Panasonic

Instruction Manual

AC Servo Motor & Driver

MINAS E-series

- Thank you very much for buying Panasonic AC Servo Motor & Driver, MINAS E-series.
- Before using this driver, please read this manual especially refer the safty precautions (page 8 to 11) to ensure proper use.
  Then, keep this manual for your future use.
- This product is for industrial equipment. Don't use this product at general household.

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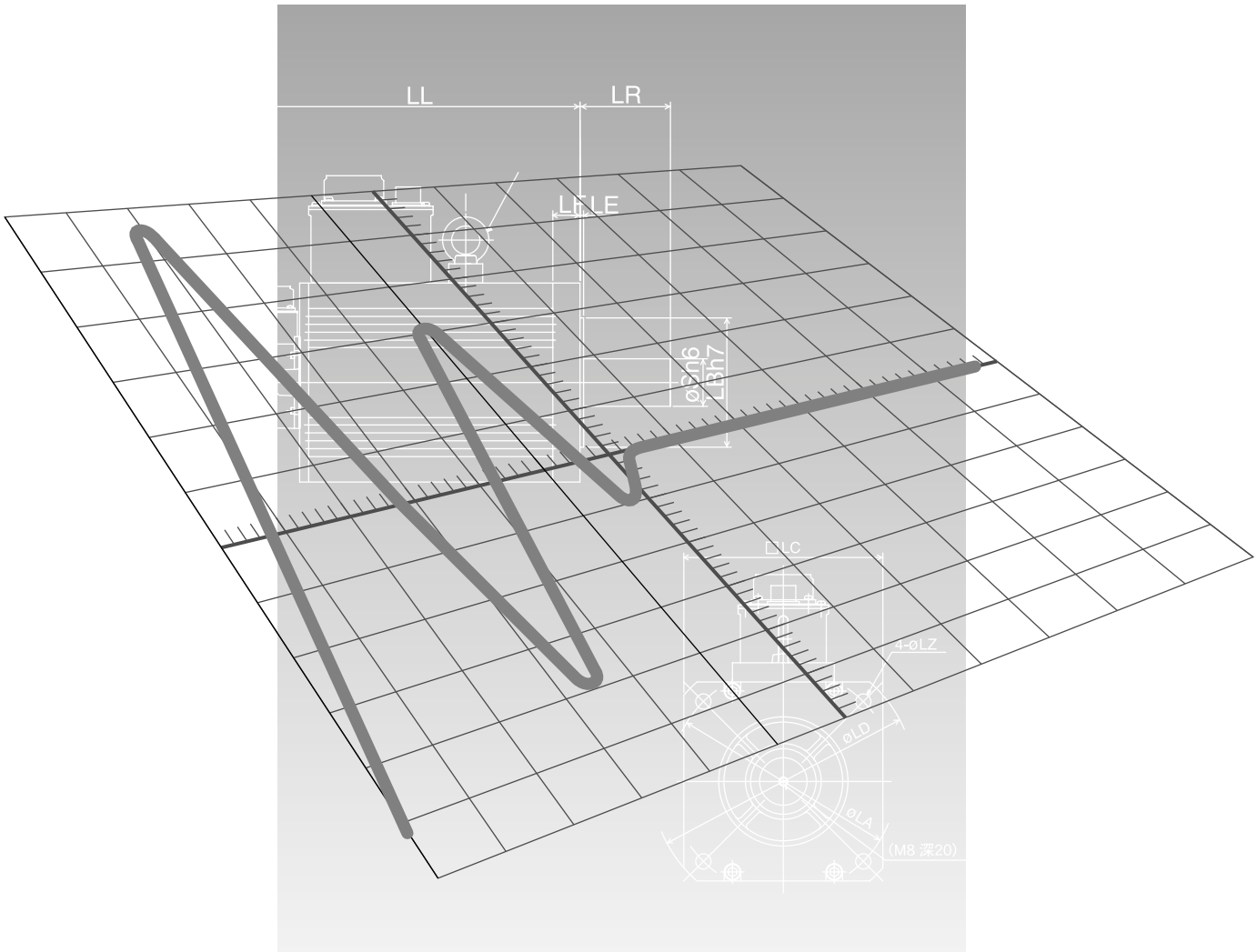
MEMO



Before Use

Safety Precautions Important

See the following precautions in order to avoid damages on machinery and injuries among the operators and other people during the operation.

■ **The following symbols are used to indicate the degrees of hazard seriousness possibly occurred when you fail to comply with the safety precautions.**

DANGER	Indicates a potentially hazardous situation, which if not avoided, will result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation, which if not avoided, will result in minor injury or physical damage.

■ **The following symbols indicate what you must do.**

	Indicates that the operation is prohibited to do.
	Indicates that the operation must be done.

DANGER

Do not subject the product to water, corrosive or flammable gases, and combustibles.

The failure could result in fire.

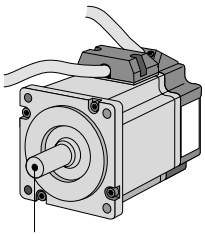
Do not expose the cables to sharp objects, excessive pressing or pinching forces, and heavy loads.

The failure could result in electric shocks, damages, or malfunction.

Do not put your hands in the servo driver.

The failure could result in burns, or electric shocks.

Do not touch the rotating part of the motor while operating.



Rotating Part

The failure could result in injuries.

Do not drive the motor from the external power.

The failure could result in fire.

Do not touch the motor, driver, and external regenerative resistor, since they become hot.

The failure could result in burns.

⚠ DANGER

Do not place inflammable matter near the motor, driver, and regenerative resistor.

The failure could result in fire.

Do not install the console near sources of heat like the heater, the resistor, or etc.

The failure could result in fire or damages.

Ground the earth of the servo motor and servo driver.

The failure could result in electric shocks.

An over-current protection, earth leakage breaker, over temperature protecter and emergency stop device must be installed.

The failure could result in electric shocks, injuries, or fire.

Install an external emergency stop device to shut down the main power source in any emergency.

The failure could result in electric shocks, injuries, fire, damages or malfunction.

Wait at least the time described on the driver after switching off the power to allow the capacitors to discharge before beginning to conduct the transportation, wiring, and inspection of the driver.

The failure could result in electric shocks.

Install the product properly to avoid personal accidents or fire in case of an earthquake.

The failure could result in electric shocks, injuries, or fire.

Confirm that there is no danger of an electric shock before beginning to conduct the transportation, wiring, and inspection of the motor.

The failure could result in electric shocks.

Make sure to secure the safety after the earthquake.

The failure could result in electric shocks, injuries, or fire.

Only persons who are trained and qualified to work with or on electrical equipment are permitted to operate or maintain this equipment.

The failure could result in electric shocks.

Attach the motor, driver, regenerative resistor to incombustible matter such as metal.

The failure could result in fire.

Arrange the phase sequense of the motor and wiring of the encoder.

The failure could result in injuries, damages, or malfunction.

Safety Precautions Important

⚠ CAUTION

Do not hold the cables or motor shaft when transporting the motor.

The failure could result in injuries.

Do not block the heat dissipation hole.

The failure could result in electric shocks, or fire.

Never start and stop the motor by magnet contactor which is provide on the main line.

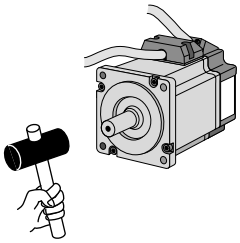
The failure could result in damages.

Do not climb or stand on the servo equipment.

The failure could result in electric shocks, injuries, damages, or malfunction.

Do not give hard pressure to the shaft.

The failure could result in damages.



Do not turn on or off the power frequently.

The failure could result in damages.

Do not shock the driver and the motor.

The failure could result in damages.

Avoid excessive gain adjustments, changes, or unstable operation of the product.

The failure could result in injuries.

Do not use the motor internal brake for the purpose of controlling speed of load.

The failure could result in injuries, or damages.

Do not approach to the equipment after recovery from the power failure because they may restart suddenly. Execute the personal safety setting on the Equipment after the restart.

The failure could result in injuries.

Do not modify, dismantle or repair the product.

The failure could result in electric shocks, injuries, or fire.

Do not pull the motor cable by too much power.

The failure could result in damages.

CAUTION

Use the motor and driver with the specified combination.

The failure could result in fire.

Make sure that the wirings are correctly connected.

The failure could result in electric shocks, or injuries.

Use the eye-bolt of the motor only when you carry the motor.
Do not use it when you carry the machine.

The failure could result in injuries, or damages.

Install the driver and the motor in the specified direction.

The failure could result in damages.

Conduct proper installation according to product weight or rated output.

The failure could result in injuries, or damages.

Use the specified voltage on the product.

The failure could result in electric shocks, injuries, or fire.

Ambient temperature of installed motor and driver should be under permittable one.

The failure could result in damages.

Execute the trial-operations with the motor fixed and a load unconnected. Connect a load to the motor after the successful trial-operations.

The failure could result in injuries.

Connect a relay that stops at emergency stop in series with the brake control relay.

The failure could result in injuries, or damages.

If an error occurs, remove the causes of the error and secure the safety before restarting the operation.

The failure could result in injuries.

This product should be treated as an industrial waste when it is disposed.

Maintenance/Inspection

- **Routine maintenance and inspections are essential for proper and satisfactory operation of the driver and motor.**

Notes to Maintenance/Inspections Personnel

(1) Power-on/off operations should be done by the operators themselves.
(2) For a while after power off, the internal circuits is kept charged at higher voltage. Inspections should be done a while (about 10 minutes), after the power is turned off and the LED lamp on the panel is extinguished.
(3) When conducting meager test (to measure insulation resistance) on the servo driver, disconnect all the connections from the driver. Conducting the test as connected would cause trouble of the driver.

Inspection Items and Cycles

Normal (correct) operating conditions:

Ambient temperature: 30˚C (annual average) Load factor: max. 80%
Operating hours: max. 20 hours per day

Daily and periodical inspections should be done per the following instructions.

Type	Cycles	Inspection items
Daily inspection	Daily	• Ambient temperature, humidity, dust, particles, foreign matters, etc. • Abnormal sound and vibration • Main circuit voltage • Odor • No yarn piece, etc. adhered to the air hole? • How the driver front and connector are cleaned? • Each wired cable is damage-free? • The portions connected with the motors of equipment/plant are free from loose and center deviation? • No inclusion of foreign matter at the load side?
Periodical inspection	Every year	• Loosened screws • Signs of overheat

<Notes>
If the operating conditions (as stated above) differ, this periodic inspection interval is subject to change.

We make the utmost effort to ensure the quality of our product. However, the product may operate differently from your settings, due to unexpectedly high exogenous noise/applied static electricity, or an unforeseen failure in the input power supply, wiring, components, etc. Hence, we would like to request you to give adequate consideration to the fail-safe design and assurance of safety within the operable range at the place of operation in your company.

Replacement Guidance

Parts replacement cycles depend on the actual operating conditions and how the equipment has been used. Defective parts should be replaced or repaired immediately.

Prohibited	**Dismantling for inspections or repairs should be done by our company (or our sales agents).**

Equipment	Part	Standard replacement cycles (hour)	Remarks
Driver	Smoothing condenser	about 5 years	The replacement cycles shown here are just only for reference if any part is found defective regardless of the standard replacement cycles, immediately replace it with a new one.
	Aluminum electrolytic capacitor on the print board	about 5 years	
	Rush current preventive relay	Approx. 100,000 cycles (The life depends on the actual operating conditions.)	
	Rush current preventive resistor	Approx. 20,000 cycles (The life depends on the actual operating conditions.)	
	Cooling fan	2 to 3 years (10,000 to 30,000 hours)	
Motor	Bearing	3 to 5 years (20,000 to 30,000 hours)	
	Oil seal	5000 hours	
	Encoder	3 to 5 years (20,000 to 30,000 hours)	
Motor with Gear	Speed reducer	10,000 hours	

Introduction

General

MINAS-E series is a unit of an AC servo motor and driver with downsized capability and performance that are useful for positioning of a motor whose capacity is small from 50W to 400W.
By adopting 2500 P/r incremental encoder with velocity response frequency of approximately 400 Hz and 5 wires, we could omit wiring.
The equipment includes real-time auto tuning and enables automatic setting of complicated gain tuning. In addition, it has a damping control function that provides for stable stop performance and contributes to miniaturization of the equipment and reduction of tact time.
It supports a console (available as an option) capable of monitoring such as display of rotation speed, parameter setting, test run (JOG operation), parameter copying, etc., and pursues maximum ease for use.
This document is designed for you to properly and sufficiently use functions of MINAS-E series with such excellent features.

Cautions
(1) No part or whole of this document may be reproduced in any form or by any means.
(2) Contents of this document are subject to change without notice.

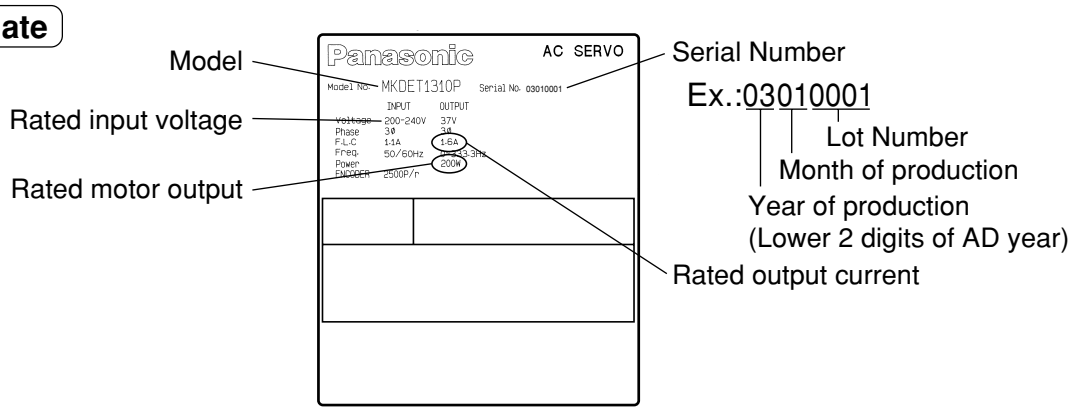
After Opening the Package

- Make sure that the product is what you ordered.
- Check whether the product is damaged.
- The instruction manual (Safety edition and Extracted edition) is included in a carton box.

If the product is not what you purchase, or it is, or damaged, contact dealer or sales agent.

Model of Driver

Name plate



Model Designation

M K D E T 1 3 1 0 P ∗ ∗
1~4 5~6 7 8~9 10 11~12

Special specifications

Outer frame symbolic characters

Symbol	Frame name
MKDE	E-Series K frame
MLDE	E-Series L frame

Control Mode
P: Position Control

Current rating of current detector

Symbol	Current rating of current detector
05	5A
10	10A

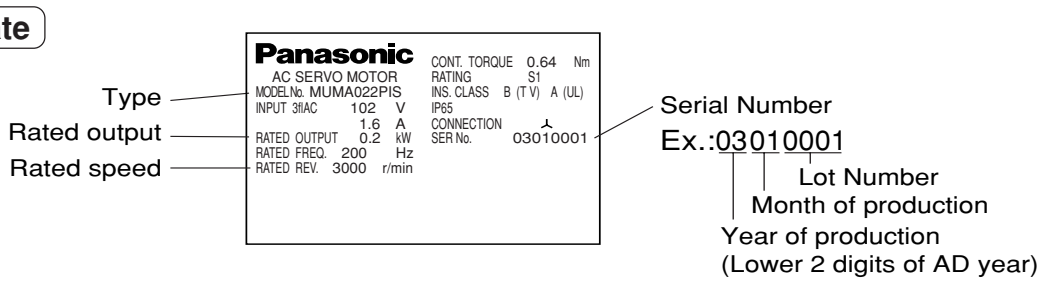
Power supply
1: Single-phase 100 V
2: Single-phase 200 V
3: Three-phase, 200 V
5: Single-phase/Three-phase, 200 V

Maximum current rating of power element

Symbol	Maximum current rating of power element
T1	10A
T2	15A

Model of Motor

Name plate



Model Designation

M U M A 5 A Z P 1 S ∗∗

1~4 | 5~6 | 7 | 8 | 9 | 10 | 11~12

Symbol	Type
MUMA	Ultra low inertia

Custom specifications

Motor structure

Design order
1: Standard

Type of encoder

Rated output

Power supply
1: 100 V
2: 200 V
Z: 100/200 V common-used
(Limited to 50W only)

Table 1a: Motor rated output

Symbol	Rated output
5A	50W
01	100W
02	200W
04	400W

Table 1-b: Rotary encoder

Symbol	Specifications			
	Type	No. of pulses	Resolution	Lead wire
P	Incremental	2500P/r	10000	5-wire

Table 1c: Motor structure

	Shaft	Holding brake		Oil seal	
	Center tap on key-wayed shaft end	Without	With	Without	With
S	●	●		●	
T	●		●	●	

Check the Combination of Driver and Motor

This driver is designed for use in combination with a motor to be specified by us.
Check a name of series, rated output, voltage specifications and encoder specifications of a motor you wish to use.

Incremental specification 2500 P/r

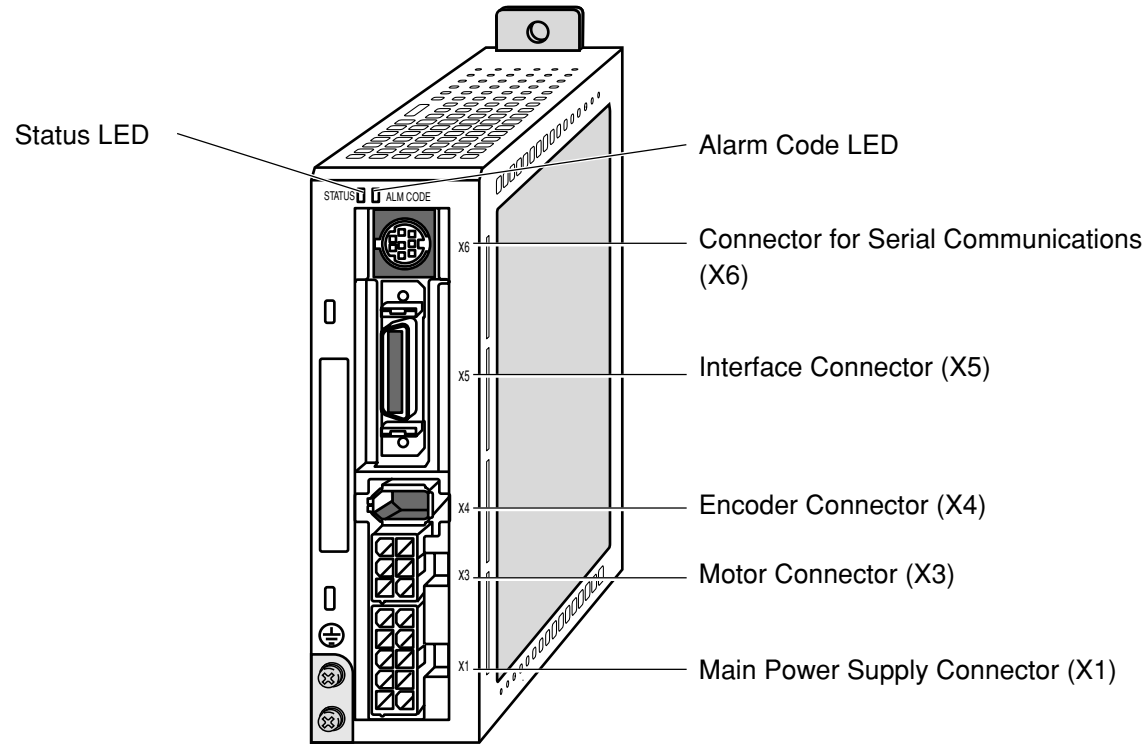
<Note> You must not use any other combinations than those listed below:

	Applicable Motor				Applicable Driver	
Power Supply	Motor Series	Rated Speed	Motor Type	Rated Output	Driver Type	Driver Frame
Single-phase 100V	MUMA Ultra low inertia	3000r/min	MUMA5AZP1*	50W	MKDET1105P	Frame K
			MUMA011P1*	100W	MKDET1110P	
			MUMA021P1*	200W	MLDET2110P	Frame L
Single-phase 200V			MUMA5AZP1*	50W	MKDET1505P	Frame K
			MUMA012P1*	100W	MKDET1505P	
			MUMA022P1*	200W	MLDET2210P	Frame L
			MUMA042P1*	400W	MLDET2510P	
Three-phase 200V			MUMA5AZP1*	50W	MKDET1505P	Frame K
			MUMA012P1*	100W	MKDET1505P	
			MUMA022P1*	200W	MKDET1310P	
			MUMA042P1*	400W	MLDET2310P	Frame L
					MLDET2510P	

<Remarks>
The marking " * " in Motor Type column of Applicable Motor represents a motor specifications.

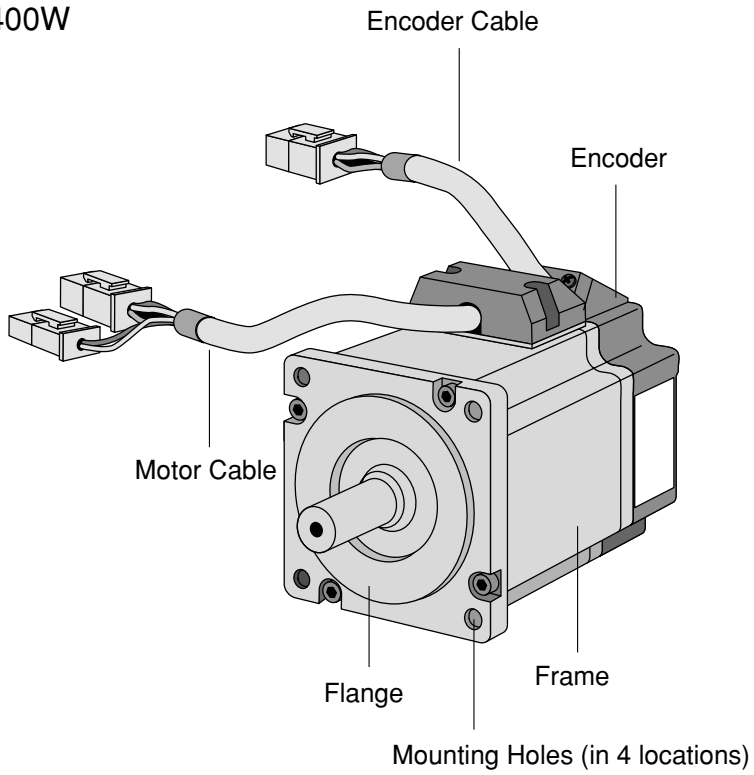
Parts Description

Driver



Motor

■MUMA 50W - 400W



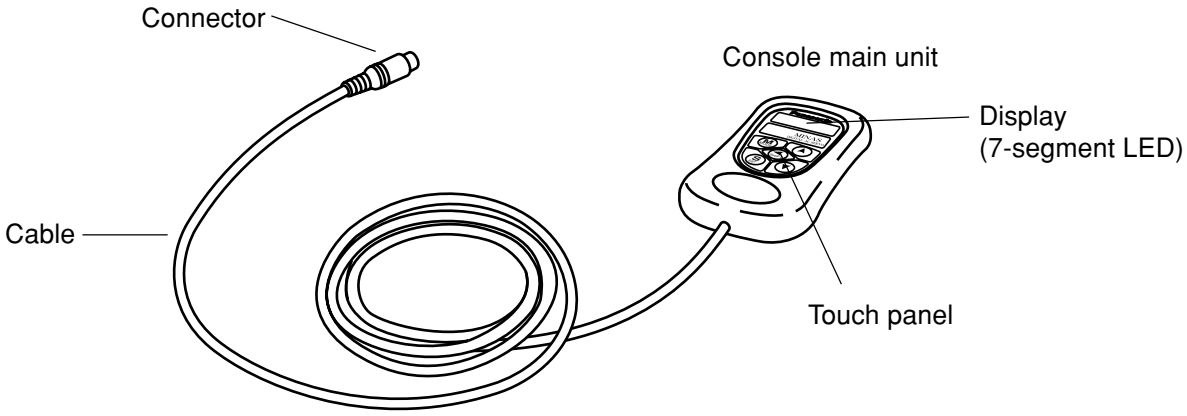
Example: Super Low Inertia Type (MUMA Series 50W)

<Remarks>

For detailed information on each type, refer to a dimensional outline drawing (Pages 194 to 195) of Reference edition.

Console

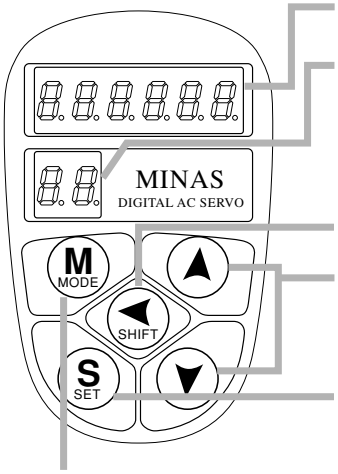
Main body



<Remarks>

The console is optionally available. (Part No.: DV0P3690)

Touch panel



Display, LED (display in 6 digits)

Display of selected Driver **ID No.** (2 digits)
The value set up on Pr00 (shaft name) is ID No.
Parameter No. (2 digits) is displayed under Parameter Setting mode.

This is used to shift the digits of data.

This is used to change the data and to execute parameter selection.
The numerical value goes up and down by pressing ▲ and ▼.

Setting Button: This is to shift each mode, which was selected by the mode selector button, to EXECUTE display.

Mode Selector Buttons: These buttons are used to select 6 different modes.

(1) MONITOR mode

(2) PARAMETER SETTING mode

(3) EEPROM WRITE mode

(4) NORMAL AUTO GAIN TUNING mode

(5) AUXI FUNCTION mode

- Test run (JOG mode)
- Alarm clear

(6) COPING FUNCTION mode

- To copy parameters to the console from the servo driver.
- To copy parameters to the servo driver from the console.

Installation

The driver and motor should be properly installed to avoid failures, mechanical damages and injuries.

Driver

Location

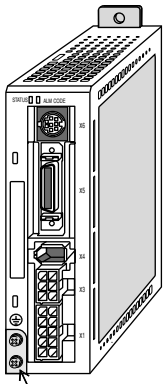
(1) Indoors, where the driver is not subjected to rain water and direct sun beams. Note that the driver is not a waterproof structure.
(2) The place where the driver is not exposed to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chlorine gas, sulfuric gas, acid, alkali, salt, etc. and is free from splash of flammable gas, grinding coolant, oil mist, iron powder, chips, etc.
(3) Place in a well-ventilated, and humid-and dust-free space.
(4) Place in a vibration-free space.

Environmental Conditions

Item	Conditions
Ambient temperature	0 to 55°C (free from freezing)
Ambient humidity	Lower than 90%RH (free from condensation)
Storage temperature	-20 to 80°C (free from freezing)
Storage humidity	Lower than 90%RH (free from condensation)
Vibration	Lower than 5.9 m/s^2 (0.6G) at 10 to 60 Hz
Altitude	Lower than 1000 m

How to Install

(1) Parallel type. Install in vertical position. Reserve a drafting space around the driver for ventilation.
(2) For the mounting dimensions onto the wall face in the board, refer to Page 193 of the dimensional outline drawing.

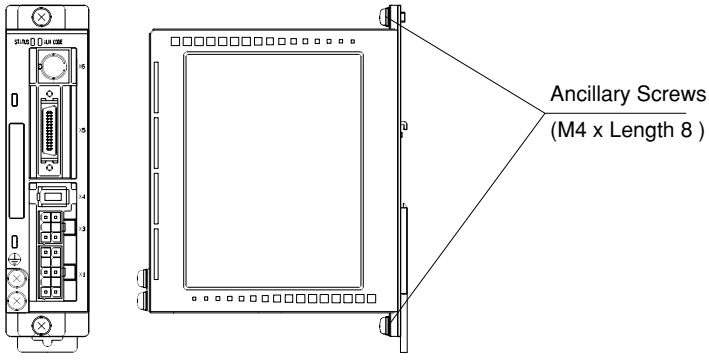


Base mount type

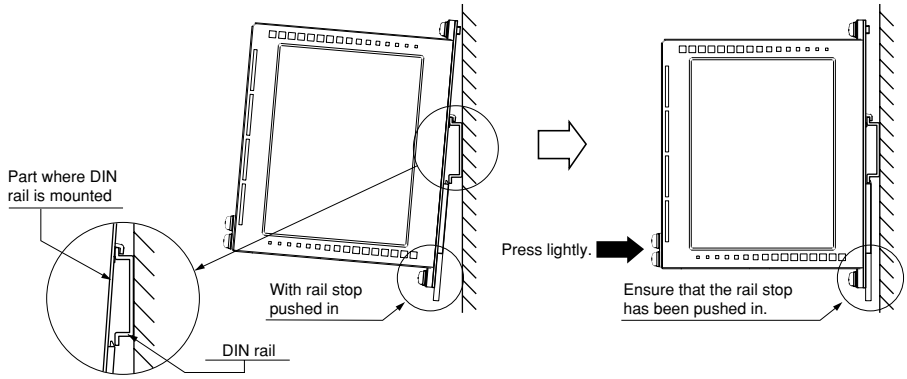
Earth connection (M4 screw) tightening torque shall not exceed 0.39 - 0.59 N•m

(3) Installing to DIN Rail

Install the main body of the driver by using optionally available DV0P3811 (see an “optional” DIN rail mounting unit on page 190 of Reference edition) and screws (M4 x length 8, pan-head machine screws) supplied with the option.



