY	Yellow(Red 3)
4	CZ	Gray (Black 1)	16	SP	White (Black 2)	28	COM-	Yellow(Black 3)
5	PULS+	White (Red 1)	17	GND	Yellow(Red 2)	29	CWL	Pink (Red 3)
6	PULS-	White (Black 1)	18	FG	Yellow(Black 2)	30	CCWL	Pink (Black 3)
7	SIGN+	Yellow(Red 1)	19	OA+	Pink (Red 2)	31	A-CLR	Orange(Red 4)
8	SIGN-	Yellow(Black 1)	20	OA-	Pink (Black 2)	32	C-MODE	Orange(Black 4)
9	INH	Pink (Red 1)	21	OB+	Orange(Red 2)	33	CWTL	Gray (Red 4)
10	ZEROSPD	Pink (Black 1)	22	OB-	Orange(Black 2)	34	CCWTL/TRQR	Gray (Black 4)
11	COM+	Orange(Red 2)	23	RX+	Gray (Red 3)	35	GND	White (Red 4)
12	SRV-ON	Orange(Black 2)	24	RX-	Gray (Black 3)	36	IM	White (Black 4)

**Note** 1. ( ) in the core color block in the table above indicates a dot mark color and mark quantity.

**Note** 2. Nominal section area of core is 0.15 [mm<sup>2</sup>] (Equivalent to AWG26 phase).

In addition to option parts above, the following items are optionally available.

- Encoder relay cable ..... Product No. MFECA□□□EAA
- Motor relay cable ..... Product No. MFMCA□□□AET
- Brake relay cable ..... Product No. MFMCB□□□CET

As for detail, see the catalogue, or consult the store you purchased your unit.

Memo

Handwriting practice lines consisting of 15 horizontal dashed lines.