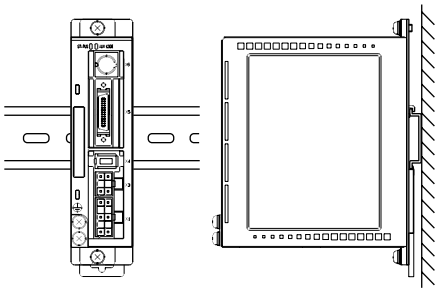
DIN rail mounting unit attached to the driver



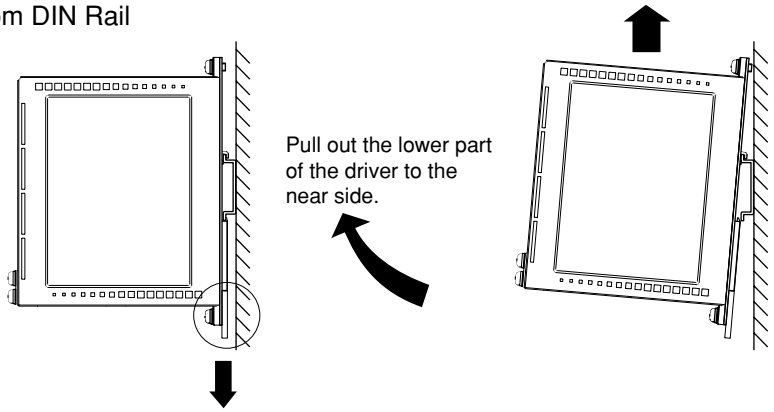
Hook the upper side of DIN rail mounting part on the DIN rail.

Press lightly the lower part of the main body of driver.

Driver mounted to DIN rail



(4) Removing from DIN Rail

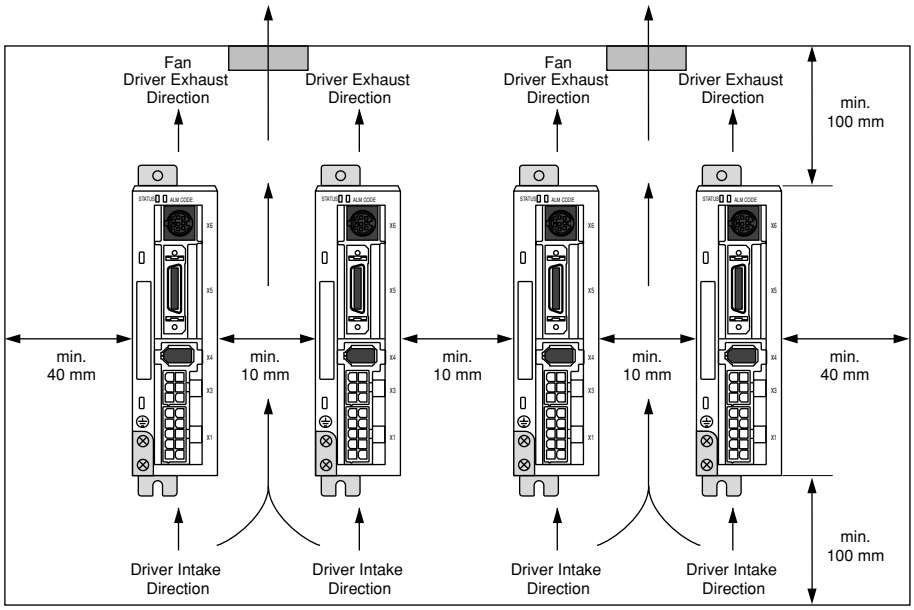


By lifting the driver, you can remove it from the DIN rail.

With the rail stop released, pull out the lower part of the driver to the near side.

Mounting Direction and Space Requirements

- Allow enough space to ensure enough cooling.
- Install fans to provide a uniform distribution of temperature in the control box.
- Observe the environmental requirements for the control box, mentioned in the previous page.



This driver has a cooling fan in its bottom and a mounting face.

To install the driver, ensure that there is enough space around the inlet and outlet ports so as not to prevent intake and exhaust of the fans.

Installation

Motor

Location

(1) Indoors, where the driver is not subjected to rain water and direct sun beams.
(2) The place where the motor is not exposed to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chlorine gas, sulfuric gas, acid, alkali, salt, etc. and is free from splash of flammable gas, grinding coolant, oil mist, iron powder, chips, etc.
(3) Place in a well-ventilated, and humid- and dust-free space.
(4) The place where the motor can be checked and cleaned easily.

Environmental Conditions

Item		Conditions
Ambient temperature		0 to 40°C (free from freezing)
Ambient humidity		Lower than 85%RH (free from condensation)
Storage temperature		-20 to 80°C (free from freezing)
Storage humidity		Lower than 85%RH (free from condensation)
Vibration	Motor only	49 m/s^2 (5G) or less at rotation, 24 5 m/s^2 (2.5G) or less
	With gear (At rotation)	High precision: 24.5 m/s^2 (2.5G) max.
Shock	Motor only	98 m/s^2 (10G) max.
	With gear	High precision: 98 m/s^2 (10G) max.

How to Install

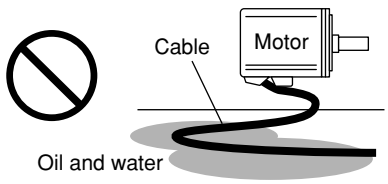
The motor can be installed either vertically or horizontally. Observe the following notes.
(1) When installing in horizontal direction
- Mount the motor with its cable lead-out port faced downward as the countermeasure for oil and water.

(2) When installing in vertical direction
- When installing the motor with speed reducer with its output shaft upside, use the oil-sealed motor to prevent oil inflow to the motor from the speed reducer. In this case, the oil-sealed motor is a special product.

(3) For the mounting dimensions, refer to a dimensional outline drawing (Pages 194 to 195).

Oil and Water Protections

(1) Don't use the motor under an environment where oil and water splash over the motor body.
(2) In combining with the speed reducer, use the oil-sealed motor to prevent oil inflow to the motor internal through its shaft through-penetration hole. In this case, the oil-sealed motor used is a special product.
(3) Don't use the motor with its cable dipped in oil/water.



Cable: Stress relieving

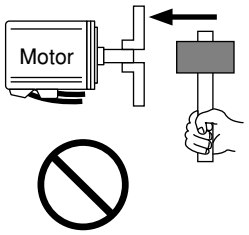
(1) Don't apply stress to the cable lead-out port and connections by bending and self-weight.
(2) Particularly in the case of application in which the servo motor must be movable, fix the accessory cable of the motor and house the extension junction cable, which is connected to the terminal end of the said cable, in the cable bearer to thereby minimize stress acting on the cable by bending.
(3) Make the cable bending radius as large as possible. (Minimum bending radius: to be 20 mm and over.)

Permissible Shaft Load

(1) Do mechanical design so both of radial load and thrust load being applied to the motor shaft during installation and running are maintained within the permissible value specified for each model.
(2) In using the rigid coupling, take good care of mounting. (Over-bending load on it, if any, would cause damage/wear of the shaft and shorter life of the bearings.)
(3) Use the flexible coupling of possibly high stiffness to control radial load arising from minor center deviation at the permissible value or less.
(4) For information on allowable load of an output shaft of each type, refer to Allowable Load of Output Shafts on Page 196 of Reference.

Installation Notes

(1) When connecting /disconnecting the coupling to/from the motor shaft end, don't apply direct impact to the shaft by hammering, etc. (Failure to observe this instruction would cause damage of the encoder mounted on the counter-load side shaft end.)
(2) Do perfect centering. (Imperfect centering would result in vibration, which would cause damage of the bearings.)



Installation

Console

Location

(1) Indoors, where the driver is not subjected to rain water and direct sun beams. The console is not water-resistant.
(2) The place where the driver is not exposed to corrosive atmospheres such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, sulfur, chlorine gas, sulfuric gas, acid, alkali, salt, etc. and is free from splash of flammable gas, grinding coolant, oil mist, iron powder, chips, etc.
(3) Place in a well-ventilated, and humid-and dust-free space.
(4) Place in a space to be easily accessed for inspection and cleaning.

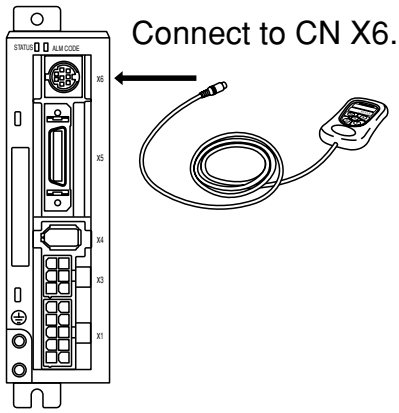
Environmental Conditions

Item	Conditions
Ambient temperature	0 to 55°C (free from freezing)
Ambient humidity	Lower than 90%RH (free from condensation)
Storage temperature	-20 to 70°C (free from freezing)
Storage humidity	Lower than 90%RH (free from condensation)
Vibration	Lower than 5.9 m/s^2 (0.6G) at 10 to 60 Hz
Shock	Compliant with free-fall test JIS C 0044 (1-m fall with a fall guide, twice in each direction)
Altitude	Lower than 1000 m

<Note>

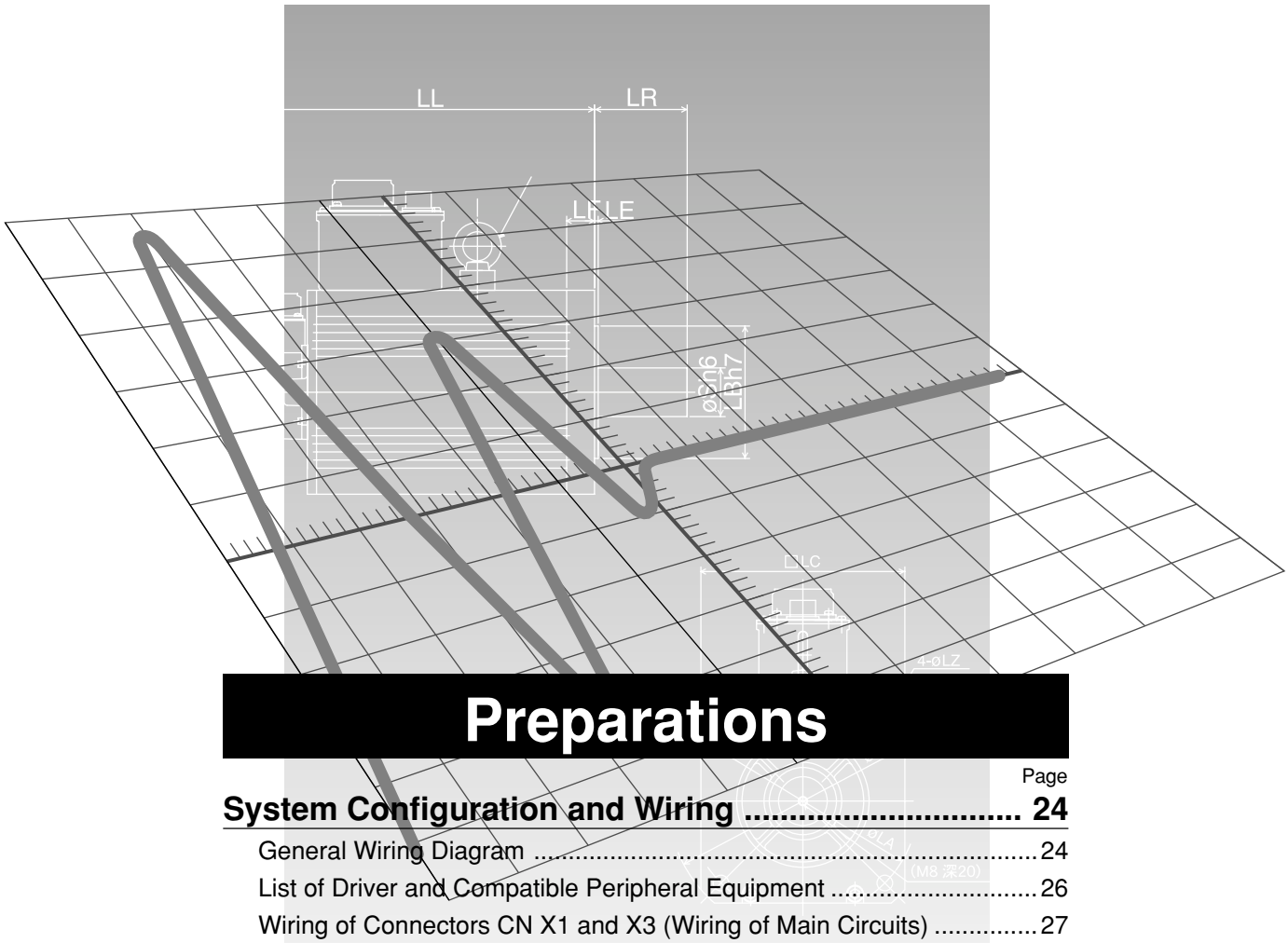
- **Avoid strong physical shock to the product.**
- **Do not drop the product.**
- **Do not pull the cable with an excessive force.**
- **Do not set the product near a heat generating device such as heater and large wire wound resistor.**

Method of Connection



<Remarks>

- Securely connect the console connector to the connector CN X6 of the driver.
- Never connect or disconnect the connector by grabbing the connector cable.



Preparations

System Configuration and Wiring

General Wiring Diagram

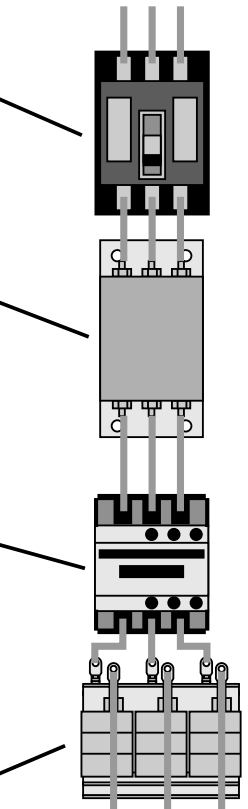
■ Main Circuits

Circuit Breaker (NFB) (Refer to Page 26)
Used to protect the power lines: overcurrent will shut off the circuit.

Noise Filter (NF) (Refer to Page 26, 182)
Prevents the external noise from the power line, and reduces the effect of the noises generated by the servo motor.

Magnetic Contactor (MC) (Refer to Page 26)
Turns on/off the main power of the servo motor. Used together with a surge absorber.
- Never start or stop the motor with the magnetic contactor.

Reactor (L) (Refer to Page 191)
Reduces the harmonic current in the main power.



■ Wiring connection to Connector CN X1

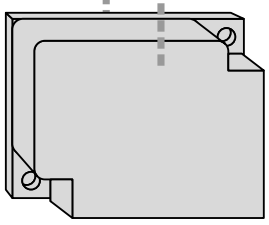
(Connection with the input power sup

P

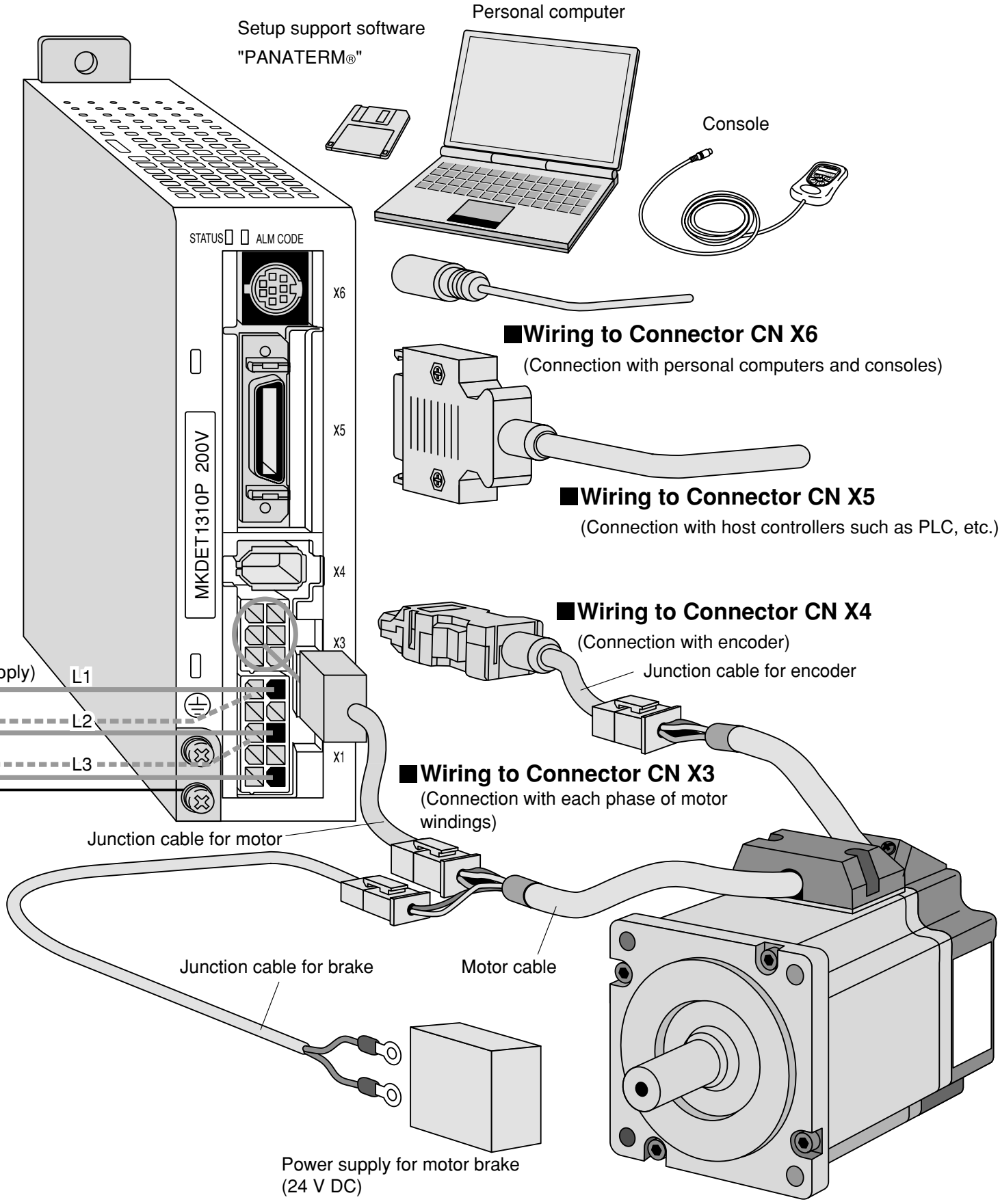
B

Ground

5 Pins - 3 Pins of CN X1 ---
- When using the driver for an application of large regenerative energy, connect an **external regenerative resistor** between P (5 pins) and B (3 pins) of connector CN X1.
- Install an external regenerative resistor on incombustible material, such as metal, and provide the regenerative resistor with a protective device such as temperature fuse, etc, to prevent the resistor from being overheated.



Regenerative discharge resistor
(Optional)



※ For connections, refer to Points in Wiring (Page 27).

System Configuration and Wiring

List of Driver and Compatible Peripheral Equipment

Driver			Required Power (rated load)	Circuit breaker (rated current)	Noise filter	Magnetic contactor (composition of contacts)	Cable diameter (L1, L2, L3, U, V, W, E)
Series	Power voltage	Output					
MKDE	1-phase, 100V	50W	0.3kVA	BBC25N (5A)	DV0P4160	BMFT61041N (3P+1a)	0.75mm² - 0.85mm² AWG18
		100W	0.4kVA				
MLDE		200W	0.5kVA	BBC2101N(10A)			
MKDE	1-phase, 200V	50W 100W	0.3kVA	BBC25N (5A)		BMFT61542N (3P+1a)	
MLDE		200W	0.5kVA				
		400W	0.9kVA	BBC2101N(10A)			
MKDE	3-phase, 200V	50W 100W	0.3kVA	BBC35N (5A)		BMFT61042N (3P+1a)	
MLDE		200W	0.5kVA				
		400W	0.9kVA	BBC3101N(10A)			

- Circuit breaker, magnetic contactor: manufactured by Matsushita Electric Industrial Co., Ltd.
  For compliance with EC Directives, don't fail to connect the circuit breaker (with LISTED, ㊊Mark), which is authorized and certified under IEC and UL Standards, between the power supply and the noise filter.
- Noise filter
  For DV0P4160, refer to Page 182.

< Remarks >

- For wiring to the power connector, motor connector and earth terminal, use the copper conductors of 60°C and over in the temperature rating.
- For the connector-side earth cable, use the cable of 0.75 mm² - 0.85 mm² (AWG18) in diameter.
- For the mounting screw-side earth cable, use the cable of 2.0 mm² (AWG14) or more in diameter.
- Where two or more drivers are used and the noise filters for the drivers are mounted in set in the power unit, feel free to consult with the noise filter manufacturer.

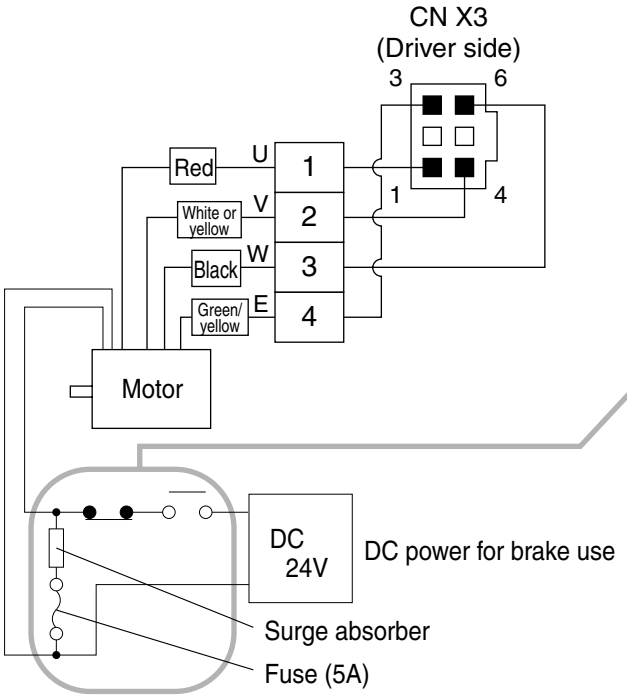
Wiring of Connectors CNX1, X3 (Wiring of Main Circuits)

- **Don't fail to request an electric wiring specialist for wiring.**
- **Don't switch ON the electric power until completion of the wiring, to prevent electric shock.**

Points in Wiring

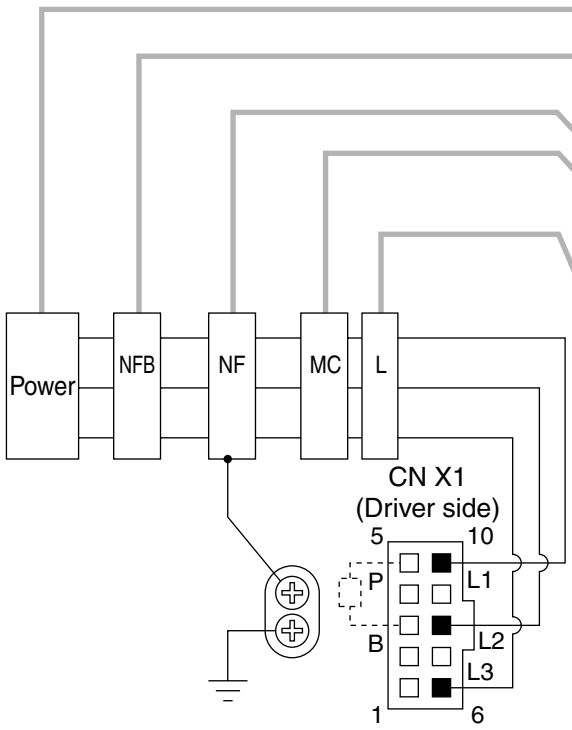
(1) For the cable diameter used, refer to "List of Driver and Compatible Peripheral Equipment" (page 26).

(2) Insert securely the connectors.



- Do wiring in perfect color matching between the identification colors of the motor lead-out cable and corresponding motor output terminal (U, V, W). Connect U (1 pin), V (4 pins), W (6 pins) and E (3 pins) respectively.
- **Avoid shorting and ground fault.**
- **At this stage, don't connect the power supply cable.**

- Adopt a duplex circuit as the brake control circuit so it can actuate even with emergency stop signal from external device.
- The magnetic brake has no polarity.
- For the power capacity and operation detail of the magnetic brake, refer to the "Holding Brake" (page 35).
- Install the surge absorber (C-5A2 or Z15D151 made by Ishizuka Electronic).



Ground resistance: 100Ω max.

For applicable wire, see page 26.

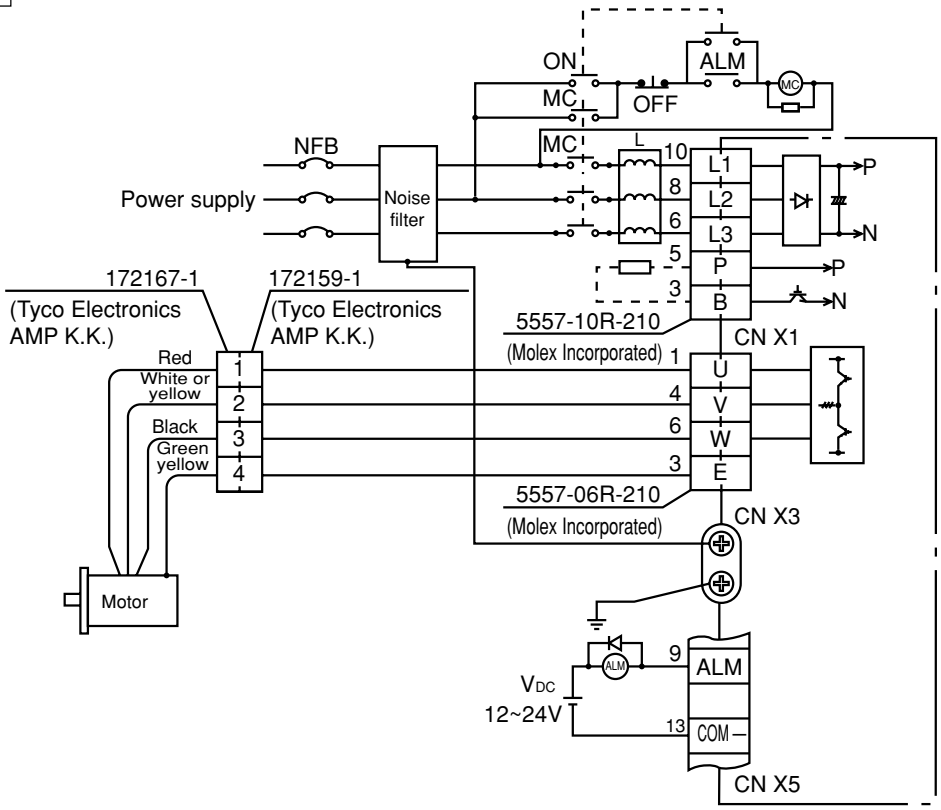
- Read the driver nameplate to check the power specification.
- Provide circuit breaker or leakage breaker without fail. In this case, use a leakage breaker to which countermeasure for high frequency is applied for "inverter application".
- Don't fail to provide noise filter.
- Provide the magnetic contactor coil with surge absorber. **Never start/stop the motor by magnetic contactor.**
- Install AC reactor.
- For three-phase 200V, connect L1 (10 pints), L2 (8 pins) and L3 (6 pins).
- For single-phase 100V and 200V, connect L1 (10 pins) and L3 (6 pins).
- **Connect to the grounding system of the facility.** Connect the driver protective earth terminal (⏚) and the protective earth (earth plate) of the control panel for preventing of electric shock. In this case, don't co-clamp the earth wires to the protective earth terminal (⏚). Two protective earth terminals are provided.

System Configuration and Wiring

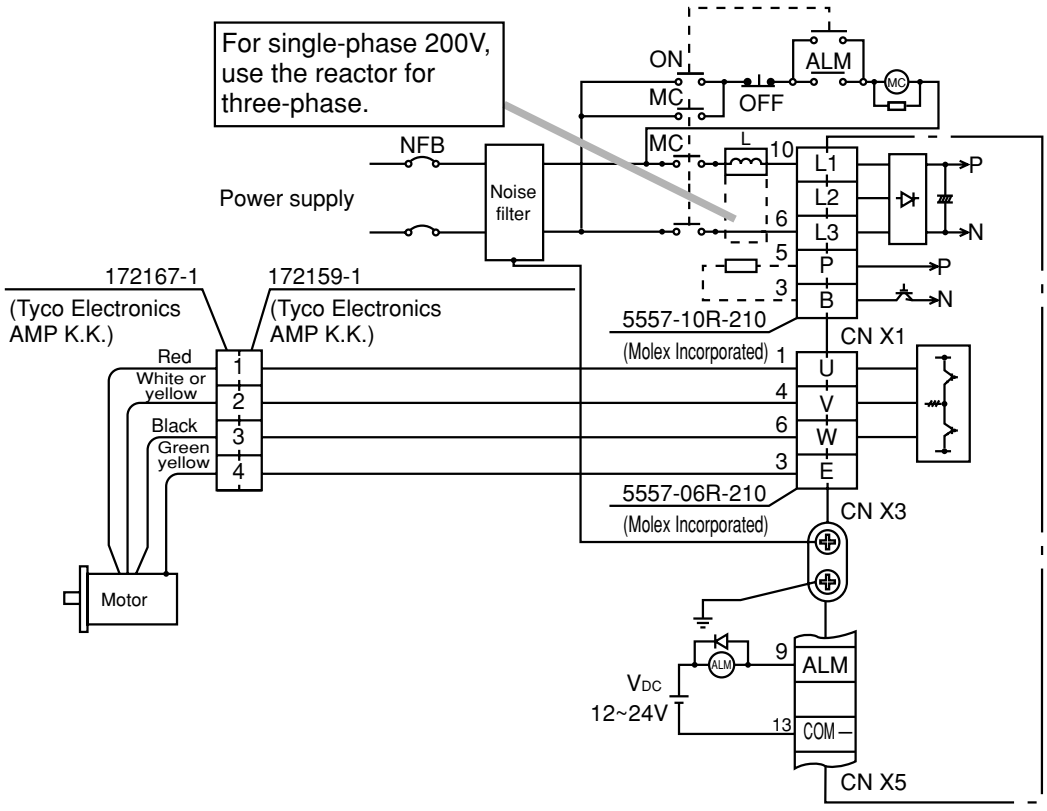
Wiring Diagrams

Compose such a power supply as to switch OFF the power against alarm output.

For three-phase 200V

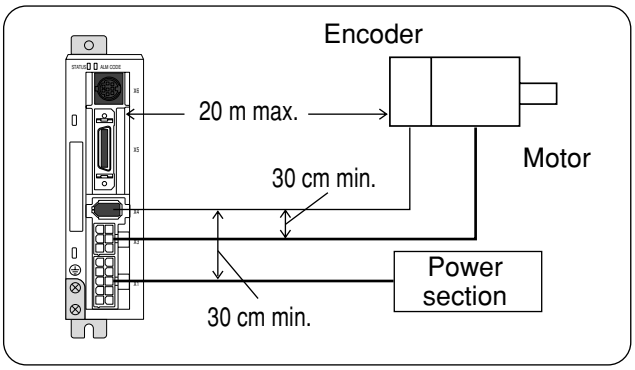


For Single-phase 100V/200V



Wiring to Connector CN X4 (Connection with Encoder)

Points in Wiring



○ Cable length between the driver and the motor - 20 m max. If this cable length exceeds 20 m, consult with the dealer/distributor from which you have purchased the driver.

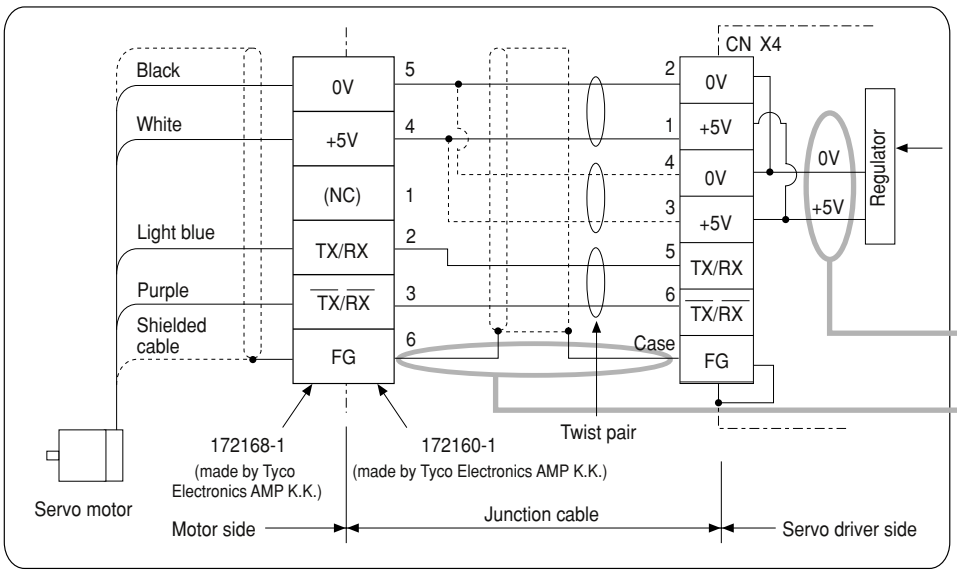
○ Keep 30 cm or more spacing from the main circuit wiring. Neither guide this wiring through the same duct, together with the main circuit nor bundle these two together.

Wiring Diagram

¥ When you plan to make an encoder junction cable by yourself, refer to Requests on a self-made encoder junction cable (For connectors, refer to Optional Parts (Connector Kits for Connection of Motor and Encoder) on Page 186 of Reference edition).

(1) Refer to the wiring diagram below.

(2) Cable used: Shielded twist pair cable of 0.18 mm^2 (AWG 24) minimum in conductor diameter that is excellent in bending resistance.



(3) For signal/power wiring in pair, use twist pair cable.

(4) Shielding treatment
- Driver-side shield sheath: Connect to CNX4 connector case (FG).
- Motor-side shield sheath: Connect to 6 pins.

(5) Where the cable length exceeds 10 m, do double-wiring for the encoder power (+5V, 0V), as illustrated left.

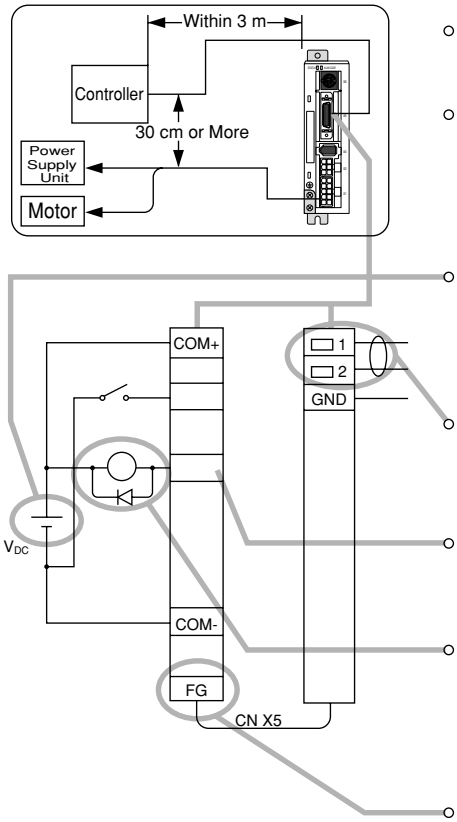
(6) Connect nothing to the empty terminal (NC) of the connector.

(7) Don't use a cable pair composed of the motor cable and encoder cable which were shielded in batch.

System Configuration and Wiring

Wiring of Connector CN X5 (Connection with Host Controller)

Points in Wiring



- Place any peripheral equipment such as a host controller within 3 meters from the driver.
- Separate the wiring at least 30 cm or more from the main circuit wires. The wiring should neither run through a same duct as the main circuit wires nor be bundled together with them.
- A customer is requested to prepare for power supply for control signals (V_{DC}) between COM+ and —COM
  Voltage: DC +12 to 24V
- For such wiring as command pulse input or encoder signal output, etc., use shielded twist pair cable.
- Neither apply 24V or more to a control signal output terminal, nor run 50mA or higher.
- If you directly activate a relay using the control signal output, install a diode in parallel with a relay in the direction shown in the left figure. Without a diode or with it but placed in the opposite direction, the driver will be damaged.
- The Frame Ground (FG) is connected to an earth terminal in the driver.

- **For detailed information on wiring of respective pins, refer to Page 65 (position control mode) and Page 103 (internal velocity control mode) of connections for each control mode.**

● CN X5 Connector Specifications

Connectors on Driver Side	Compatible Connectors on User Side		Manufacturer
	Part Name	Part No.	
10226-52A2JL	Connector (solder type)	10126-3000VE	Sumitomo 3M Ltd.
	Connector cover	10326-52A0-008	

<Remarks>

- **For details, refer to “Optional Parts” on Page 188 of Reference edition.**

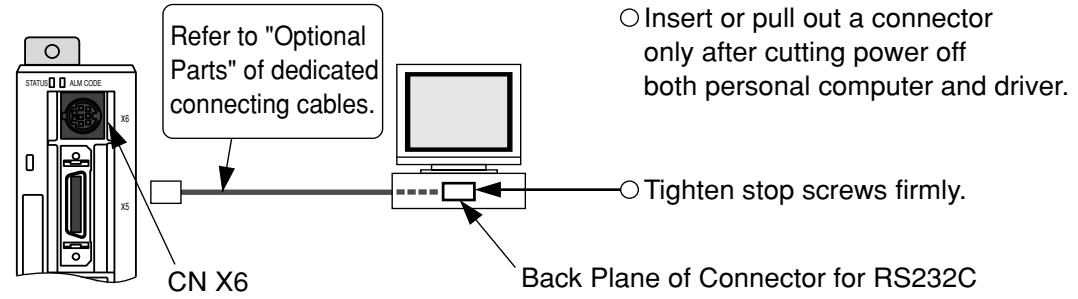
Wiring of Connector CN X6 (Connection with Personal Computer/Console)

- It is capable of RS232C communications.

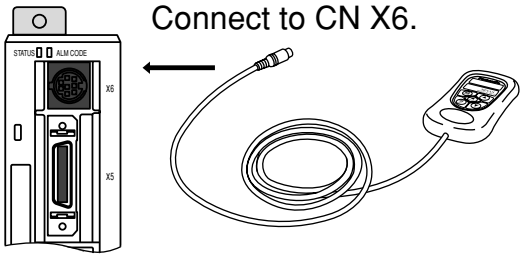
For RS232C communications only

1) Connect the personal computer and driver 1:1 through RS-232C, and use “PANATERM®” (optional component), the setup supporting software. Running “PANATERM®” on your personal computer, you can have convenient functions with excellent operability, such as various types of monitors, parameter settings/changes, waveform graphic displays, etc.
2) You can connect a host (personal computer, or host controller) and driver through RS 232C for communications. For detailed information, refer to “Communications” on Page 158 of Reference edition.

Connection

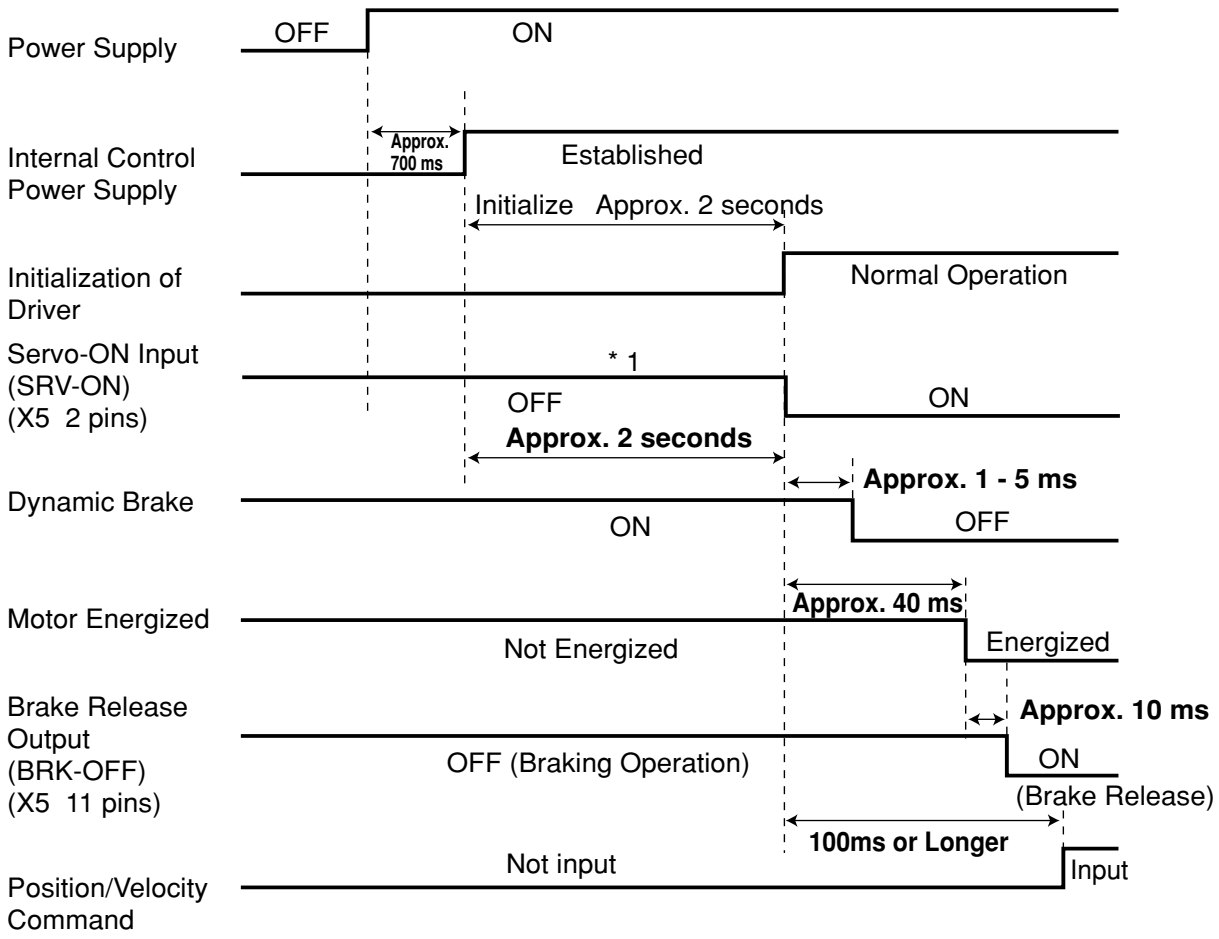


Connection with Console



Timing Chart

After Power-ON (Receiving Servo-ON Signal)

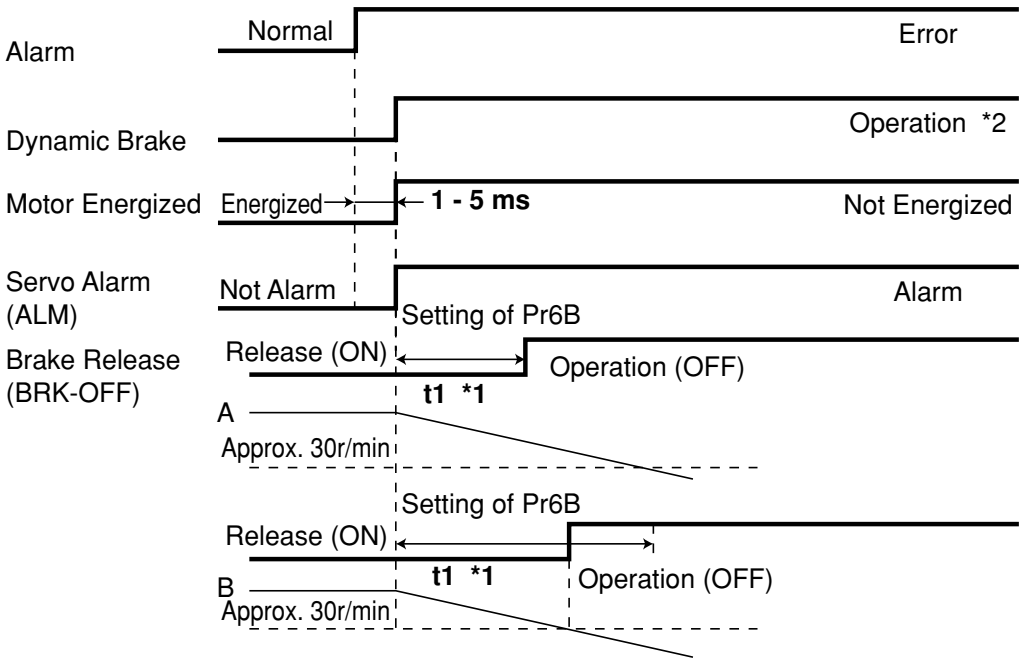


<Cautions>

- **The above chart shows timing from AC power-ON to command input.**
- **Enter Servo-ON signal and external command according to the above timing chart.**

***1: During this period, the SRV-ON signal has not been accepted although it was mechanically input.**

After an Alarm event (during Servo-ON)

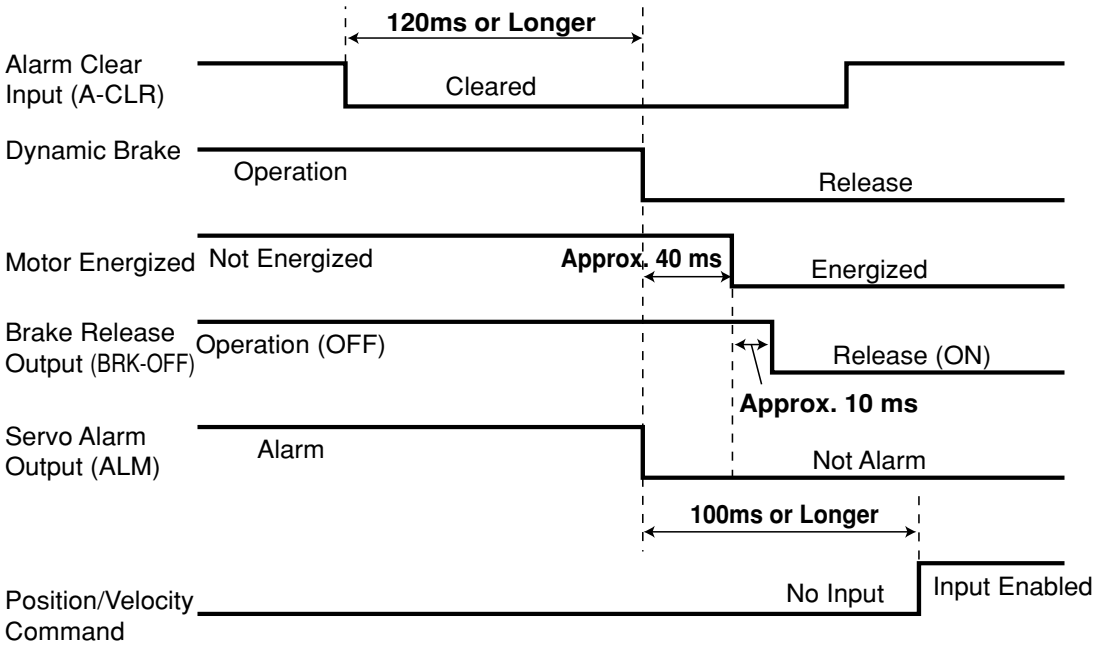


<Cautions>

*1. A value of t1 is a value of Pr6B or time needed for decreasing the motor speed to approx. 30 r/min, whichever is shorter.

*2. For operation of the dynamic brake following an alarm event, also refer to the description in “Sequence at Alarm” (“Parameter Setting” for every control mode) on Pr68.

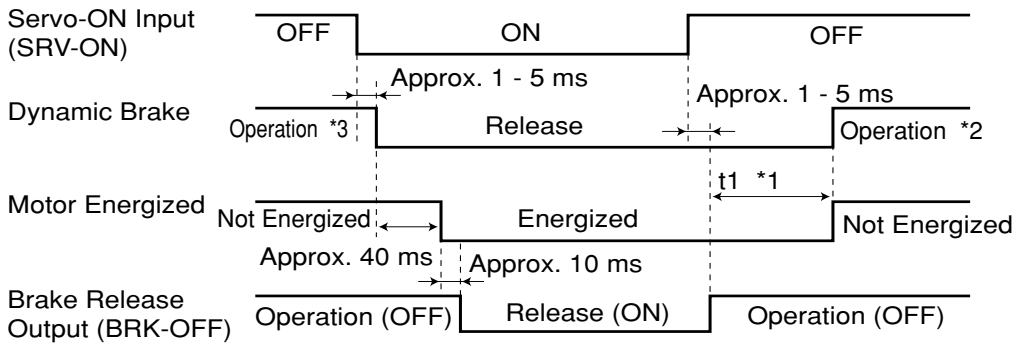
After an Alarm is Cleared (during Servo-ON Command)



Timing Chart

Servo-ON/OFF Operation When the Motor is Stopped

(During normal operation, perform the Servo-ON/OFF operation after the motor stops.)



When you turn off the power of the electromagnetic brake, the motor brake will run. When you turn on the power of the electromagnetic brake, the motor brake will be released.

<Cautions>

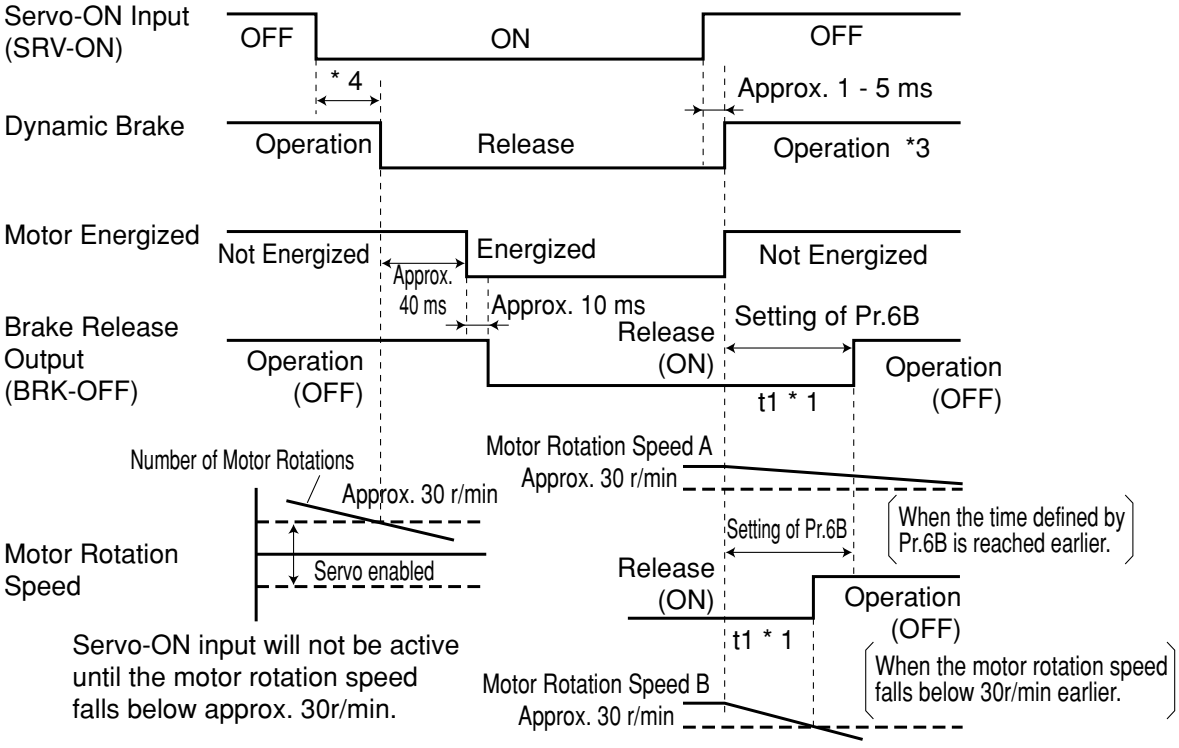
*1. A value of t1 depends on a setting of Pr6A.

*2. For the operation of the dynamic brake during Servo-OFF, also refer to the description of “Sequence during Servo-OFF” (“Parameter Settings” of every control mode) on Pr69.

*3. Servo-ON input will not be active until the motor rotation speed falls below approx. 30r/min.

Servo-ON/OFF Operation When the Motor is Rotating

(The following chart shows timing in the case of emergency stop or trip. You cannot use Servo-ON/OFF repeatedly.)



<Cautions>

*1. A value of t1 is a value of Pr6B or time needed for decreasing motor speed to approx. 30 r/min, whichever is shorter.

*2. Even if SRV-ON signal turns on again during deceleration of the motor, SRV-ON input does not become active until it stops.

*3. For operation of the dynamic brake during Servo-OFF, also refer to the description of “Sequence at Servo-OFF” (“Parameter Settings” of every control mode) on Pr69.

*4. Servo-ON input will not be active until the motor rotation speed falls below approx. 30r/min.

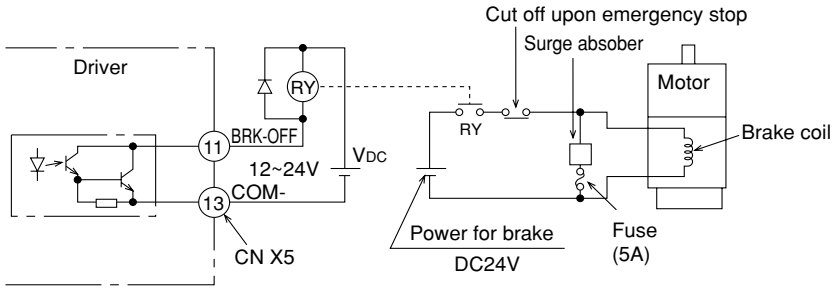
Holding Brake

The brake is to hold a work (movable part) and prevent it from dropping by gravity when power to the servo is shut off for the purpose of driving a vertical shaft in the servo motor.

<Caution> **The brake built in the servo motor is only for holding, namely, maintaining, stopped condition. Thus, you must not use it for "braking" to stop moving load.**

Wiring (Example)

This circut shows an example in which a brake release (BRK-OFF) signal from the driver is used to control the brake.



<Remarks and Cautions>

1. A brake coil has no polarity.
2. A customer is requested to provide for power supply for the brake. In addition, do not use power supply for control signals (V_{DC}) for driving the brake.
3. In order to suppress surge voltage due to ON/OFF operation of the relay (RY), install a surge absorber. When you're using a diode in place of a surge absorber, note that start of the servo motor is delayed in comparison with when the latter is used.
4. For a surge absorber for the brake, refer to "Recommended Parts" on Page 192 of Reference edition.
5. The recommended parts are those specified for measuring brake release time. In some cases, reactance of electric wires may vary depending on wire length, causing sporadic rise of voltage. Select a surge absorber so that the relay coil voltage (maximum rating: 30V, 50 mA) and voltage between brake terminals do not exceed a rated value.

BRK-OFF Signal Output Timing

- For timing of brake release upon power-on or that of brake operations in case of servo-off/alarm while the motor is rotating, refer to "Timing Chart" on Page 32.
- In case of Servo-OFF or alarm while the motor is rotating, you can set with the parameter (i.e., Pr6B: Mech. break action set-up at motor in motion) time till BRK-OFF signal turns off (i.e., the brake is actuated) after the motor is freed from energized state. For details, refer to "Parameter Settings" of every control mode.

<Remarks>

1. The servo motor with built-in brake could result in brake lining sound (Chattering, etc.) while it is running. But this is not a problem.
2. When the current is fed into the brake coil (with the brake kept released), it could result in leak magnetic flux from the shaft, etc. Be careful when a magnetic sensor, etc. are used around the motor.

Specifications of Holding Brake

Motor Series	Motor Output	Static Friction Torque (N/m)	Inertia x 10^{-4} kg•m^2	Intake Time (ms)	Release Time (ms) *1	Excitation Current DC A (during cooling)	Release Voltage	Allowable Workload per Braking J	Total Allowable Workload x 10^3J
MUMA	50W, 100W	0.29 or higher	0.003	25 or shorter	20 or shorter(30)	0.26	DC1V or higher	39.2	4.9
	200W, 400W	1.27 or higher	0.03	50 or shorter	15 or shorter (100)	0.36		137	44.1

- Excitation voltage should be DC24V ± 10%.
  *1 A value when the surge absorber is used.
  Values given in ( ) are actual values measured with diodes (V03C manufactured by HITACHI Semiconductor and Devices Sales Co., Ltd.).
- The values in the above table are representative characteristics (except static friction torque, releasing voltage, and excitation current).
- A backlash of the brake is ± 1˚ of a setup value.
- Allowable angular acceleration of MUMA series: .....10000 rad/s^2
- Service life of the number of accelerations/decelerations with the allowable angular acceleration is 10 million times or greater. (The number of accelerations/decelerations till backlash of the brake changes drastically.)

Dynamic Brake

Dynamic Brake

Dynamic brake is built in this driver for emergency stop.
For this dynamic brake observe the precautions given below.

<Notes>

1. This dynamic brake functions for emergency stop of the driver.

Don't start and stop by ON/OFF of the Servo-ON signal (SRV-ON signal). Doing so could result in rupture of the dynamic brake circuit built in the driver.

If the motor is started by an external unit, it would acts as a generator and, as a result, short current would flow while the dynamic brake is acting, which could then result in fuming and fire.

2. The dynamic brake is a short-time rating brake just for emergency stop use. If the dynamic brake acts commencing from the time of high speed running, provide a lead time of about 3 minutes after complete stop.

● This dynamic brake can be started in the following cases.

(1) Against "Servo OFF"

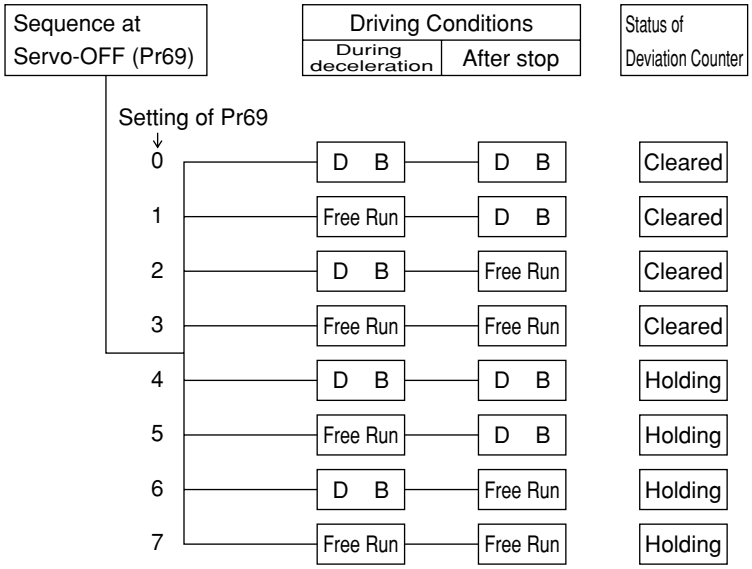
(2) When any of the protective functions actuate

(3) When the overtravel inhibit inputs (CWL, CCWL) of the connector CN X5 actuate

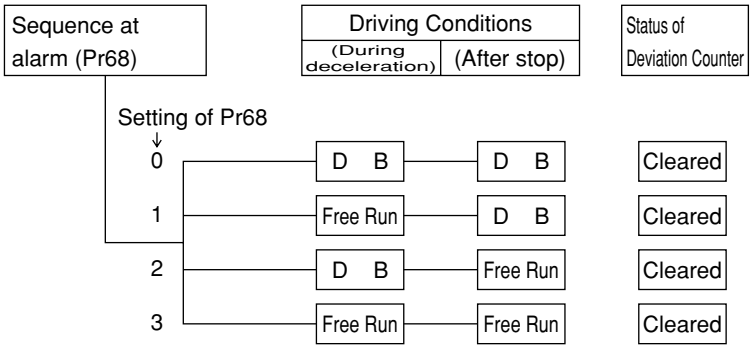
In the above cases (1) - (3), it is selectable by setting up the applicable parameters whether the dynamic brake is started or put in free running during deceleration or after complete stop.

However, the dynamic brake is kept actuating when the power is switched OFF.

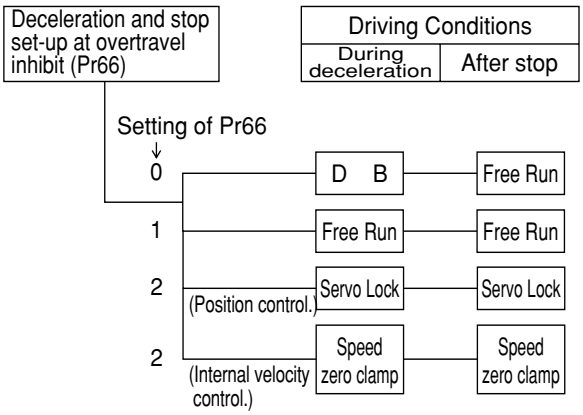
(1) Setting driving conditions through deceleration and stop by turning on Servo-OFF (Pr69)



(2) Setting of Driving Conditions from Deceleration till Stop by Turning on Protective Function (Pr68)



(3) Setting of Driving Conditions through Deceleration and Stop by Enabling Overtravel Inhibit Input (CWL, CCWL) (Pr66)



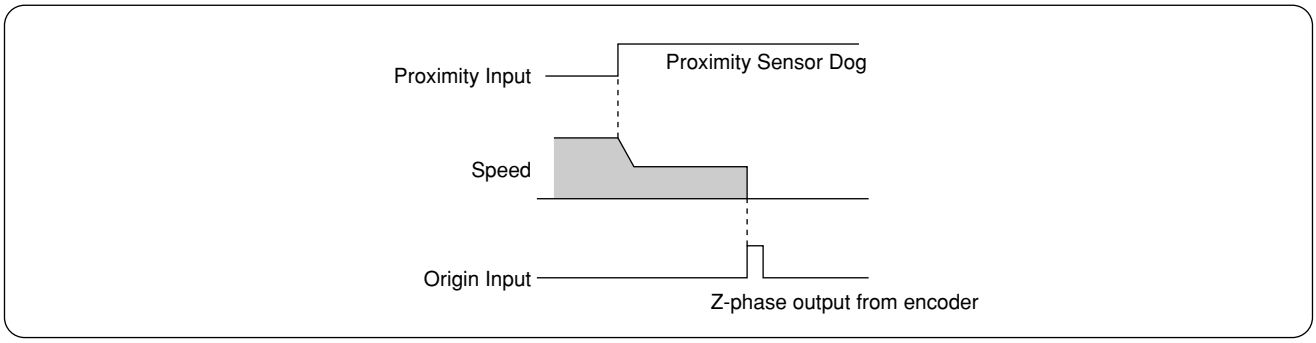
Homing Operation (Precautions)

■ In initialization (i.e., operation to return to a home position) by using the host controller, if origin input (Z-phase from the encoder) is entered before the motor has not adequately decelerated since the proximity sensor was activated, the motor may not stop at a requested position. In order to prevent this, determine positions where the proximity input and origin input turn on, by taking into consideration the number of pulses required for successful deceleration. As settings of parameters “acceleration/deceleration time” have also effects on initialization, consider both positioning and initialization when you set them.

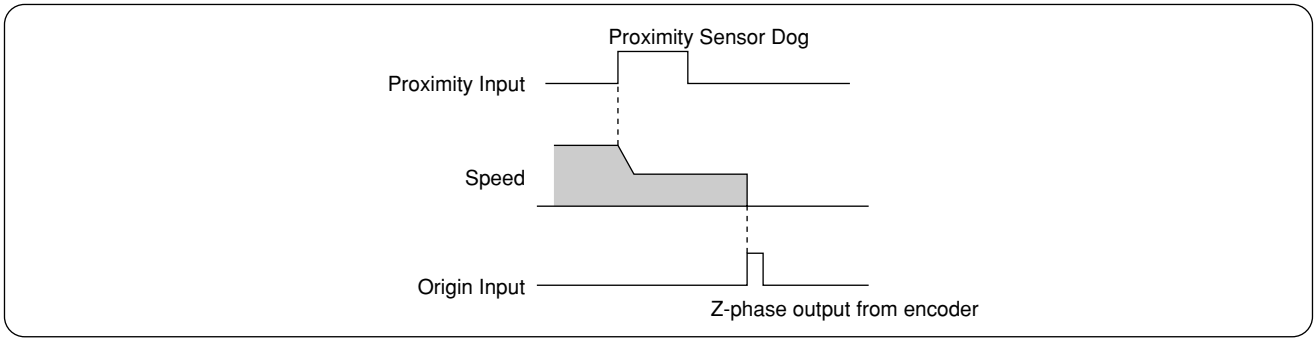
For detailed information on initialization, refer to the operating manual for the host controller.

Example of Homing Operation

Proximity dog on .... When the proximity input turns ON, the motor will start to decelerate, and stop when a first origin input (Z phase) is entered.



Proximity dog off .... When the proximity input turns ON, the motor will start to decelerate, and stop when a first origin input (Z phase) is entered after the proximity input turns off.



Overview of Parameters

The servo driver has various parameters to set up its characteristics, functions, etc. This Section describes the function and purpose of each parameter. Before using, understand well the descriptive contents and adjust each parameter to the condition optimum to your intended operational conditions.

How to Set

- Parameters can be set up on;

(1) Console
(2) the screen of personal computer (PC) wherein the setting-up support software “PANATERM®” for E-Series was installed.

<Remarks>
For how to set up the parameters on the PC screen, refer to “PANATERM®” Instruction Manual.

Overview of Console

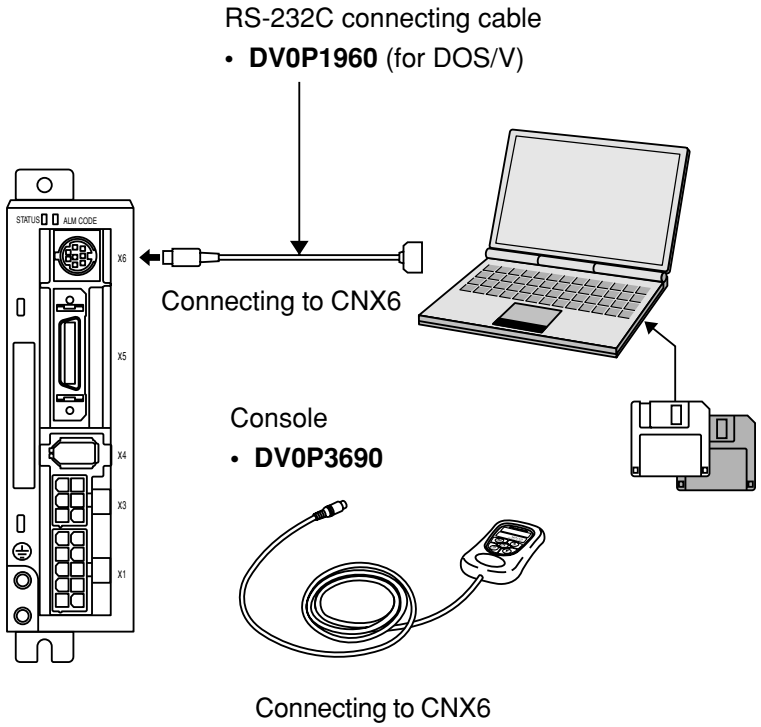
Console is able to:
(1) Monitor rotation speed, torque, positional deviation, input/output power, pulse input, load factor, etc. of servo-motors,
(2) Setup and save parameters of servo-motor drivers,
(3) Write the data into memory (EEPROM),
(4) Execute normal-auto-gain tuning,
(5) Indicate current alarms and make reference to error history,
(6) Operate test runs,
(7) Make copies of parameters and clear alarms.

Overview of PANATERM®

This PANATERM® is able to;
(1) Set up, save and write the driver parameters in the memory (EEPROM),
(2) Monitor I/O data, pulse input data and load factor,
(3) Refer to current alarm display and error history,
(4) Measure the waveform graphic data and to call the saved data,
(5) Execute auto gain tuning,
(6) Measure the frequency characteristic of the mechanical system.

Setting the Parameters

How to Connect



Setup Disk for Setting-up Support Software “PANATERM®”
- DV0P4230: Japanese version
- DV0P4240: English version

For the latest version, contact us.

<Notes>
- **Securely connect the connector with the connector CN X6 of the driver.**
- **Never insert or pull out the connector while holding a cable.**

Parameter Groups and Listing

Group	Parameter No. (Pr□□)	Briefing
Function selecting	00 - 0E	These parameters are used to select control mode, allocate I/O signals and to set up communication baud rate.
Adjustment	10 - 1E	These parameters are used to set up servo gains (1st, 2nd) of position, velocity, integration, etc. and the time constants of various filters.
	20 - 2F	These parameters related to real time auto tuning and damping function are used to set up the modes and to select mechanical stiffness.
	30 - 35	These parameters are used to set up the data related to interchange of 1st gain 2nd gain.
Position control	40 - 4E	These parameters are used to set up input form and logical selection of command pulses and dividing of encoder output pulses, and to set up the dividing multiplier ratio of command pulses, etc.
Internal velocity and torque control	53 - 59	These parameters are used to set up internal velocity (1 - 4 velocity, JOG speed), acceleration/deceleration time, etc.
	5E	This parameter is used to set up torque limit.
Sequence	60 - 6B	These parameters are used to set up the conditions for detecting output signals such as positioning end, zero speed, etc. and the conditions for corrective action against positional over-deviation. Furthermore, these are used to set up deceleration and stopping against power OFF, alarm output and servo OFF, and the conditions for clearing the deviation counter.
	70 - 73	

Setting the Parameters

Parameters for Selecting Function

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
*00	Axis address	1 - 15	1	—	P • P2 • S
*01	7-segment LED for console, initial condition display	0 - 15	1	—	P • P2 • S
*02	Control mode set up	0 - 2	2	—	P • P2 • S *1
03	(For manufacturer use)	—	0	—	—
*04	Overtravel Input inhibit	0 - 1	1	—	P • P2 • S
05	(For manufacturer use)	—	0	—	—
*06	ZEROSPD/TC input selection	0 - 2	1	—	P • P2 • S
07,08	(For manufacturer use)	—	0	—	—
09	Warning output selection	0 - 6	2	—	P • P2 • S
0A,0B	(For manufacturer use)	—	0	—	—
*0C	Baud rate set-up of RS232C	0 - 2	2	—	P • P2 • S
0D	(For manufacturer use)	—	0	—	—
0E	(For manufacturer use)	0 - 1	0	—	—
0F	(For manufacturer use)	—	0	—	—

Parameters for adjusting the time constants of gain filter

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
10	1st position loop gain	0 - 32767	<63>	1/s	P • P2
11	1st velocity loop gain	1 - 3500	<35>	Hz	P • P2 • S
12	1st velocity loop integration time constant	1 - 1000	<16>	ms	P • P2 • S
13	1st speed detection filter	0 - 5	<0>	—	P • P2 • S
14	1st torque filter time constant	0 - 2500	<65>	0.01ms	P • P2 • S
15	Velocity feed forward	–2000 - 2000	<300>	0.1%	P • P2
16	Feed forward filter time constant	0 - 6400	<50>	0.01ms	P • P2
17	(For manufacturer use)	—	0	—	—
18	2nd position loop gain	0 - 32767	<73>	1/s	P • P2
19	2nd velocity loop gain	1 - 3500	<35>	Hz	P • P2 • S
1A	2nd velocity loop integration time constant	1 - 1000	<1000>	ms	P • P2 • S
1B	2nd speed detection filter	0 - 5	<0>	—	P • P2 • S
1C	2nd torque filter time constant	0 - 2500	<65>	0.01ms	P • P2 • S
1D	1st notch frequency	100 - 1500	1500	Hz	P • P2 • S *1
1E	1st notch width selection	0 - 4	2	—	P • P2 • S
1F	(For manufacturer use)	—	0	—	—
26	Software limit function	0 - 1000	10	0.1 rev	P • P2
27 - 2A	(For manufacturer use)	—	0	—	—
2B	Damping frequency	0 - 5000	0	0.1Hz	P • P2 *1
2C	Damping filter setting	–200 - 2500	0	0.1Hz	P • P2

Parameters for Auto Gain Tuning

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
20	Inertia ratio	0 - 10000	<100>	%	P • P2 • S
21	Real time auto tuning set-up	0 - 7	1	—	P • P2 • S *1
22	Machine stiffness at auto turning	0 - 15	4	—	P • P2 • S
23,24	(For manufacturer use)	—	0	—	—
25	Normal auto tuning motion set-up	0 - 7	0	—	P • P2 • S
2D,2E	(For manufacturer use)	—	0	—	—
2F	Adaptive filter frequency	0 - 64	<0>	—	P2 *1

Parameters for Adjustment for 2nd Gain

P: High velocity response positioning control, P2: High function positioning control, S: Internal velocity control

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
30	**2nd gain action set-up**	0 - 1	<1>	—	P • P2
31	**Position control switching mode**	0 - 10	<10>	—	P • P2
32	**Position control switching delay time**	0 - 10000	<30>	166μs	P • P2
33	**Position control switching level**	0 - 20000	<50>	—	P • P2
34	**Position control switching hysteresis**	0 - 20000	<33>	—	P • P2
35	**Position loop gain switching time**	0 - 10000	<20>	Setup value × 166μs	P • P2
36 - 3F	**(For manufacturer use)**	—	0	—	—

- ***-marked parameter No. in the above table is validated by writing the parameter No. in EEPROM after set up and re-switching ON the power after once switched OFF.**

<Note>

- **The parameters which of "standard default value" is enclosed with < > vary automatically with execution of the real time auto tuning function. For adjusting in MANUAL mode, set Pr21 real time auto tuning set-up to "0" (invalidated).**

<Remarks>

***1**

Parameter No. (Pr□□)	Parameter description	High velocity response positioning control: P	High function positioning control: P2	Internal Velocity Control: S
02	Control mode set-up	0	2	1
1D	1st notch frequency	Conditional *2	Validated	Conditional *2
2B	Damping frequency	Conditional *2	Validated	Invalidated
21	Real time auto tuning set-up	Conditional *2	Validated	Conditional *2
2F	Adaptive filter frequency	Invalidated	Validated *3	Invalidated

***2** In "High Velocity Response Positioning Control" and "Internal Velocity Control" modes, simultaneous use of the first notch frequency, damping frequency and real time auto tuning set-up is not allowed, and any one of parameters (functions) can only be used. By priority a parameter that is entered first will be validated.
(Ex.) By setting "Real time auto tuning" parameter, 1st notch frequency is set compulsorily to 1500 (Invalidated) at the driver side even it was input.

***3** An adaptive filter is only validated in high function positioning control mode.

Setting the Parameters

Parameters for Positioning Control

P: High velocity response positioning control, P2: High function positioning control, S: Internal velocity control

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
*40	Command pulse multiplier set-up	1 - 4	4	—	P • P2
*41	Command pulse direction of rotation set-up	0 - 3	0	—	P • P2
*42	Command pulse input mode set-up	0 - 3	1	—	P • P2
43	(For manufacturer use)	—	0	—	—
*44	Output pulses per single turn	1 - 16384	2500	P/r	P • P2 • S
*45	Pulse output logic inversion	0 - 1	0	—	P • P2 • S
46	Numerator of 1st command pulse ratio	1 - 10000	10000	—	P • P2
47	Numerator of 2nd command pulse ratio	1 - 10000	10000	—	P • P2
48,49	(For manufacturer use)	—	0	—	—
4A	Multiplier of numerator of command pulse ratio	0 - 17	0	2^n	P • P2
4B	Denominator of command pulse ratio	1 - 10000	10000	—	P • P2
4C	Smoothing filter set-up	0 - 7	1	—	P • P2
4D	(For manufacturer use)	—	0	—	—
*4E	FIR filter set-up	0 - 31	0	(Setup value + 1) cycles	P • P2
4F	(For manufacturer use)	—	0	—	—

- ***-marked parameter No. in the above table is validated by writing the parameter No. in EEPROM after set up and re-switching ON the power after once switched OFF.**

Parameters for Velocity Control and Torque Limit

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
50 - 52	(For manufacturer use)	—	0	—	—
53	1st internal speed set-up	–20000 - 20000	0	r/min	S
54	2nd internal speed set-up	–20000 - 20000	0	r/min	S
55	3rd internal speed set-up	–20000 - 20000	0	r/min	S
56	4th internal speed set-up	–20000 - 20000	0	r/min	S
57	JOG internal speed set-up	0 - 500	300	r/min	P • P2 • S
58	Acceleration time set-up	0 - 5000	0	2ms/(1000r/min)	S
59	Deceleration time set-up	0 - 5000	0	2ms/(1000r/min)	S
5A - 5D	(For manufacturer use)	—	0	—	—
5E*1	1st torque limit set-up	0 - 500	See next page	%	P • P2 • S
5F	(For manufacturer use)	—	0	—	—

***1 : Each standard default setup value in Pr5E differs depending on combination of driver and motor. Refer to "Pr5E 1st Torque Limit Set-up" on next page, too.**

Pr5E 1st Torque Limit Set-up

Driver power	Motor model	Parameter 5E standard default setup value
1-phase 100V	MUMA5AZP1□	300
	MUMA011P1□	
	MUMA021P1□	330
1-phase/ 3-phase 200V	MUMA5AZP1□	300
	MUMA012P1□	
	MUMA022P1□	330
	MUMA042P1□	

- Pr5E 1st torque limit can't be set up in excess to the value that was set up before shipping, under "Maximum Torque Setting" of the system parameters. The setup value under "Maximum Torque Setting" is the same as the standard default setup value.
- The system parameters are those before shipping from the shop which can't be changed in PANATERM® and the console.

<Note>

Where the motor model was changed, the maximum value of Pr5E may vary eventually. Therefore, recheck the setup value and re-set it as necessary.

Notes in Replacing Motor

The upper limit value of Pr5E 1st torque limit setting-up range is automatically decided by connecting the motor to the driver. Therefore, Pr5E setup value must be rechecked when replacing the motor.

1. When replacing the current motor with motor of the same model

Pr5E 1st torque limit value to be set up after motor replacement is the value that has been written in the driver before the replacement. Particularly, the setup value needs no change.

Ex.) **Before replacing motor** **After having replaced**

50W motor had been used with 100-% torque limit. → In the case the current 50W motor is replaced with another 50W motor of the same output capacity, Pr5E setup value remains unchanged as 100-% torque limit.

2. When limiting motor torque

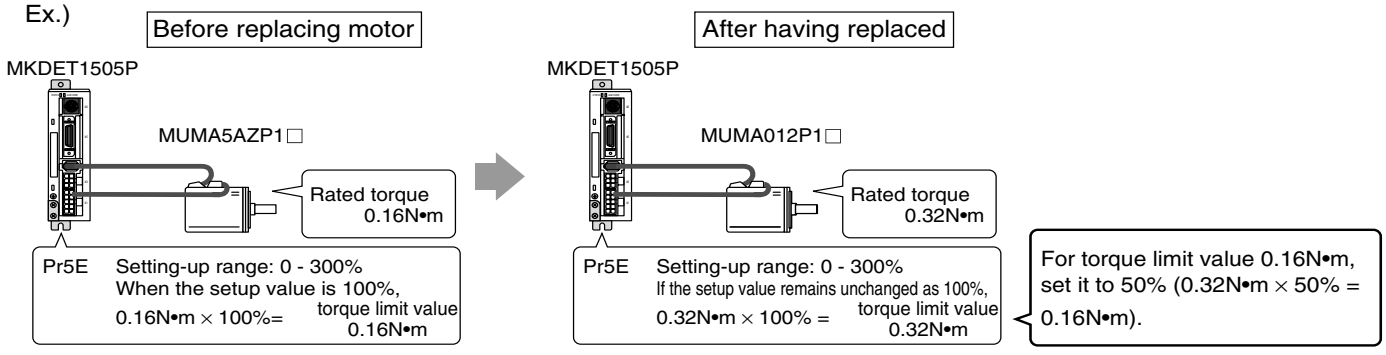
Pr5E 1st torque limit is set up at percentile (%) value against the rated torque. In the case the current motor was replaced with another motor different from it in the motor series or W-number, Pr5E setup value must be re-set up because the rated torque value differs from that of the motor before being replaced.

Ex.) **Before replacing motor** **After having replaced**

50W motor had been used with 100-% torque limit. → In the case the current motor is replaced with 100W motor, must be re-set at 100-% torque limit to 100W motor.

When limiting 100W motor torque with the same torque as 50W motor, set up the Pr5E 1st torque limit at 50.

Ex.)



Setting the Parameters

Parameters for Sequence

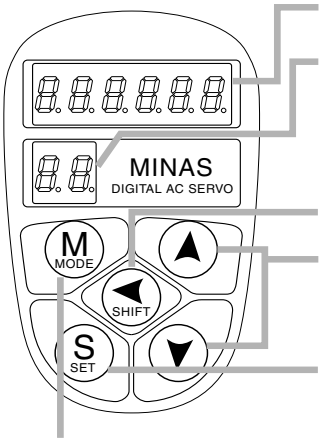
P: High velocity response positioning control, P2: High function positioning control, S: Internal velocity control

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
60	**In-position range**	0 - 32767	10	Pulse	P • P2
61	**Zero speed**	0 - 20000	50	r/min	P • P2 • S
62	**At-speed**	0 - 20000	1000	r/min	S
63	**1st position over-deviation set-up**	1 - 32767	1875	256Pulse	P • P2
64	**Position over-deviation invalidation**	0 - 1	0	—	P • P2
65	**(For manufacturer use)**	—	0	—	—
***66**	**Deceleration and stop set-up at overtravel inhibit**	0 - 2	0	—	P • P2 • S
67	**(For manufacturer use)**	—	0	—	—
68	**Sequence at alarm**	0 - 3	0	—	P • P2 • S
69	**Sequence at Servo-OFF**	0 - 7	0	—	P • P2 • S
6A	**Mech. break action set-up at motor standstill**	0 - 100	0	2ms	P • P2 • S
6B	**Mech. break action set-up at motor in motion**	0 - 100	0	2ms	P • P2 • S
6C	**External regenerative discharge resister selection**	0 - 3	3	—	P • P2 • S
6D	**(For manufacturer use)**	—	0	—	—
6E - 6F	**(For manufacturer use)**	—	0	—	—

Pr63 position over-deviation is set up at the over-deviation detection value of "setup value x 256pulses". The default setup value would result in position over-deviation error if the value of "1875 x 256pulses" is exceeded.

Parameter No. (Pr□□)	Parameter description	Range	Default	Unit	Related control mode
70	**1st over-speed level set-up**	0 - 6000	0	r/min	P • P2 • S
71	**2nd torque limit set-up**	0 - 500	0	%	P • P2 • S
72	**2nd position over-deviation set-up**	1 - 32767	1875	256Pulse	P • P2
73	**2nd over-speed level set-up**	0 - 6000	0	r/min	P • P2 • S

Using the Console



Display, LED (display in 6 digits)

Display of selected Driver **ID No.** (2 digits)
The value set up on Pr00 (shaft name) is ID No.
Parameter No. (2 digits) is displayed under “Parameter Setting” mode.

This is used to shift the digits of data to be changed.

This is used to change the data and to execute parameter selection.
The numerical value increments by pressing Ⓐ,
and it decrements by pressing Ⓥ.

Setting Button: This is to shift each mode, which was selected by the mode selector button, to "EXECUTE" display.

Mode Selector Buttons: These buttons are used to select 6 different modes.

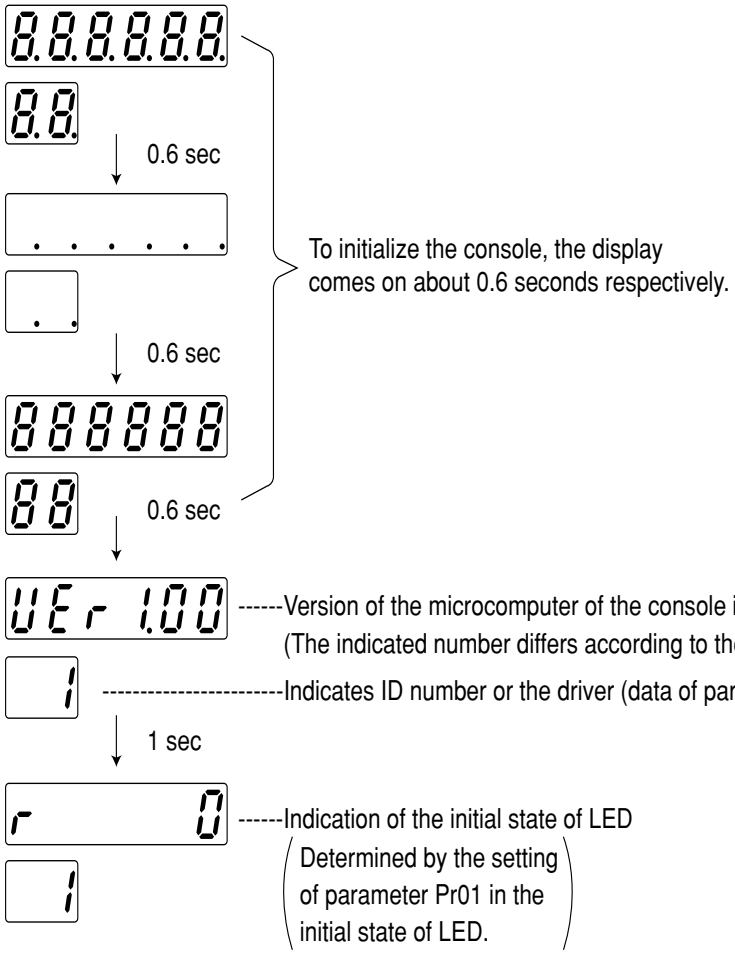
(1) MONITOR mode
(2) PARAMETER SETTING mode
(3) EEPROM WRITE mode
(4) NORMAL AUTO GAIN TUNING mode
(5) AUXI FUNCTION mode
- Test run (JOG mode)
- Alarm clear

(6) COPING FUNCTION mode
- To copy parameters from the servo driver to the console.
- To copy parameters from the console to the servo driver.

In parameter setting, set data after switching to parameter set mode.

The Initial State of the Display (7-Segment LED)

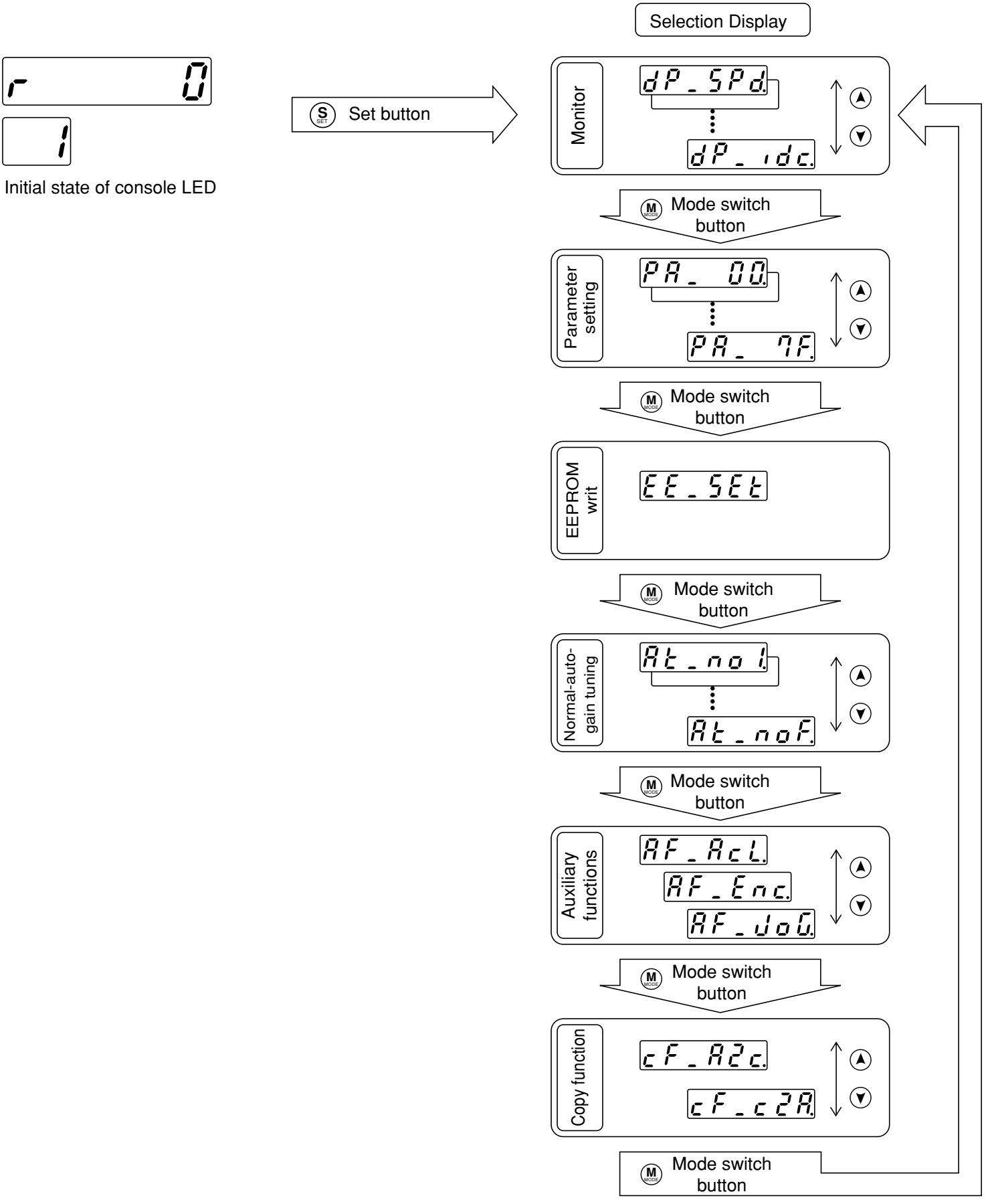
Turn on the driver with the console connector connected to the driver, or connect the console connector to connector CN X6.

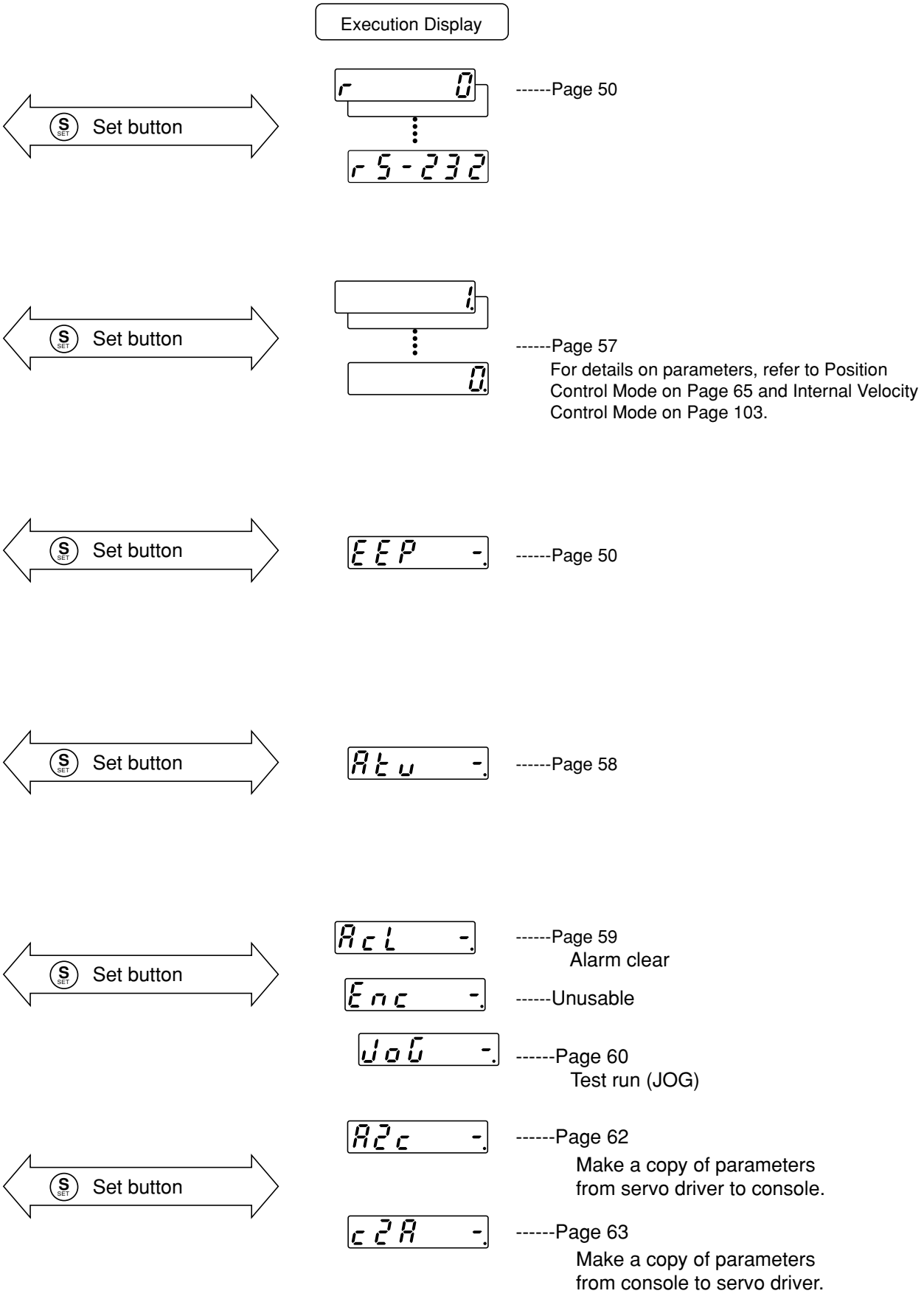


Using the Console

Structure of Each Mode

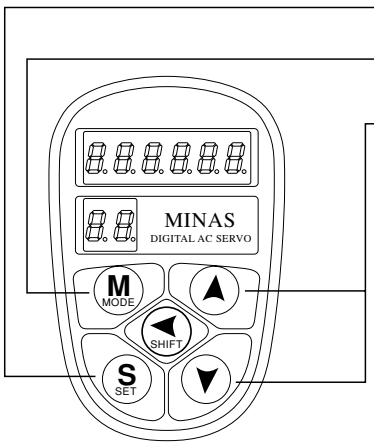
The structure of each mode and the mode switching procedure can be changed with each button on the operation panel.




Execution Display
Set button
r 0
r5-232
------Page 50
Set button
1.
0.
------Page 57
For details on parameters, refer to Position Control Mode on Page 65 and Internal Velocity Control Mode on Page 103.
Set button
EEP -.
------Page 50
Set button
Atu -.
------Page 58
Set button
AcL -.
------Page 59
Alarm clear
Enc -.
------Unusable
JoG -.
------Page 60
Test run (JOG)
A2c -.
------Page 62
Make a copy of parameters from servo driver to console.
c2A -.
------Page 63
Make a copy of parameters from console to servo driver.

Using the Console

Example of Settings



(1) Insert the connector of console into CN X6 of the driver, and then turn on the power of the driver. → `r 0`

Setting parameters:

(2) Press (S SET). → `dP_SPd`

(3) Press (M MODE). → `PA_ 00.`

(4) Select the parameter to be set with (▲) and (▼). → `PA_ 10.`

(5) Press (S SET). → `50.`

(6) Change the value with (SHIFT), (▲), and (▼). → `100.`

(7) Press (S SET). → `PA_ 10.`

Starting EEPROM write:

(8) Press (M MODE). → `EE_SEt`

(9) Press (S SET). → `EEP -.`

(10) Keep pressing (▲) (about 5 seconds). Then, the number of bars increases as shown on the right. → `EEP --.` → `------.`

Start of write (indicated momentarily.) → `StArt`

End → `FinISh.` (Write finishes.) / `rESEt.` / `Error.` (Write error occurs.)

After finishing write, return to Selection Display referring to “Structure of Each Mode” (Page 48 and 49).

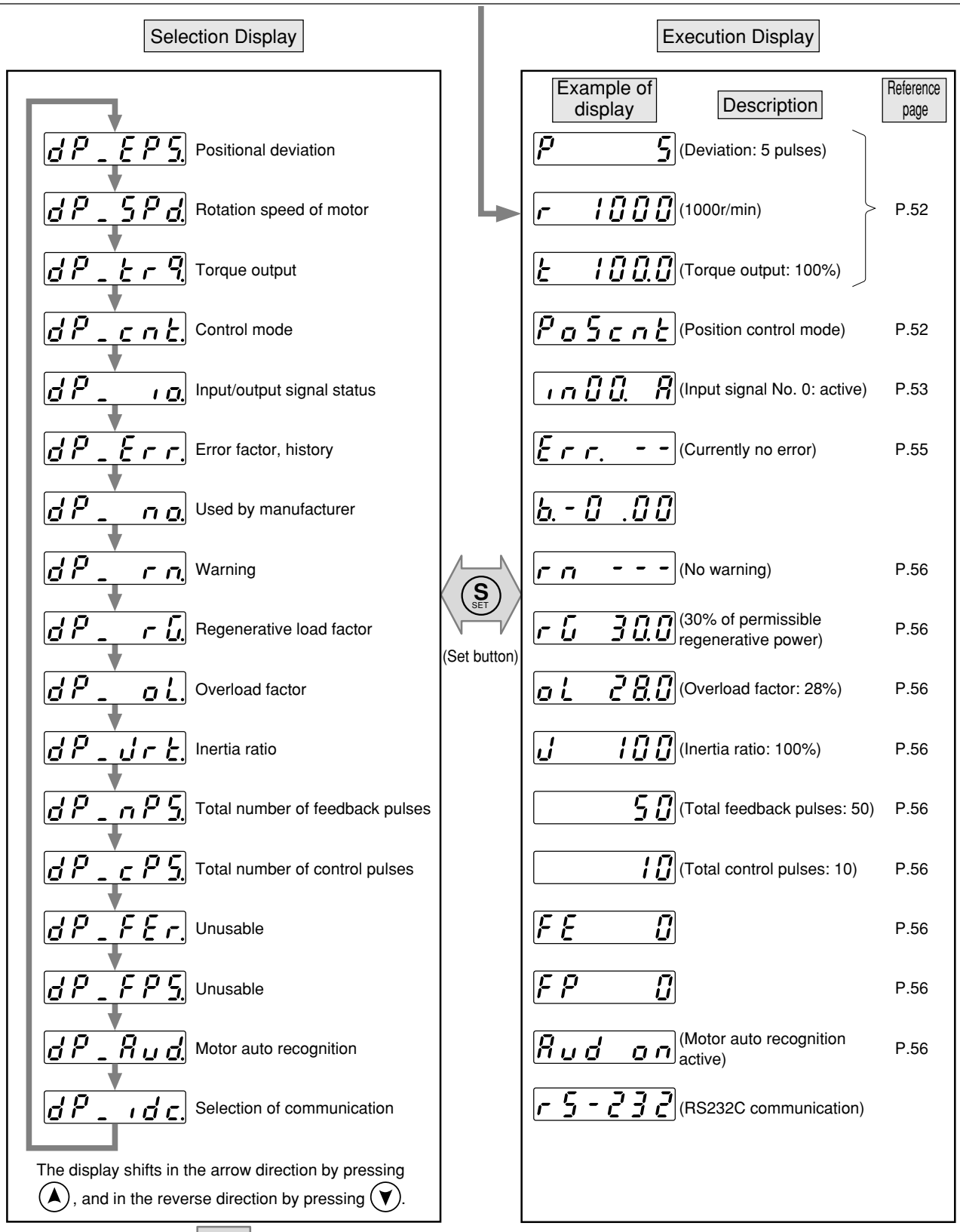
<Notes>

When the parameters that become active after they are reset have been changed, `rESEt.` appears on completion of the write. Once turn off power for the console to reset them.

- If any data write error has occurred, write the data again. If the write error occurs repeatedly, the console may be in failure.
- Do not turn off power while writing data into EEPROM. Otherwise, some false data may be written in the EEPROM. If such an erroneous operation were made, setup all the parameters again, and after thoroughly checking the settings, write the data again.
- Do not disconnect the console connector from the servo driver during the proceeding from `StArt` to `FinISh.`. If the connector is disconnected during the time by any chance, connect the connector again, and restart the operation from the beginning.

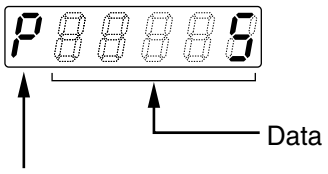
Monitoring Mode

When power of the servo driver is turned on for the first time after the driver is purchased, r 0 appears on the display (when the motor is stopped). If the indication on the display that appears after turning on power is to be changed, change the initial setting of Pr01LED. For the details, refer to the parameter setting in each control mode.



Using the Console

Display of positional deviation, rotation speed of motor, and torque output



P ••••••• Positional deviation (cumulative number of pulses counted by deviation counter)

- Indication with "-" : Rotation torque is generated in CW direction viewed from the end of axis.
  Without "-" : Rotation torque is generated in CCW direction viewed from the end of axis.

r ••••••• Rotation speed of motor [r/min]

- Indication with "-": CW rotation, Without "-": CCW rotation

t ••••••• Torque output [%] (Rated output: 100%)

- Indication with "-": CW rotation, Without "-": CCW rotation

<Remarks>

"+" is not indicated with LED. Only "-" is indicated.

Display of control mode

PoScnt ••••••• Position control mode
(High velocity response positioning control made, High function positioning control mode)

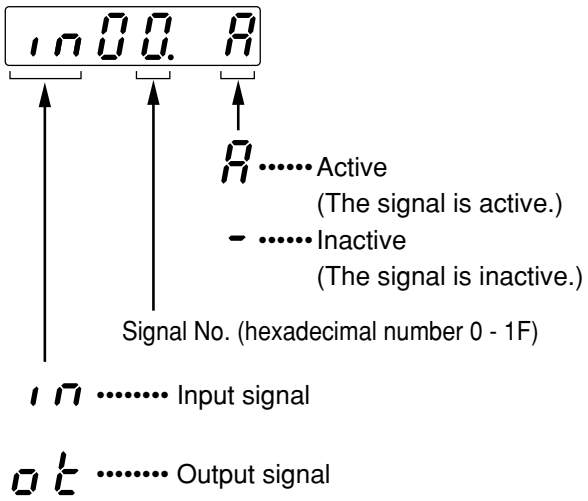
SPdcnt ••••••• Velocity control mode
(Internal velocity control mode)

<Remarks>

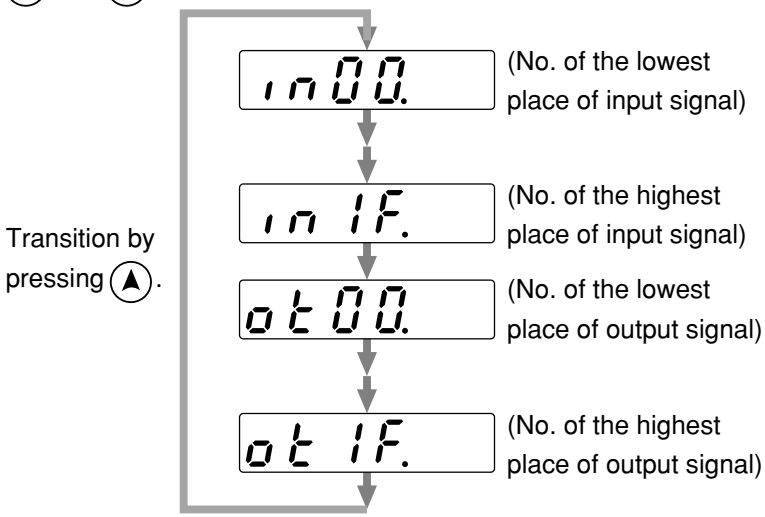
Both high velocity response positioning control and high function positioning control are indicated as PoScnt. To discriminate between them, check the setting value of Pr02 control mode.

Display of input/output signal status

The status of control input/output signal connected with connector CN X5 is displayed.
Make use of this display to check the quality of wiring and for other purposes.

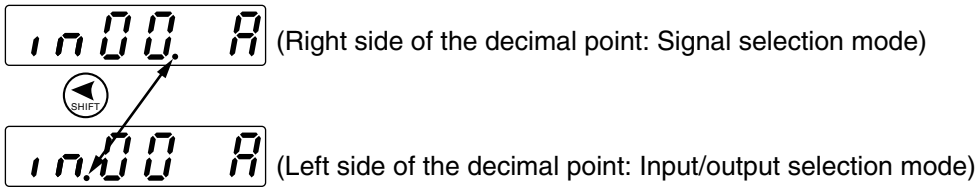


Select no. of the signal to be monitored by pressing ▲ and ▼.

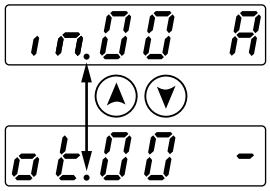


<Remarks>

- The blinking decimal point is shifted by pressing SHIFT.



- Signal No. can also be changed with input/output mode as follows:



Correspondence between signal no., signal name, and signal status

● Input signals

Connector CN X5				Description
Signal no.	Signal name	Designation	Pin no.	
00	Servo-ON	$\overline{\text{SRV-ON}}$	2	When Servo-ON signal is connected (turned on), A is indicated.
01	Alarm clear	$\overline{\text{A-CLR}}$	3	When alarm clear signal is connected (turned on), A is indicated.
02	CW overtravel inhibition	CWL	7	When the overtravel inhibit input, Pr04 is inactive (set to 1), - is indicated. When it is active (set to 0), that is, the signal input is open (off), A is indicated and any torque is not generated.
03	CCW overtravel inhibition	CCWL	8	
04	For manufacturer use			
05	Zero speed clamp	ZEROSPD	5	When ZEROSPD/TC input selection, Pr06 is active (set to 1), the motor stops with the signal open (off) and A is indicated.
06	First command division/ multiplication switching	$\overline{\text{DIV}}$	6	When the signal is connected (turned on), A is indicated and the second command division/multiplication numerator is brought in.
07 - 08	For manufacturer use			
09	Gain switching	$\overline{\text{GAIN}}$	5	When 2nd gain action set-up Pr30 is set to 0 and gain switching signal is open (off), Pl operation (proportion and integration) is performed and - is indicated.
0A	Deviation counter clear	$\overline{\text{CL}}$	4	Used in clearing deviation counter, and A is indicated when the signal is connected (turned on).
0B	For manufacturer use			
0C	Internal command speed selection 1	$\overline{\text{INTSPD1}}$	6	When the signal is connected (turned on), A is indicated.
0D	Internal command speed selection 2	$\overline{\text{INTSPD2}}$	4	
0E - 0F	For manufacturer use			
10 - 1F	For manufacturer use			

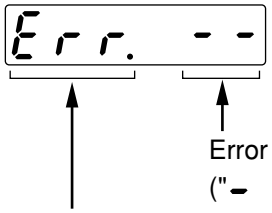
● Output signals

Connector CN X5				Description
Signal no.	Signal name	Designation	Pin no.	
00	For manufacturer use			
01	Servo alarm	ALM	9	When servo alarm occurs, output transistor comes off and A is displayed.
02	Positioning completion	$\overline{\text{COIN}}$	10	When number of deviation pulses comes in the in-position range Pr60, A is indicated.
03	Brake release	$\overline{\text{BRK-OFF}}$	11	When output transistor for electromagnetic brake release signal is turned on, A is indicated.
04	Zero speed detected	$\overline{\text{ZSP}}$	12	When signal output selected by warning output selection Pr09 turns on the transistor, A is indicated.
05	Torque limited	$\overline{\text{TLC}}$	12	
06 - 08	For manufacturer use			
09	Achieved speed	$\overline{\text{COIN}}$	10	When actual speed of motor exceeds achieved speed set by Pr62, the transistor is turned on and A is indicated.
0A - 1F	For manufacturer use			

<Remarks>

The signals of connector CN X5 that have $\overline{}$ attached on them are active when they are L (ON).

Referring to error factors and error history



- It is possible to review the factors of the past 14 errors including current error. Select the error to be reviewed by pressing ▲ and ▼.

<Note>

- The following errors are not recorded in the error history:
  - 11: Power voltage shortage protection
  - 36: EEPROM parameter error protection
  - 37: EEPROM check code error protection
  - 38: Driving Prohibit input protection
  - 95: Motor auto recognition error protection
  - 96: LSI setup error protection
- When an error to be recorded in the history occurs, both the current error and history 0 have same error code No. indicated.
- When an error occurs, the error display blinks.

■ Relation between error code no. and error factor

Error code no.	Error factor
11	Power voltage shortage protection
12	Over-voltage protection
14	Over-current and ground fault protection
15	Internal resistor heating protection
16	Overload protection
18	Regenerative resistor overload protection
21	Encoder communication error protection
23	Encoder communication data error protection
24	Position over-deviation protection
26	Over-speed protection
27	Command pulse multiplier error protection
29	Deviation counter overflow protection

Error code no.	Error factor
34	Software limit protection
36	EEPROM parameter error protection
37	EEPROM check code error protection
38	Overtravel inhibit input protection
44	ABS 1-rotation counter error protection
45	ABS multi-rotation counter error protection
48	Encoder Z-phase error protection
49	Encoder CS signal error protection
95	Motor auto recognition error protection
96	LSI setup error protection
Other No.	Other trouble and error

Using the Console

Warning display

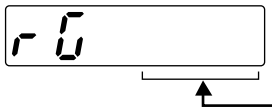
- ····· No occurrence of warning A ····· Occurrence of warning

Warning of overload: Load has exceeded 85% of the level where overload protection alarm occurs.

Warning of regenerative overload:
Regenerative load has exceeded 85% of the level where regenerative overload protection alarm occurs. When externally added regenerative resistor, Parameter No. 6C, is selected to be "1", the alarm is set to occur at 10% of the full working level of the regenerative resistor.

For manufacturer use : Can not be used.

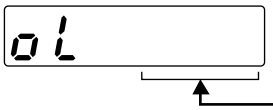
Display of regenerative load factor



Regenerative resistor load factor is indicated as a percentage with reference to 100% level where regenerative protection is activated.

With externally added resistor, this display is active when parameter Pr6C is set to "0" or "1".

Display of overload factor



Load factor is indicated as a percentage with reference to the rated load 100%.

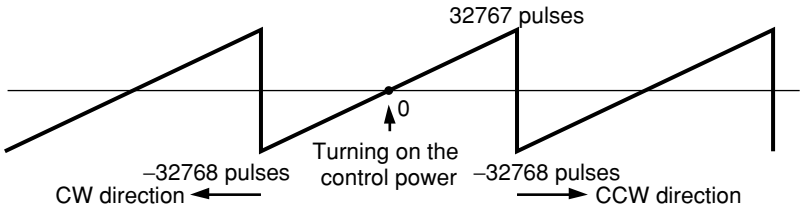
See also "Overload Protection Time-limiting Characteristics" on Page 146.

Display of inertia ratio

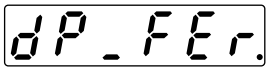
Inertia ratio is indicated in percent.

Display of total number of feedback pulses and total number of control pulses

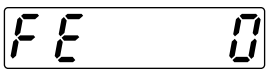
Total number of the pulses after turning on the control power. This display overflows as shown on the right.

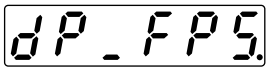


The indicated total pulse number can be reset (comes to 0) by pressing (S SET) about 5 seconds or more.

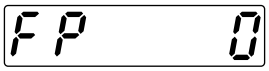


•••Can not be used.

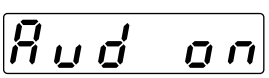




•••Can not be used.



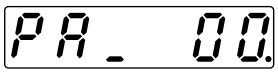
Auto recognition of motor



Auto recognition is active (always indicated as shown on the left).

Parameter Setting Mode

Operations with Selection Display

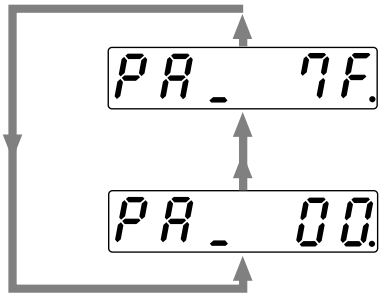
Bring in the display of parameter setting mode 

by pressing (M MODE) once after pressing (S SET) in the initial state of LED.

Parameter No. (hexadecimal)

<Note>
The parameters in which "r" is indicated in this place are made active after they are changed and written into EEPROM and then power is once turned off.

Select the number of the parameter to be referred to or to be set by pressing (▲) or (▼).



In the arrow direction by pressing (▲).

In the reverse direction by pressing (▼).

Operation with Execution Display

Reveal execution display 

by pressing (S SET).

The number of the place accompanied by blinking decimal point can be changed.

Value of the parameter

<Remarks>
Number of shifts to the upper place of the decimal point depends on each of the parameters.

(1) By pressing (◀ SHIFT), shift the decimal point to the place where the number is to be changed.

(2) Set the value of the parameter by pressing (▲) or (▼).
The value increases by pressing (▲) and decreases by pressing (▼).

After setting parameters, return to Selection Display by referring to "Structure of Each Mode". (Page 48 and 49).

<Notes>
After you change a parameter value and press (S SET), the changed content is reflected in the associated control. When a parameter having a significant effect on motion of the motor, especially motor velocity loop gain, positional loop gain, etc., is to be changed, do not change the value by a large quantity at one time, but change the value in small increments.

Using the Console

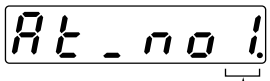
Normal Auto Gain Tuning Mode

<Notes>

- For details on normal auto gain tuning function, refer to “Normal Auto Gain Tuning” on Page 132 of Adjustment edition. Especially, please thoroughly understand the scope and cautions described in the manual to use the auto gain tuning function.
- In the normal auto gain tuning mode the driver automatically drives the servo-motor in a predetermined operating pattern. The operating pattern can be changed with Pr25 (normal auto tuning motion set-up), but be sure to execute normal auto gain tuning after moving the load to the position where the motor can be driven in the changed operating pattern without any hitch.
- **Execute the normal auto gain tuning after switching on the servo.**

Operations with Selection Display

Bring in the normal auto gain tuning mode display



by pressing (S SET) once and then (M MODE) three times in the initial state of LED.

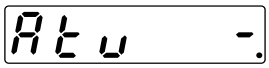
Mechanical stiffness no.

Select mechanical stiffness no. by pressing (▲) and (▼).

<Remarks>
For mechanical stiffness No., see Page 134.

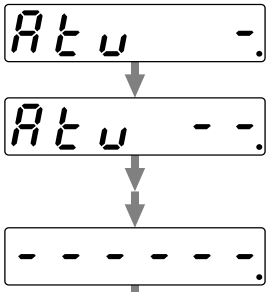
Operation with Execution Display

Reveal execution display



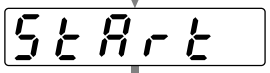
by pressing (S SET).

Switch on the servo after inhibiting entry of command input, and then keep pressing (▲) until the LED display of the console is changed to “StArt”



Keeping pressing (▲) (about 5 seconds) increases number of “ - ” as shown left.

Motor start



<Remarks>
Write the gain value into EEPROM so that the value may not be lost with power off.

Finish

Tuning has completed

Tuning error

After finishing the tuning, return to Selection Display referring to “Structure of Each Mode” (Page 48 and 49).

<Notes>

Do not disconnect the console cable from the servo driver during the proceeding from StArt to Finish.

If the connector is disconnected (during the time) by any chance, connect the connector again, and restart the operation from the beginning.

<Remarks>

If any of the followings takes place during the tuning operation, it will cause a tuning error:

(1) During the tuning operation: 1) Any failure occurs, 2) The servo is switched off, 3) The deviation counter is cleared, 4) The operation is made near the limit switch.
(2) The inertial or load is too heavy and the output torque is saturated.
(3) The tuning operation can not be carried out properly because some oscillation of the servo occurs.

If a tuning error occurs, value of each gain is brought back to the value that was assigned before the execution of the tuning. The tuning is not tripped except when some failure occurs. In some occasions depending on the load, oscillation of the servo may occur without indication of tuning error (“Error .” is not displayed). Therefore, great attention must be given to safety of the operation.

Alarm Clear

The motor stop condition (trip condition) is cleared by the protective function.

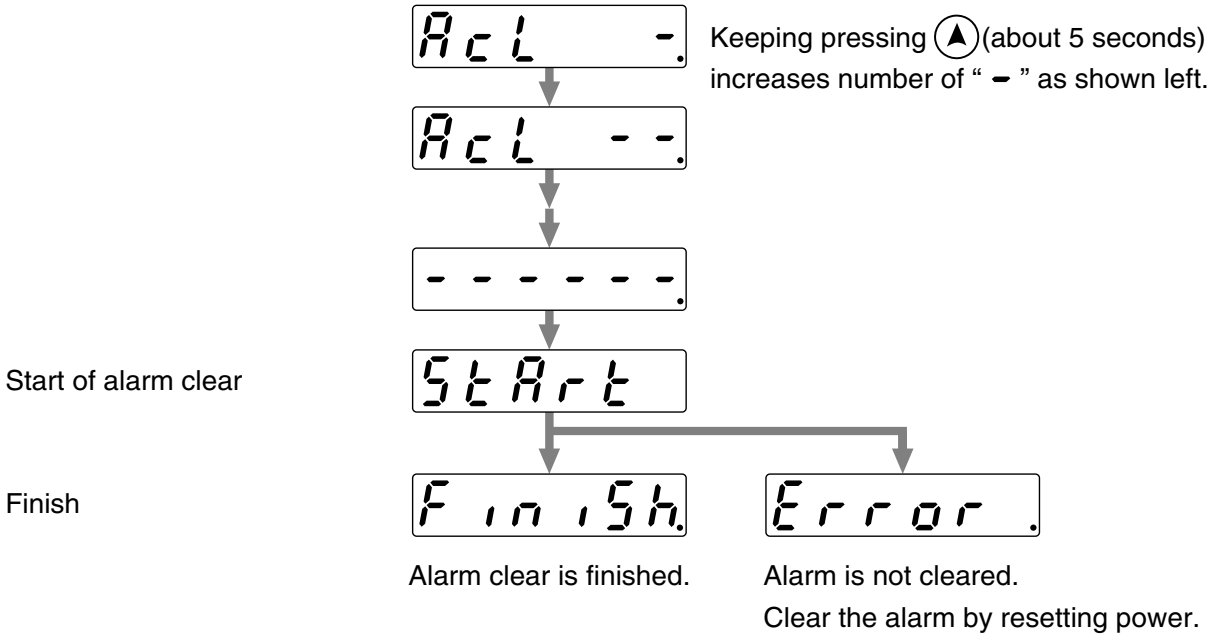
Operations with Selection Display

Enter the auxiliary function mode by pressing (S SET) once and (M MODE) four times in the initial state of LED, and then bring in AF_AcL. by pressing (▲) and (▼).

Operation with Execution Display

Reveal execution display AcL -. by pressing (S SET).

Keep pressing (▲) until the LED display of the console is changed to "StArt".



After clearing the alarm, return to Selection Display referring to “Structure of Each Mode” (Page 48 and 49).

<Notes>

Do not disconnect the console cable from the servo driver during the proceeding from StArt to Finish. If the connector is disconnected during the time by any chance, connect the connector again, and restart the operation from the beginning.

Using the Console

Test Run (JOG)

It is possible to make test runs without connecting any host controller such as PLC to connector CN X5.

<Note>

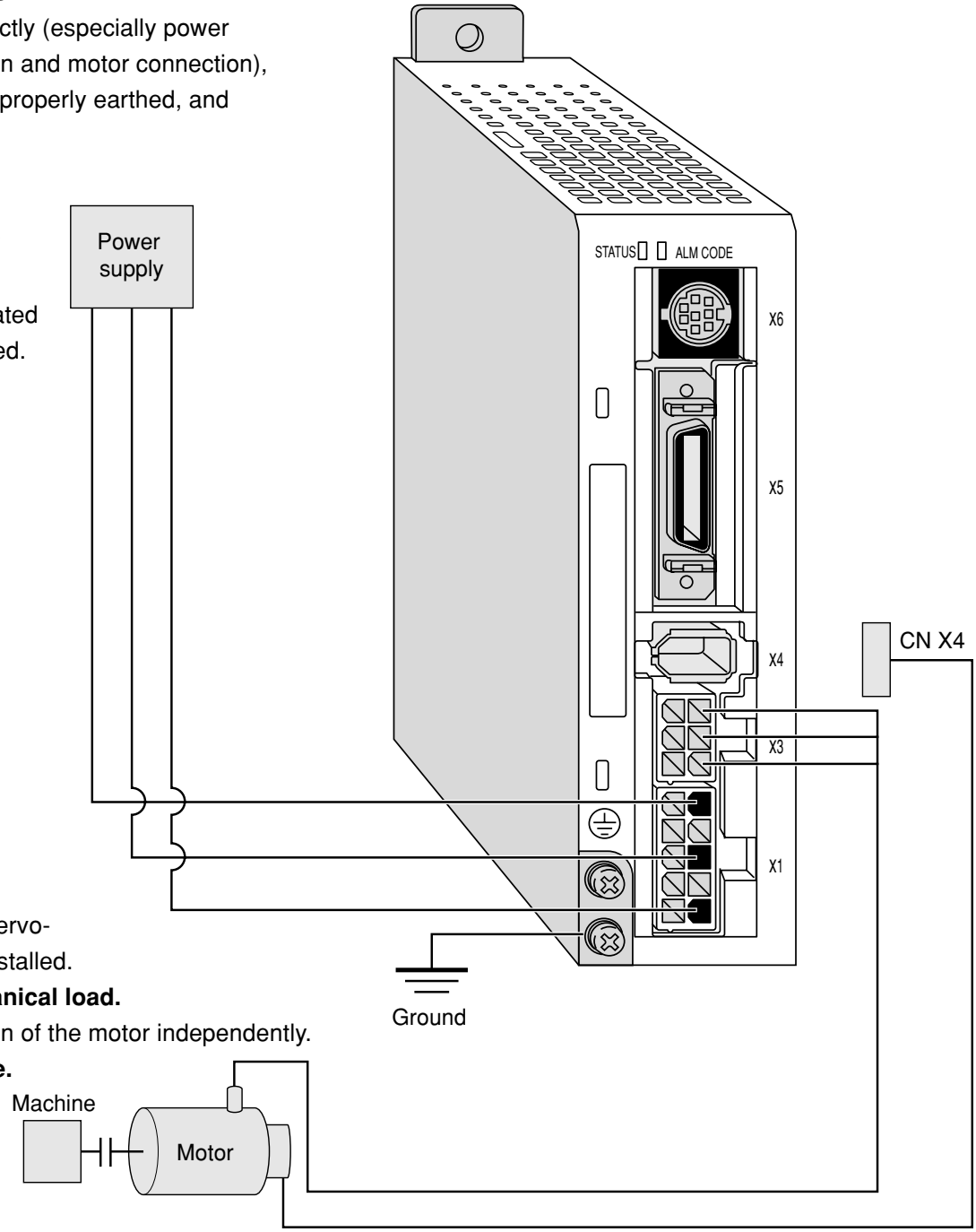
- Be sure to make test runs after isolating the motor from the load and disconnecting connector CN X5.
- To avoid any failure such as oscillation of the servo, reset the user parameters (especially, the 1st position loop gain Pr10 and the 1st velocity loop gain Pr11) to their default value.

(1) Check the wirings:

- Connected correctly (especially power supply connection and motor connection),
- Not shorted and properly earthed, and
- Not loose.

(2) Check the supply voltage:

- Check that the rated voltage is supplied.



(3) Install the motor:

- Check that the servo-motor is firmly installed.

(4) Isolate the mechanical load.

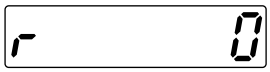
- Perform a test run of the motor independently.

(5) Release the brake.

(6) Switch off the servo by pressing (S SET) after finishing test runs.

Test Run Procedure

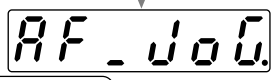
Turn on power for the driver and connect the console connector to connector CN X6 of the driver.



Display of motor rotation speed (Initial state of LED)

Operations with Selection Display

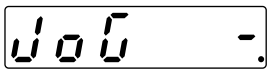
Enter the auxiliary function mode by pressing (S SET) once and (M MODE) four times, and then bring in



by pressing (▲) and (▼).

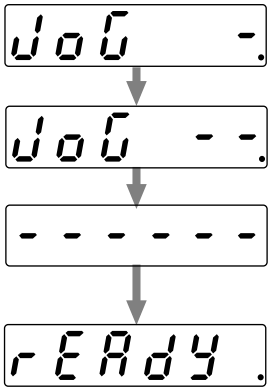
Operation with Execution Display

Reveal execution display



by pressing (S SET).

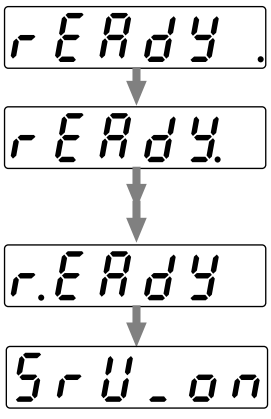
Keep pressing (▲) until the LED display of the console is changed to "rEAdy .".



Keeping pressing (▲) (about 5 seconds) increases number of " - " as shown left.

Step 1 ready for motor test run

Keep pressing (◀ SHIFT) until the LED display is changed to "SrU_on.".



By keeping pressing (◀ SHIFT) (about 3 seconds), position of the decimal point shifts to left as shown on the left.

Step 2 ready for motor test run

Servo is turned on.

Pressing (S SET) turns off the servo.

After the servo is turned on at Step 2 ready for motor test run:

The servo-motor continues to turn in CCW direction by keeping pressing (▲) and in CW direction by keeping pressing (▼) at the speed determined by Pr57 (JOG speed).

After finishing test runs, return to Selection Display referring to "Structure of Each Mode" (Page 48 and 49).

<Remarks>

If connector CN X6 is disconnected during JOG operation, the servo is turned off after 100 ms at maximum.

<Note>

If any trouble, such as break of cable or disconnection of connector, occurs during test run, the servo-motor overruns for 100 ms at maximum. Check the safety about test runs to a sufficient degree.

Using the Console

Copying parameters from servo driver to console (Copy Function)

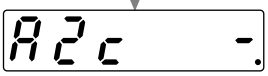
Operations with Selection Display

Enter the copy mode by pressing (S SET) once and (M MODE) five times in the initial state of LED, and then bring in

by pressing (▲) and (▼).

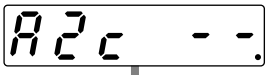
Operation with Execution Display

Reveal execution display

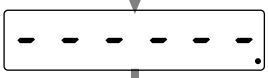


by pressing (S SET).

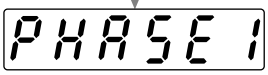
Keep pressing (▲) until the LED display of the console is changed to "PHASE 1".



Keeping pressing (▲) (about 3 seconds) increases number of " - " as shown left.

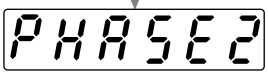


Initialization of EEPROM of the console starts.

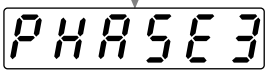


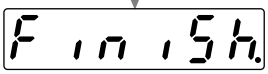
····· The number decreases over time as 10, 9, 8, ----.

Copying parameters and model code from servo driver to consloe starts.

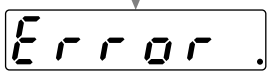


Writing parameters into EEPROM of console starts.





Copying has finished normally.



Error display

<Note>
If this error display appears, start the operation from the beginning again.
To cancel the error, press (S SET).

After finishing copying, return to Selection Display referring to Structure of Each Mode (Page 48 and 49).

<Note>

Do not disconnect the console cable from the servo driver during the proceeding from PHASE1 to PHASE3.

If the connector is disconnected during the time by any chance, connect the connector again, and restart the operation from the beginning.

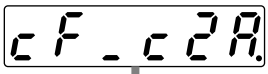
<Remarks>

If the error display appears repeatedly, that is presumably because of break of cable, disconnection of connector, wrong operation due to noises, or failure of EEPROM of the console.

Copying parameters from console to servo driver (Copy Function)

Operations with Selection Display

Enter the copy mode by pressing (S SET) once and (M MODE) five times in the initial state of LED, and then bring in



by pressing (▲) and (▼).

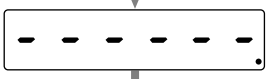
Operation with Execution Display

Reveal execution display

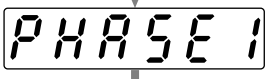
by pressing (S SET).

Keep pressing (▲) until the LED display of the console is changed to "PHASE 1".

Keeping pressing (▲) (about 3 seconds) increases number of " - " as shown left.

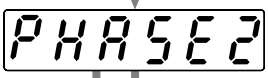


Reading parameters and model code from EEPROM of console starts.



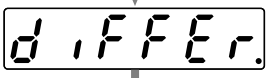
The number decreases over time as 10, 9, 8, ----.

Checking whether parameters can be transmitted to servo driver starts.



When the model code read from console is corresponded to the model code of servo driver.

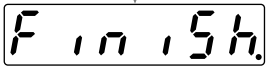
When the model code read from console is different from the model code of servo driver.



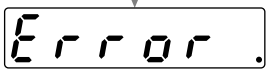
By keeping pressing (◀ SHIFT) (about 3 seconds), position of the decimal point shifts to left as shown on the left.

To cancel the copy, press (S SET).

Writing parameters into EEPROM of servo driver starts.



Copying has finished normally.



Error display

<Note>

If this error display appears during PHASE2, a parameter value read from the console is out of range. In this occasion check and modify the parameters in the copy source driver, and then copy the parameters from the copy source driver to the console, and then copy the parameters from the console to the copy destination driver.

If this error display appears except for PHASE2, start the operation from the beginning again.

To cancel the error, press (S SET).

After finishing copying, return to Selection Display referring to "Structure of Each Mode" (Page 48 and 49).

<Note>

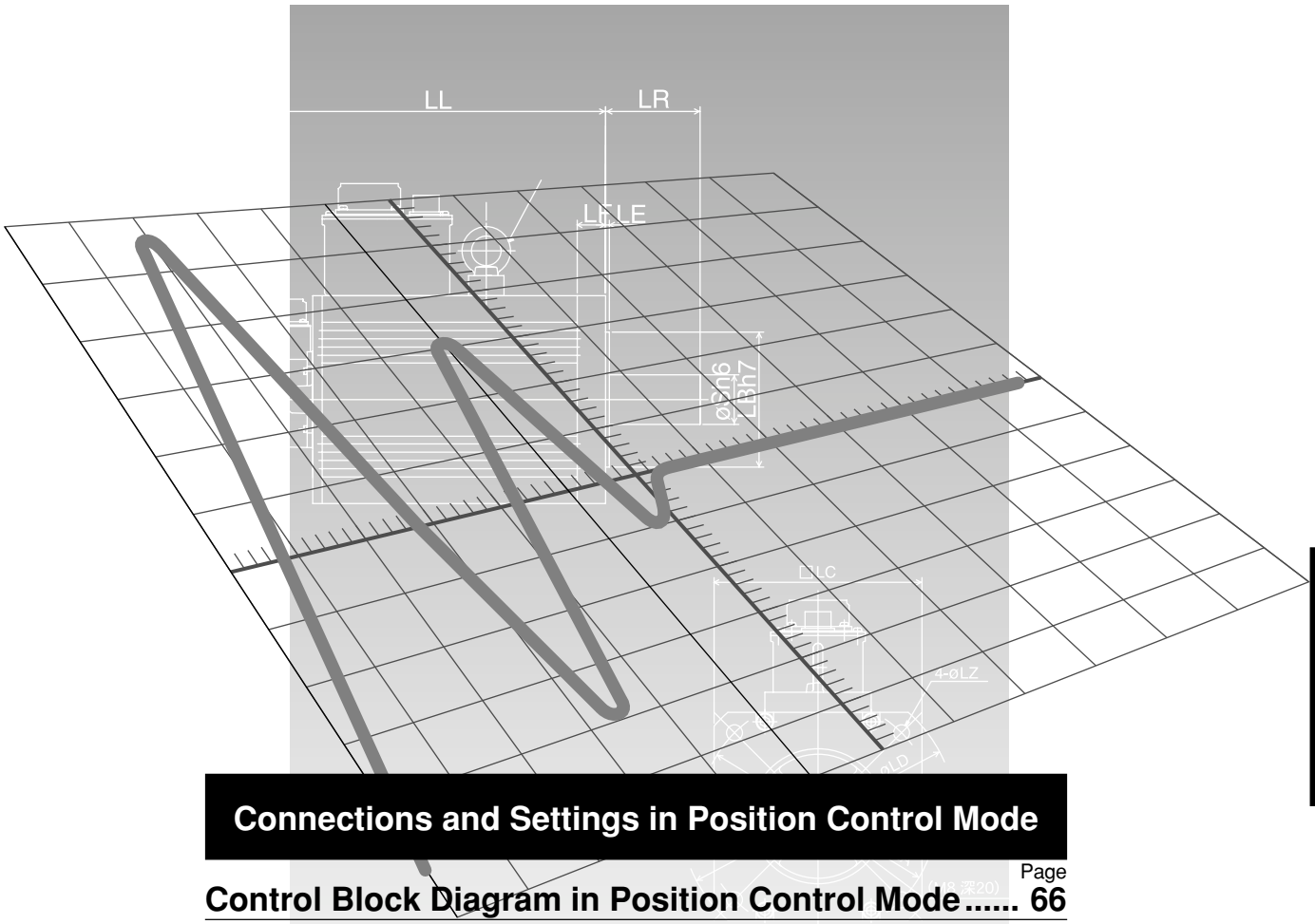
Do not disconnect the console cable from the servo driver during the proceeding from PHASE 1 to PHASE3.

If the connector is disconnected during the time, wrong data will be written in and the data will be crashed. In this occasion, copy the parameters from the copy source driver to the console, and then copy the parameters from the console to the copy destination driver.

<Remarks>

If the error display appear repeatedly except for PHASE2, that is presumably because of break of cable, disconnection of connector, wrong operation due to noises, or failure of EEPROM of the console.

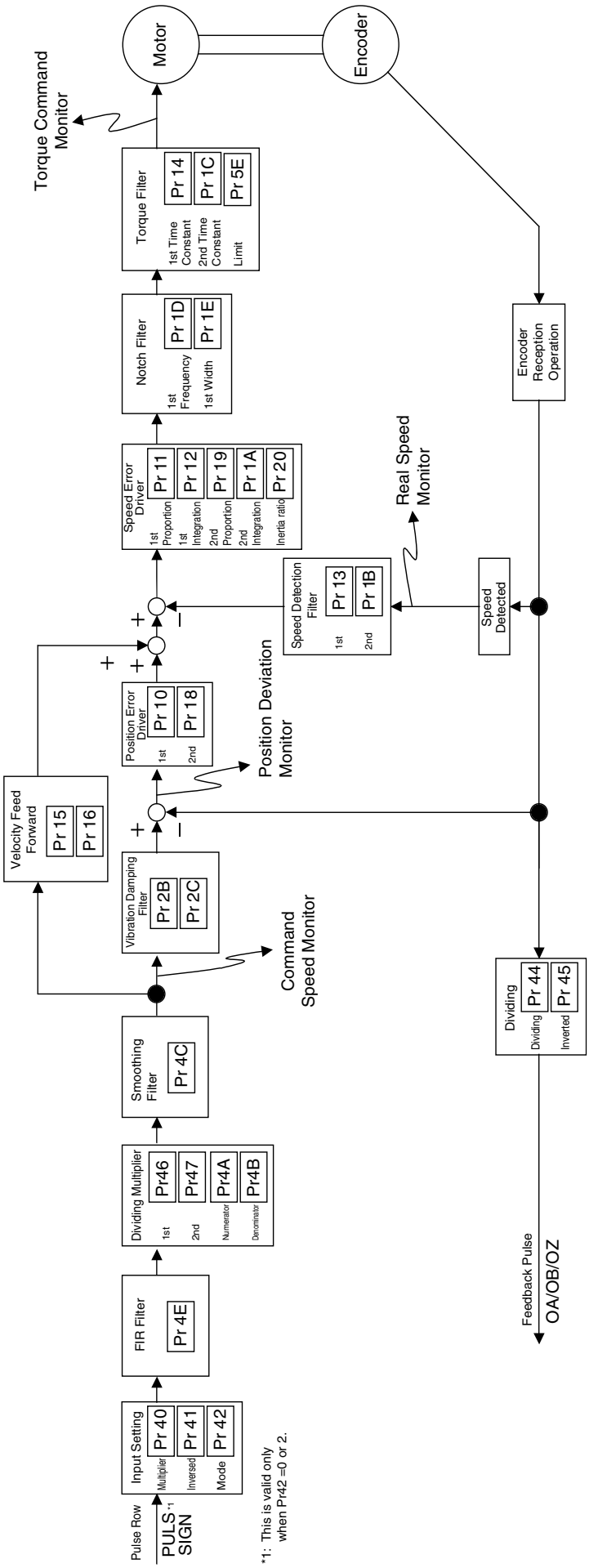
MEMO



Connections and Settings in Position Control Mode

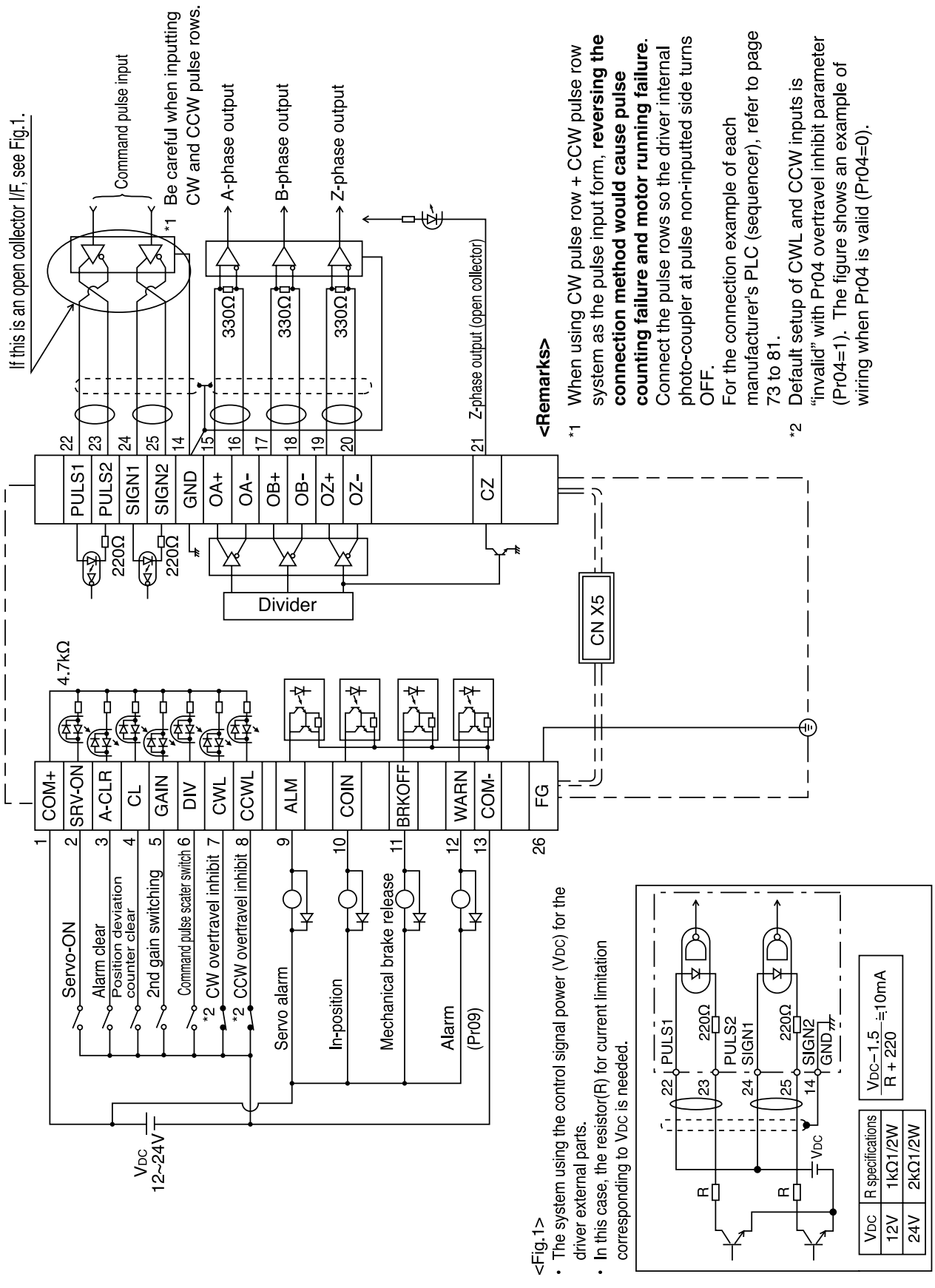
Control Block Diagram in Position Control Mode

■When Pr02, parameter for setting control mode is [0] or [2]*:



Example of Wiring in Position Control Mode

Example of Wiring in Position Control Mode



<Remarks>

*1 When using CW pulse row + CCW pulse row system as the pulse input form, **reversing the connection method would cause pulse counting failure and motor running failure.** Connect the pulse rows so the driver internal photo-coupler at pulse non-inputted side turns OFF.
For the connection example of each manufacturer's PLC (sequencer), refer to page 73 to 81.

*2 Default setup of CWL and CCW inputs is "invalid" with Pr04 overtravel inhibit parameter (Pr04=1). The figure shows an example of wiring when Pr04 is valid (Pr04=0).

<Fig.1>
- The system using the control signal power (VDC) for the driver external parts.
- In this case, the resistor(R) for current limitation corresponding to VDC is needed.

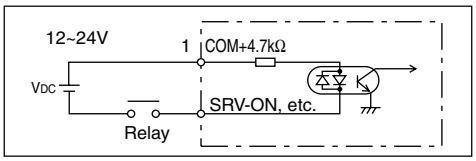
Wiring to Connector CN X5

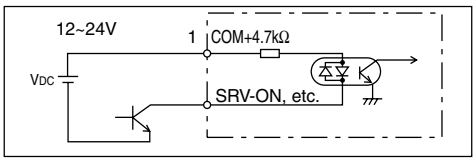
Interface Circuit

Input Circuit

SI Connection with Sequence Input Signal

- Connect to a contact of switch and relay, or a transistor of an open collector output.
- When you plan to use a contact input, use switch and relay for minute electric current so as to avoid poor contact.
- In order to secure appropriate level of primary current of the photo coupler, set lower limit voltage of the power supply (12 to 24 V) 11.4V or more.





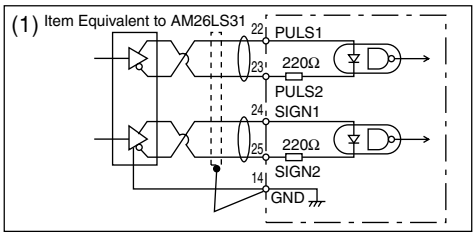
PI Command Pulse Input Circuit

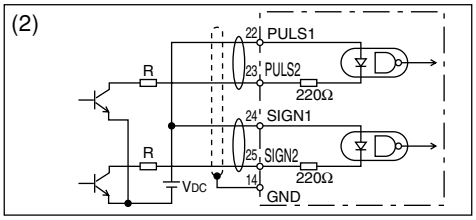
(1) Line Driver I/F
- This signal transmission method is less susceptible to effects of noise. We recommend this method to improve reliability of signal transmission.

(2) Open Collector I/F
- The method uses control power supply (V_{DC}) external to the driver.
- This requires a current-limiting resistor (R) that relies on V_{DC}.
- Be sure to connect specified resistor (R).

V_{DC}	Specification of R
12V	1kΩ 1/2W
24V	2kΩ 1/2W

$$\frac{V_{DC}-1.5}{R+220} \fallingdotseq 10mA$$





Maximum Input Voltage DC24V
Rated Current: 10mA

This represents a twisted pair cable.

When the connection method is inversed if you use the CW pulse row + CCW pulse row method as pulse input form, pulses do not count and the motor does not rotate.
Connect so that a photo coupler in the driver on the side on which pulse input is not done turns OFF.

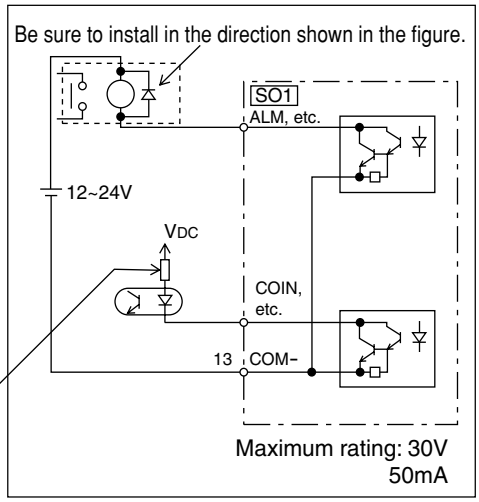
Output Circuit

SO1 Sequence Output Circuit

- This output circuit is configured with a Darlington connection transistor output of open collector. It is connected to a relay or photo coupler.
- Due to Darlington connection of the output transistor, there exists a collector-to-emitter voltage V_{CE} (SAT) of approx. 1V upon power-ON of the transistor. Note that normal TTLIC cannot be directly connected since it does not meet VIL requirement.
- When a recommended value of primary current of a photo coupler to be used is 10mA, determine a resistance value with the following formula:

$$R\ [k\Omega] = \frac{V_{DC}[V] - 2.5[V]}{10}$$

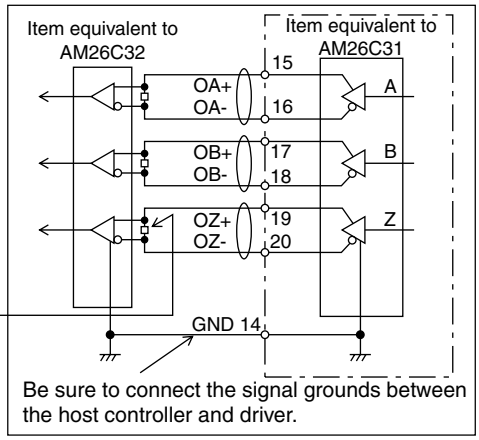
For a recommended primary current value, check the data sheets of equipment or photo coupler you plan to use.



PO1 Line Driver (Differential Output) Output

- Provide differential outputs of encoder signal output (Phases A, B and Z) after dividing operation is performed, by respective line drivers.
- On the host controller side, receive signals with a line receiver. Then, be sure to install termination resistor (approx. 330Ω) between inputs of the line receivers.
- These outputs are non-insulated signals.

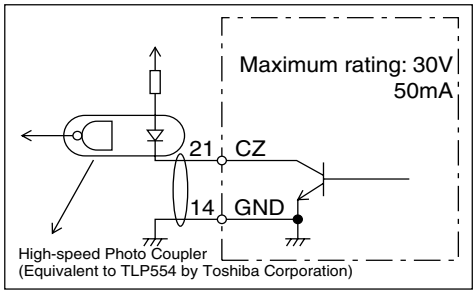
This represents a twisted pair cable.



PO2 Open Collector Output

- Among signals from the encoder, output phase Z signals with the open collector. This is non-insulated output.
- On the host controller side, use a high-speed photo coupler for reception, since pulse width of phase Z signal is usually narrow.

This represents a twisted pair cable.



Wiring to Connector CN X5

Input Signal and Pin No. of Connector CN X5

Input signals (common) and their functions

<table>
<tr><th>Signal Name</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F Circuit</th></tr>
<tr><td>Control Signal Power Supply Input (+)</td><td>1</td><td>COM +</td><td>• Connect positive (+) pole of external DC power supply (12 to 24V).
• Total supply voltage should range from 12V ± 5% to 24V ± 5%.</td><td>——</td></tr>
<tr><td>Control Signal Power Supply Input (–)</td><td>13</td><td>COM–</td><td>• Connect negative (-) pole of external DC power supply (12 to 24V).
• The voltage source capacity varies depending on configuration of input/output circuits to be used. We recommend 0.5A or greater.</td><td></td></tr>
<tr><td>Servo-ON input</td><td>2</td><td>SRV-ON</td><td>• When this signal is connected to COM-, the driver will be enabled (Servo-on) (motor energized).
<Cautions>
1. The signal will become valid about 2 seconds after power-ON. (See the timing chart.)
2. Don't use Servo ON/OFF signal to drive/stop the motor. Refer to "Dynamic Brake" on Page 36 of Preparation edition.
• Take the time of 100 ms or longer before entering a command on speed, pulse, etc., after transition to Servo-ON.
• When you open the connection with COM-, the driver will be disabled (Servo-OFF) and the current flow to the motor will be cut off.
• You can select dynamic brake operation during Servo-OFF and clear operation of the deviation counter by using Pr69 (sequence during Servo-OFF).</td><td>SI Page 68</td></tr>
<tr><td>Alarm Clear Input</td><td>3</td><td>A-CLR</td><td>• If this signal is connected to COM- for 120 ms or longer, it will clear alarm status.
• There are some alarms that this signal cannot release. For details, refer to "Protective Functions" on Page 144 of Edition of When You Have Trouble.</td><td>SI Page 68</td></tr>
<tr><td>Deviation Counter Clear/Internal Command Speed Selection 2 Input</td><td>4</td><td>CL / INTSPD2</td><td>The control mode changes functions.
<table><tr><td>Position Control</td><td>• Input of this signal is to clear the deviation counter. When the signal is connected to COM- for 2 ms or longer, it will clear the deviation counter.</td></tr><tr><td>Internal Velocity Control</td><td>• With input of internal command speed selection 2 (INTSPD2), four-speed can be set in combination with INTSPD1 input.
• For details on settings of control mode, refer to Page 117.</td></tr></table></td><td>SI Page 68</td></tr>
<tr><td>Gain Switching/Speed Zero Clamp/Torque Limit Switching Input</td><td>5</td><td>GAIN /ZEROSPD /TC</td><td>• Settings of Pr06 and control mode can change functions.
<table><tr><th>Pr06</th><th>Control Mode</th><th>Descriptions</th></tr><tr><td>0, 1</td><td>When position control Pr02 is 0 or 2</td><td>• The following 2 functions can be used with settings of Pr30.
• Gain switching input (GAIN) switches P1/P operation and first/second gain.
<table><tr><th>Setting of Pr30</th><th>Setting of Pr31</th><th>Connection with COM-</th><th>Description</th></tr><tr><td rowspan="2">0 [Default value]</td><td rowspan="2">–</td><td>Open</td><td>Velocity loop: P1 (proportional/integral) operation</td></tr><tr><td>Connected</td><td>Velocity loop: P (proportion) operation</td></tr><tr><td rowspan="2">1</td><td rowspan="2">2</td><td>Open</td><td>1st gain selected (Pr10,11,12,13,14)</td></tr><tr><td>Connected</td><td>2nd gain selected (Pr18,19,1A,1B,1C)</td></tr></table>For details on the 2nd gain switching function, refer to Page 138.</td></tr><tr><td></td><td>When internal velocity control Pr02 is 1</td><td>• With speed zero clamp input (ZEROSPD), velocity command is opened when connection with COM- is opened.
• You can override this input with Pr06.
• A default value of Pr06 is 1, and this input is valid. When connection with COM- is opened, speed will be zero.
<table><tr><th>Pr06</th><th>Description</th></tr><tr><td>0</td><td>ZEROSPD input is invalid.</td></tr><tr><td>1 [Default value]</td><td>ZEROSPD input is valid.</td></tr></table></td></tr><tr><td>2</td><td>Position Control/ Internal Velocity Control</td><td>With torque limit switching input, parameters of acceleration level, torque limit, excessive position deviation can be switched.
<table><tr><th>Connection with COM-</th><th>Description</th></tr><tr><td>Open</td><td>1st setting value selected (Pr70,5E,63)</td></tr><tr><td>Connected</td><td>2nd setting value selected (Pr71,72,73)</td></tr></table></td></tr></table></td><td>SI Page 68</td></tr>
</table>

Signal Name	Pin No.	Symbol	Function	I/F Circuit
Command Dividing Multiplier Switching/ Internal Command Speed Selection 1 Input	**6**	**DIV /INTSPD1**	The control mode can change functions. **Position Control**: • Input to switch dividing multiply of command pulse • When this signal is connected to COM-, it will switch a command dividing multiply numerator from Pr46 (Numerator of 1st command pulse ratio) to Pr47 (Numerator of 2nd command pulse ratio). <Caution> You must not enter any command pulse for 10 ms before or after switching. **Internal Velocity Control**: • With internal command speed selection 1 (INTSPD1), four-speed can be set in combination with INTSPD 2. • For details on settings of control mode, refer to Page 117. You must not enter any command pulse for 10 ms before or after switching.	SI Page 68
CW Overtravel Inhibit Input	**7**	**CWL**	• If you open connection with COM- when a moving part of the machine exceeds the movable range in CW direction, no torque will be generated in CW direction.	SI Page 68
CW Overtravel Inhibit Input	**8**	**CCWL**	• If you open connection with COM- when a moving part of the machine exceeds the movable range in CCW direction, no torque will be generated in CCW direction. • If you set 1 to Pr04 (Overtravel input inhibit), CWL/CCWL inputs will be invalid. A default value is invalid (1). • Setting of Pr66 (DB inaction during driving prohibition) can activate the dynamic brake when CWL/CCWL input is valid. According to a default value, the dynamic brake will run (Pr66 is 0).	SI Page 68

Input Signal (Related to Position Control) and its Functions

Signal Name	Pin No.	Symbol	Function	I/F Circuit
Command Pulse Input	**22**	**PULS1**	• Input terminal of command pulse. The signal is received by the high-speed photo coupler on the driver side. • Allowable Input Highest Frequency At the time of the line driver input : 500kpps At the time of the open collector input : 200kpps • Input impedance of PULS and SIGN is 220Ω. • The following 3 forms of command pulse input can be selected with Pr42 (command pulse input mode set up). (1) 2-phase (Phase A/B) input (2) CW (PULS)/CCW (SIGN) pulse input (3) Command pulse (PULS)/sign (SIGN) input	PI Page 68
	23	**PULS2**		
Command sign input	**24**	**SIGN1**		
	25	**SIGN2**		

Wiring to Connector CN X5

Output Signal and Pin No. of Connector CN X5

Output Signals (Common) and their Functions

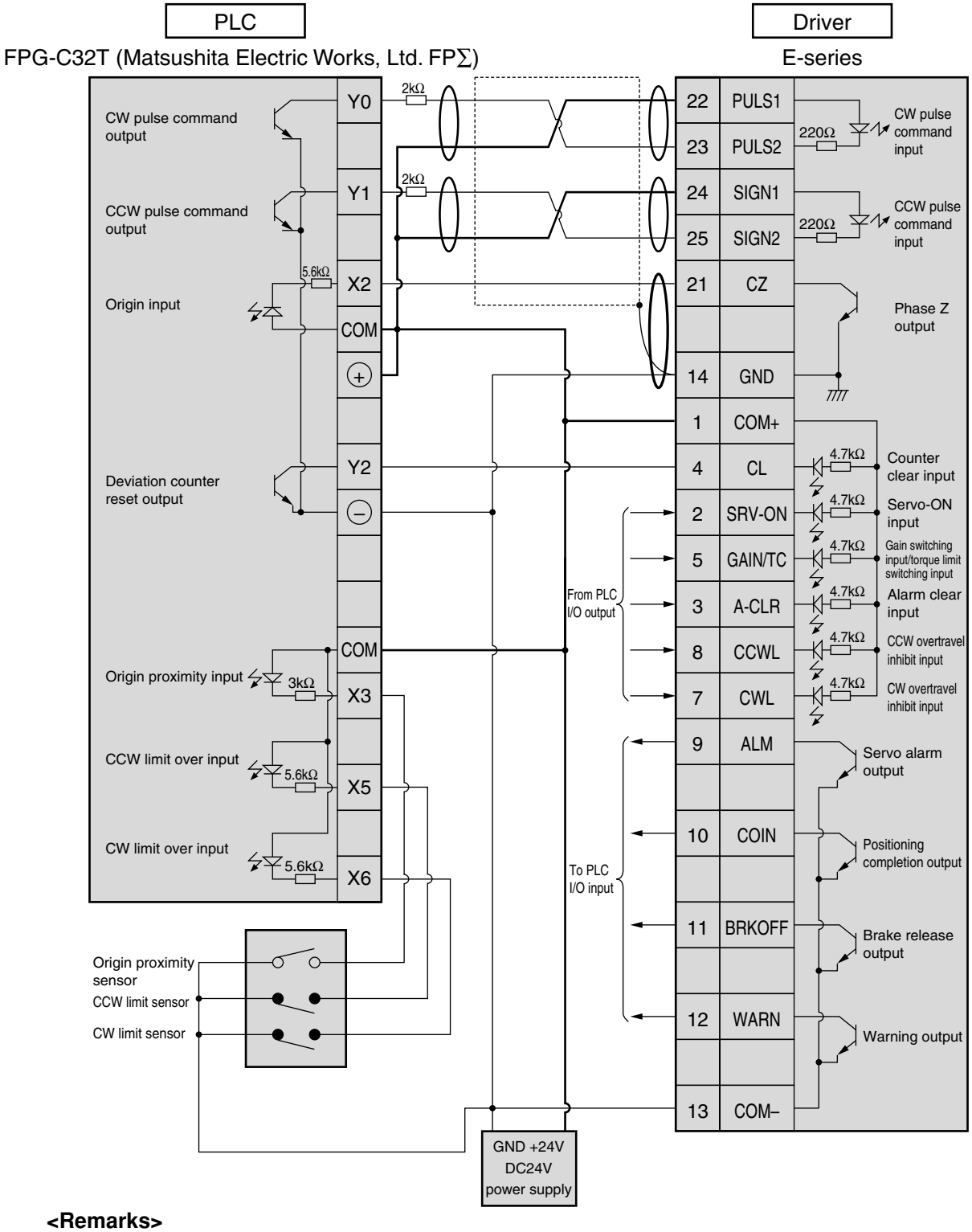
Signal Name	Pin No.	Symbol	Function	I/F Circuit
Servo Alarm Output	**9**	**ALM**	• The output transistor turns OFF when an alarm is generated.	**SO1** **Page 69**
Positioning Completion/Achieved Speed Output	**10**	**COIN**	• The control mode changes functions. **Position Control:** • Positioning completion output • The output transistor turns ON when the deviation pulse does not exceed setting of Pr60 (In-position range). **Internal Velocity Control:** • Achieved Speed Output • The output transistor turns ON when motor speed exceeds Pr62 (At-speed).	**SO1** **Page 69**
Brake Release Signal Output	**11**	**BRK-OFF**	• This signal is used to release the electromagnetic brake of the motor. • The output transistor turns ON when the brake is released. • Refer to “Timing Chart” on Page 32 of Preparation edition.	**SO1** **Page 69**
Warning Output	**12**	**WARN**	• A signal selected with Pr09 (warning output selection) is output. **Settings** / Functions: **0** The output transistor turns ON while torque is limited. **1** The output transistor turns ON when the speed falls below setting of Pr61 (Zero speed). **2* [Default value]** The output transistor turns ON when any of the following 3 warning functions is activated: regenerative/overload/fan rotation speed abnormality. **3*** With the regenerative warning function activated (85% of the regenerative abnormality detection level is exceeded), the output transistor turns ON. **4*** With overload warning function activated (effective torque exceeds 85% when the detection level of overload protection is considered 100%), the output transistor turns ON. **5*** Displays may appear but do not function. **6** With the abnormal fan rotation speed warning function activated (the fan stops), the output transistor turns ON. * With settings of 2 to 6, once a warning is detected, the output transistor turns ON for at least 1 second.	**SO1** Page 69
Phase-A Output	**15**	**OA+**	•This signal provides differential output of the encoder signal (Phases A/B/Z) that undergoes dividing process (RS 422 phase, etc.). • The logical relation between phases A and B can be selected with Pr45 (Pulse output logic inversion). • Not insulated	**PO1** Page 69
	16	**OA–**		
Phase-B Output	**17**	**OB+**		
	18	**OB–**		
Phase-Z Output	**19**	**OZ+**		
	20	**OZ–**		
Phase-Z Output	**21**	**CZ**	• Phase Z signal output in an open collector • Not insulated	**PO2** **Page 69**

Output Signals (Others) and their Functions

Signal Name	Pin No.	Symbol	Function	I/F Circuit
Signal Ground	**14**	**GND**	• Signal ground in the driver • Insulated from the control signal power supply (COM-) in the driver.	**—**
Frame Ground	**26**	**FG**	• Connected with the earth terminal in the driver.	**—**

Example of Connection to a Host Controller

Matsushita Electric Works, Ltd. FPG-C32T

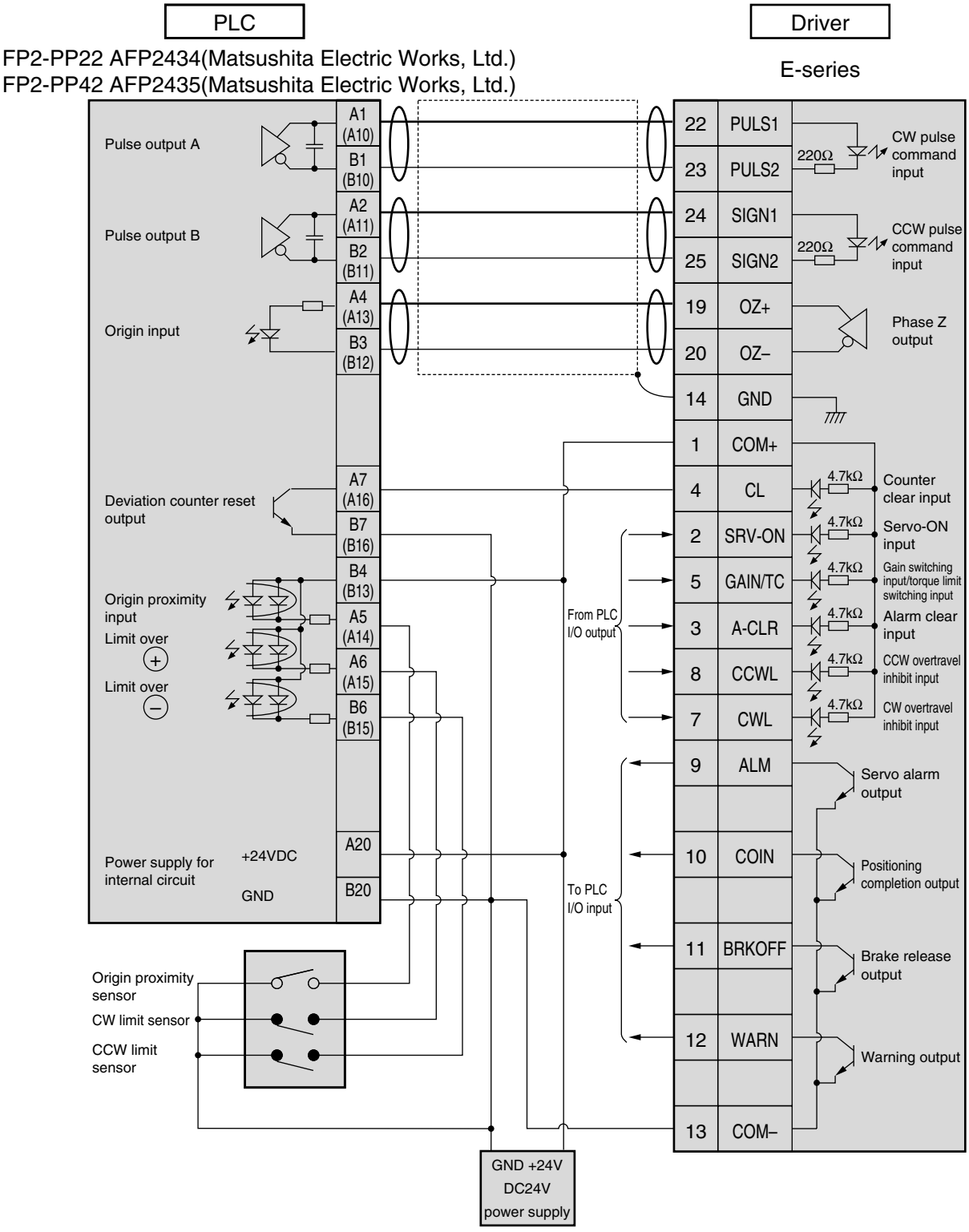


<Remarks>

This represents a twisted pair cable.

Wiring to Connector CN X5

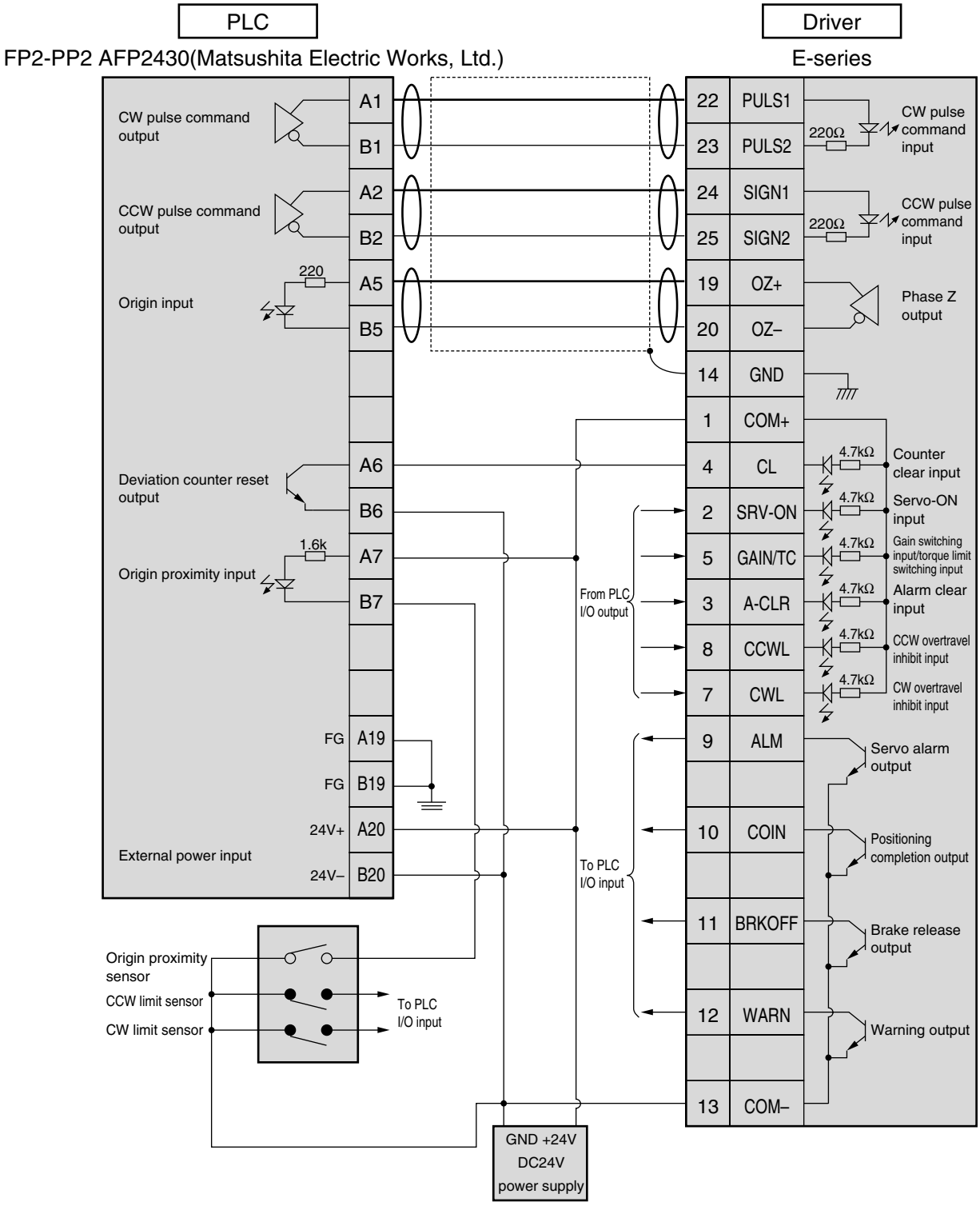
Matsushita Electric Works, Ltd. FP2-PP22 AFP2434/FP2-PP42 AFP2435



<Remarks>

This represents a twisted pair cable.

Matsushita Electric Works, Ltd. FP2-PP2 AFP2430

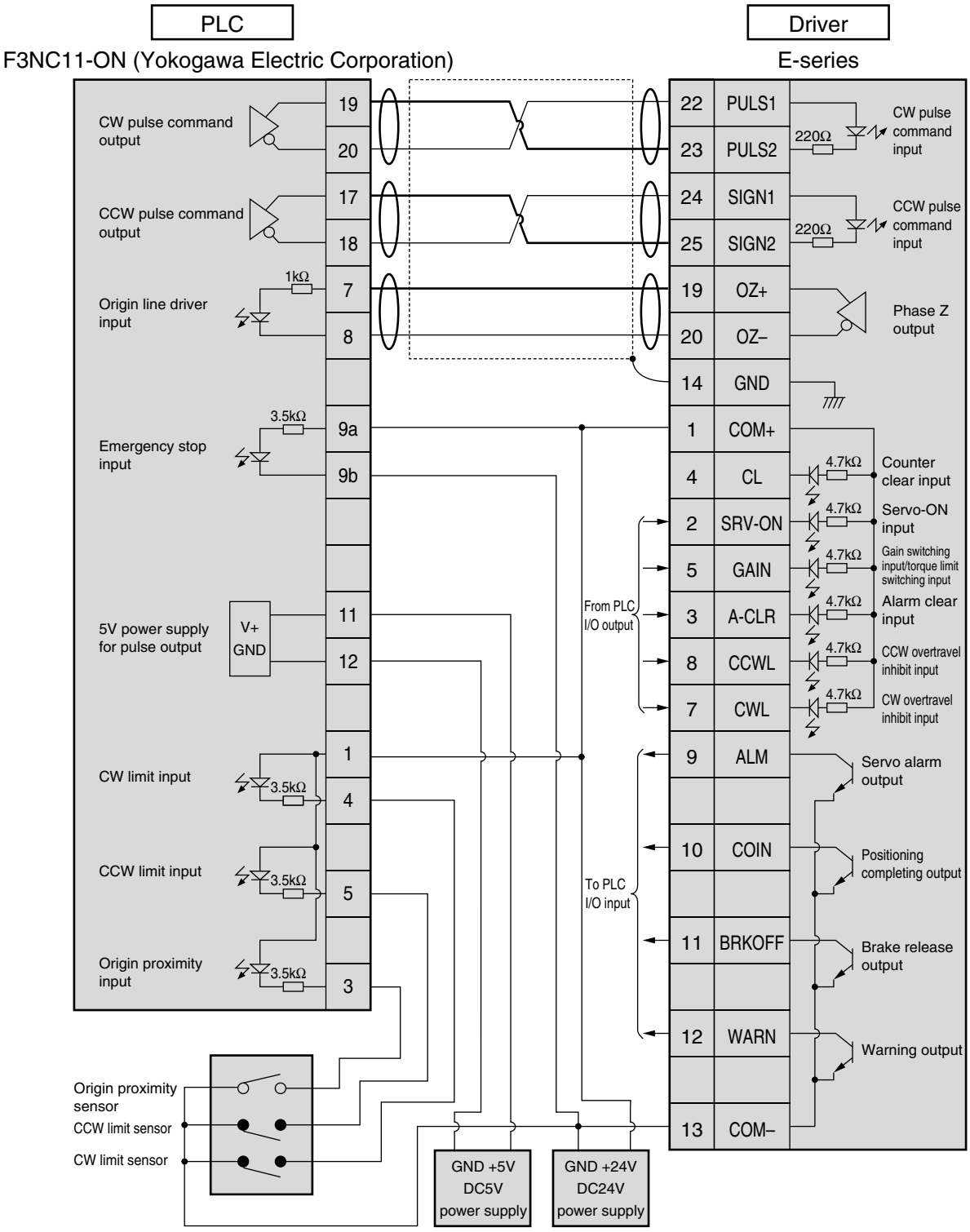


<Remarks>

This represents a twisted pair cable.

Wiring to Connector CN X5

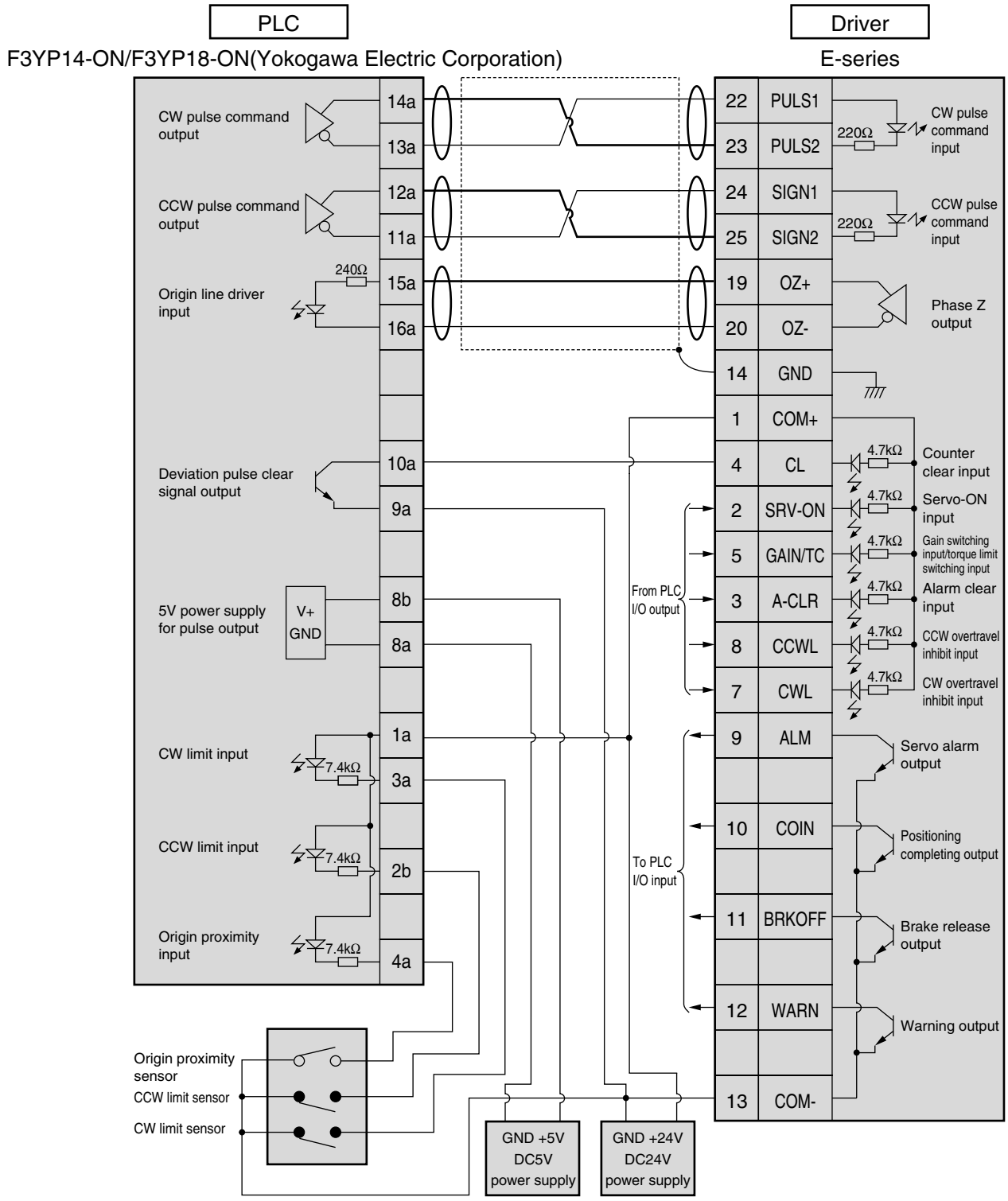
Yokogawa Electric Corporation F3NC11-ON



<Remarks>

This represents a twisted pair cable.

Yokogawa Electric Corporation F3YP14-ON/F3YP18-ON

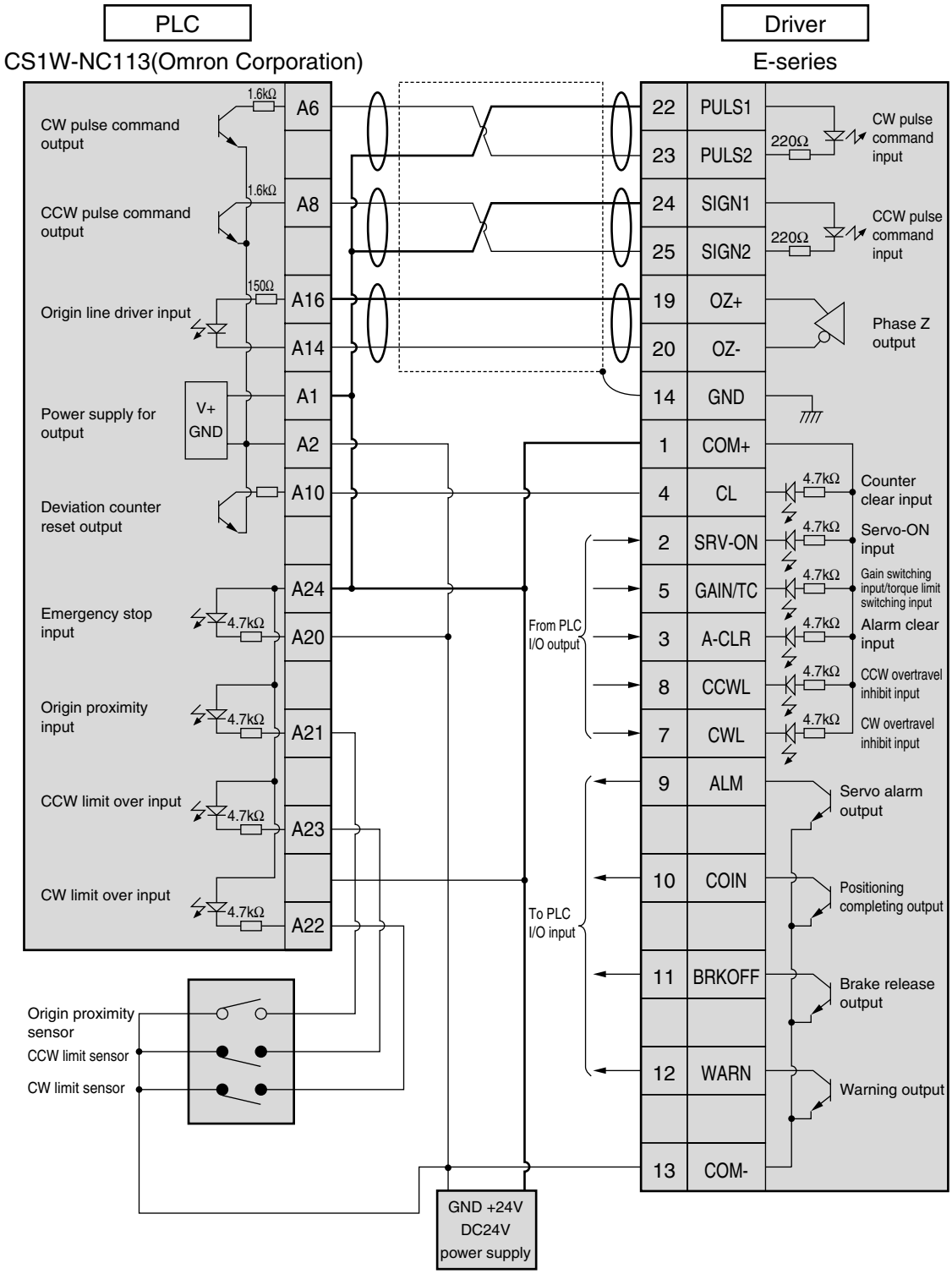


<Remarks>

This represents a twisted pair cable.

Wiring to Connector CN X5

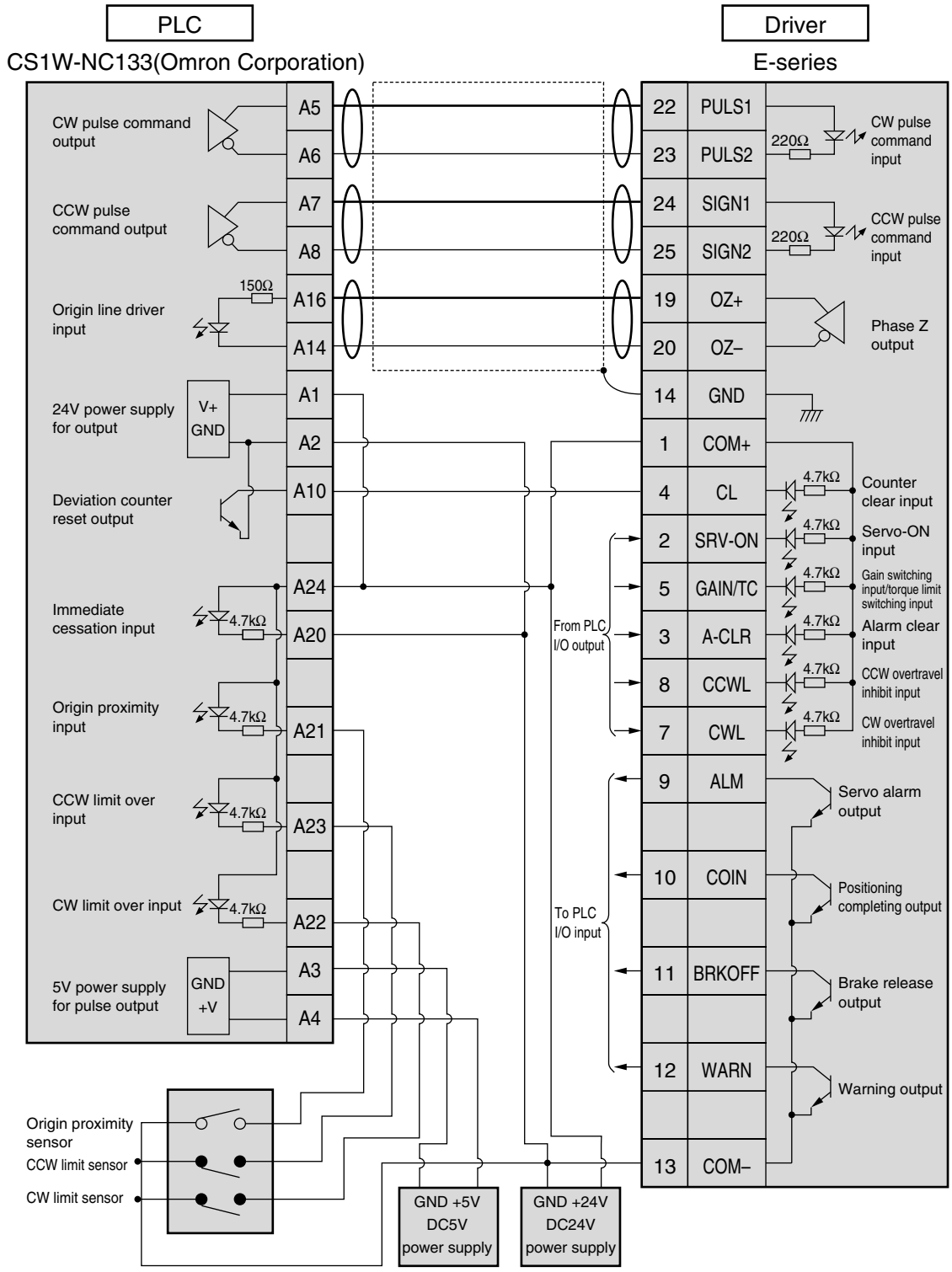
Omron Corporation CS1W-NC113 (Open Collector Output)



<Remarks>

This represents a twisted pair cable.

Omron Corporation CS1W-NC133 (Line Driver Output)

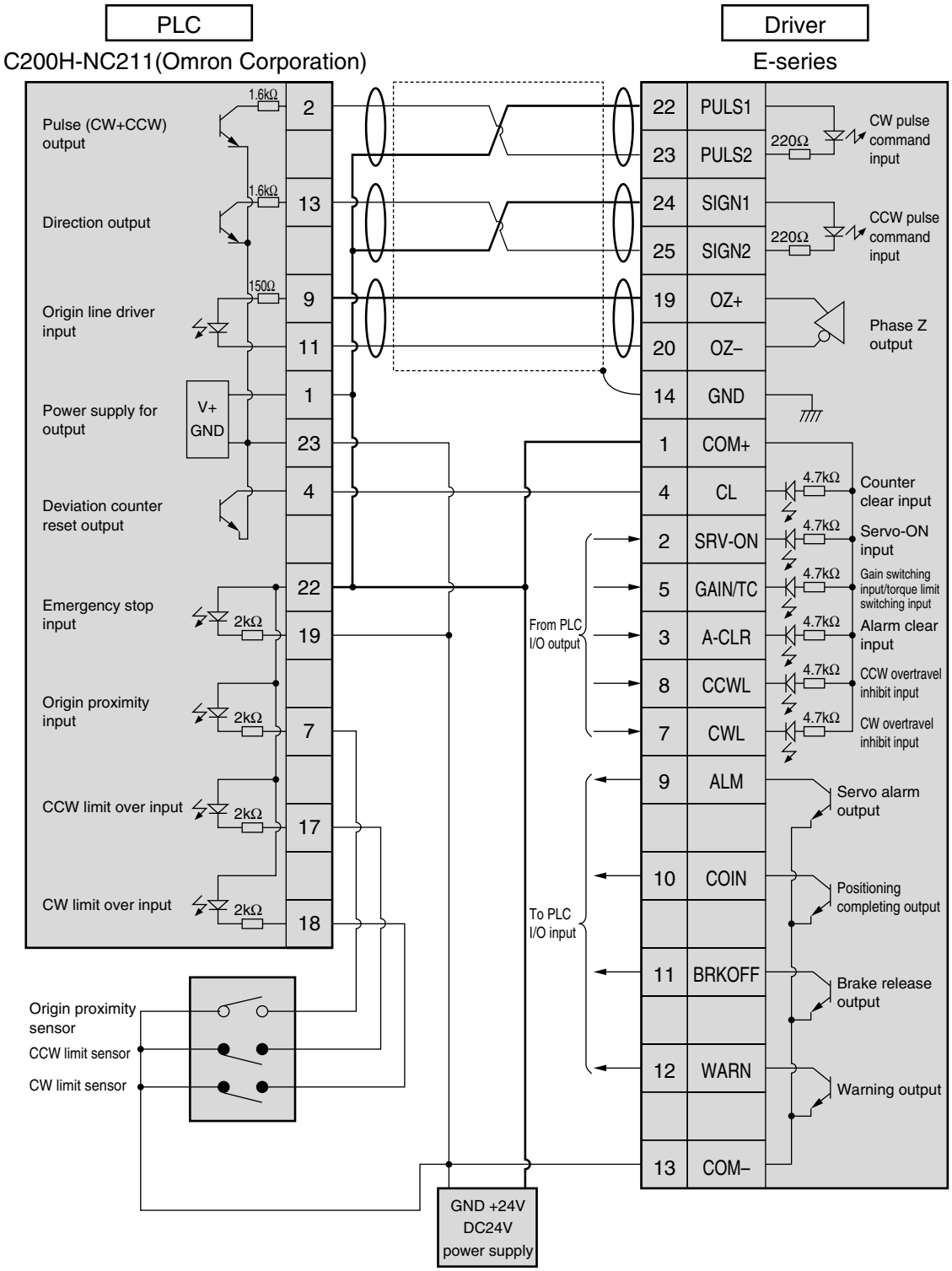


<Remarks>

This represents a twisted pair cable.

Wiring to Connector CN X5

Omron Corporation C200H-NC211



<Remarks>

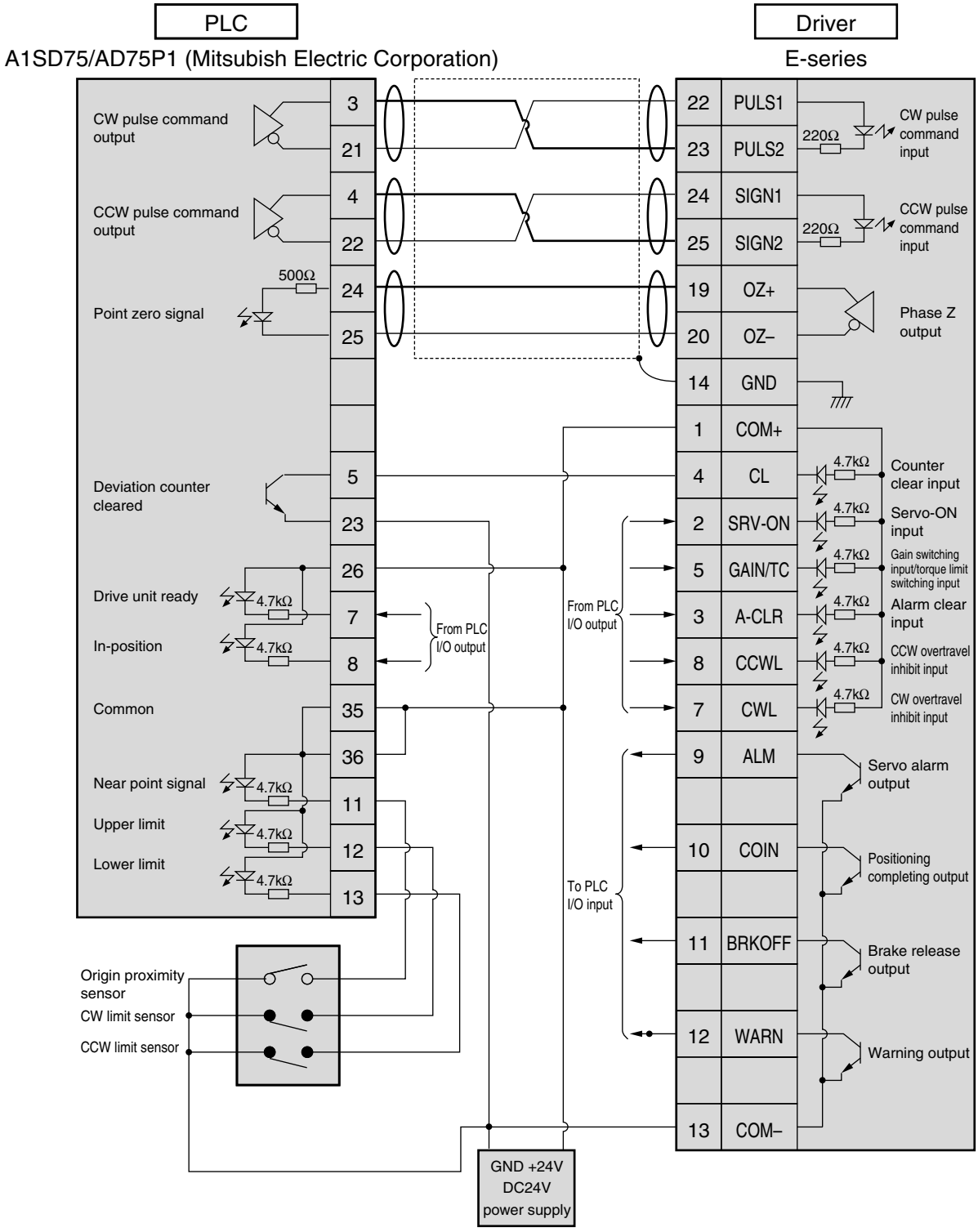
This represents a twisted pair cable.

Mitsubishi Electric Corporation A1SD75/AD75P1

<Note>

You can switch output of an open collector/line driver. Use this with the line driver.

If you use the open collector, it does not count pulse and the motor does not rotate.



<Remarks>

This represents a twisted pair cable.

Test Run in Position Control Mode

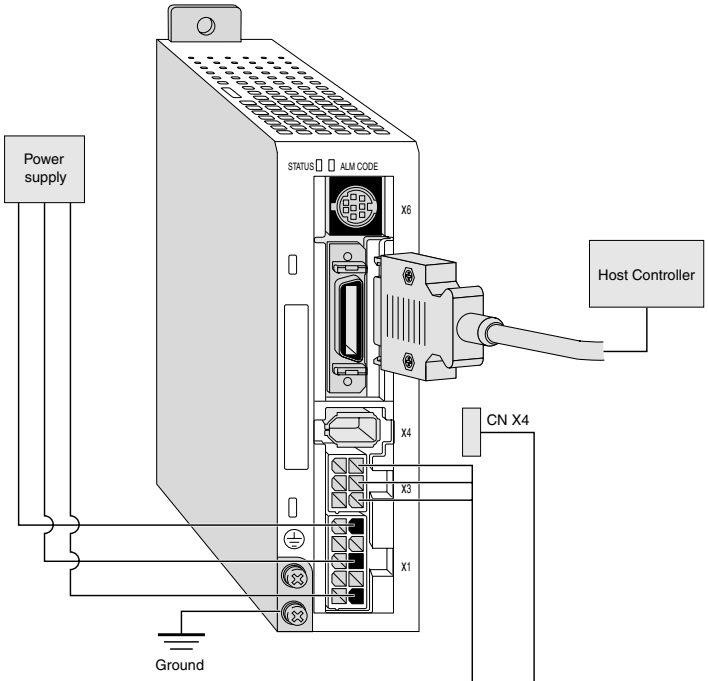
Inspection prior to Test Run

(1) Check the wirings:

- Connected correctly (especially power supply connection and motor connection),
- Not shorted and properly earthed, and
- Not loose.

(2) Check the supply voltage:

- Check that the rated voltage is supplied.



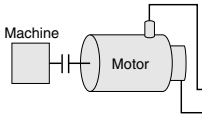
(3) Install the motor:

- Check that the servo-motor is firmly installed.

(4) Isolate the mechanical load.

- Perform a test run of the motor independently.

(5) Release the brake.

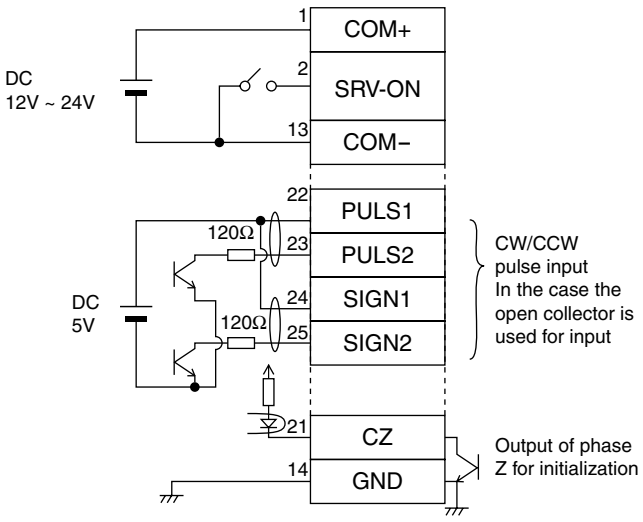


Test Run with Connector CN X5 Connected

(1) Connect CN X5.
(2) Connect the control signal (COM+/COM-) to the power supply (12 to 24 VDC).
(3) Turn on the power (of the driver).
(4) Check default settings of parameters.
(5) Activate Servo-ON by connecting Servo-ON input SRV-ON (CN X5 pin 2) and COM- (CN X5 pin 13). Then the motor will be energized.
(6) Set Pr42 (command pulse input mode set up) according to output form of the host controller, and write it into EEPROM. Then, you should turn the power OFF and ON again.
(7) Send a low-frequency pulse signal from the host controller to run the motor at low speed.
(8) Check rotation speed of the motor in the monitor mode.

- Check that the motor rotates at set speed.
- Check if the motor stops when you stop the command (pulse).

Wiring Diagram



Parameters

PrNo.	Parameter Name	Settings
Pr02	Control mode set up	2
Pr04	Overtravel input inhibit	1
Pr42	Command pmulse input mode set up	1

• Use the host controller to send command pulses.

Input Signal Status

Signal No.	Input Signal Name	Monitor Display
00	Servo-ON	+A
02	CW overtravel inhibit	–
03	CCW overtravel inhibit	–
0A	**Counter clear**	–

Setting of Motor Rotation Speed and Input Pulse Frequency

Input pulse frequency (pps)	Motor rotation speed (r/min)	$\frac{\boxed{\text{Pr 46}} \times 2^{\boxed{\text{Pr 4A}}}}{\boxed{\text{Pr 4B}}}$
500k	3000	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{10000}}$
250k	3000	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{5000}}$
100k	3000	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{2000}}$
500k	1500	$\frac{\boxed{5000} \times 2^{\boxed{0}}}{\boxed{10000}}$

←Defaul Setup

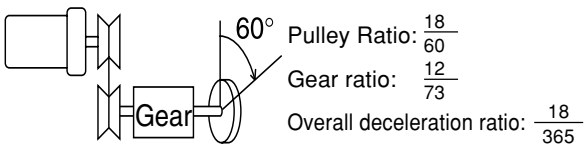
*** Our default setup is "the motor shaft rotates once at 10000 pulse input". Note that the maximum input pulse frequency is 500 kpps for a line driver and 200 kpps for an open collector.**

*** You can set any value depending on a numerator and denominator setting. However, if you specify an extreme dividing/multiplier ratio, we cannot guarantee proper operation of the motor. We recommend that you set the dividing/multiplier ratio in the range of $\frac{1}{50}$ to 20 times.**

Relationship between Motor Angle of Rotation and Input Pulse Frequency

(Example 1) Rotate the motor at 60 degrees with overall deceleration ratio of 18/365.

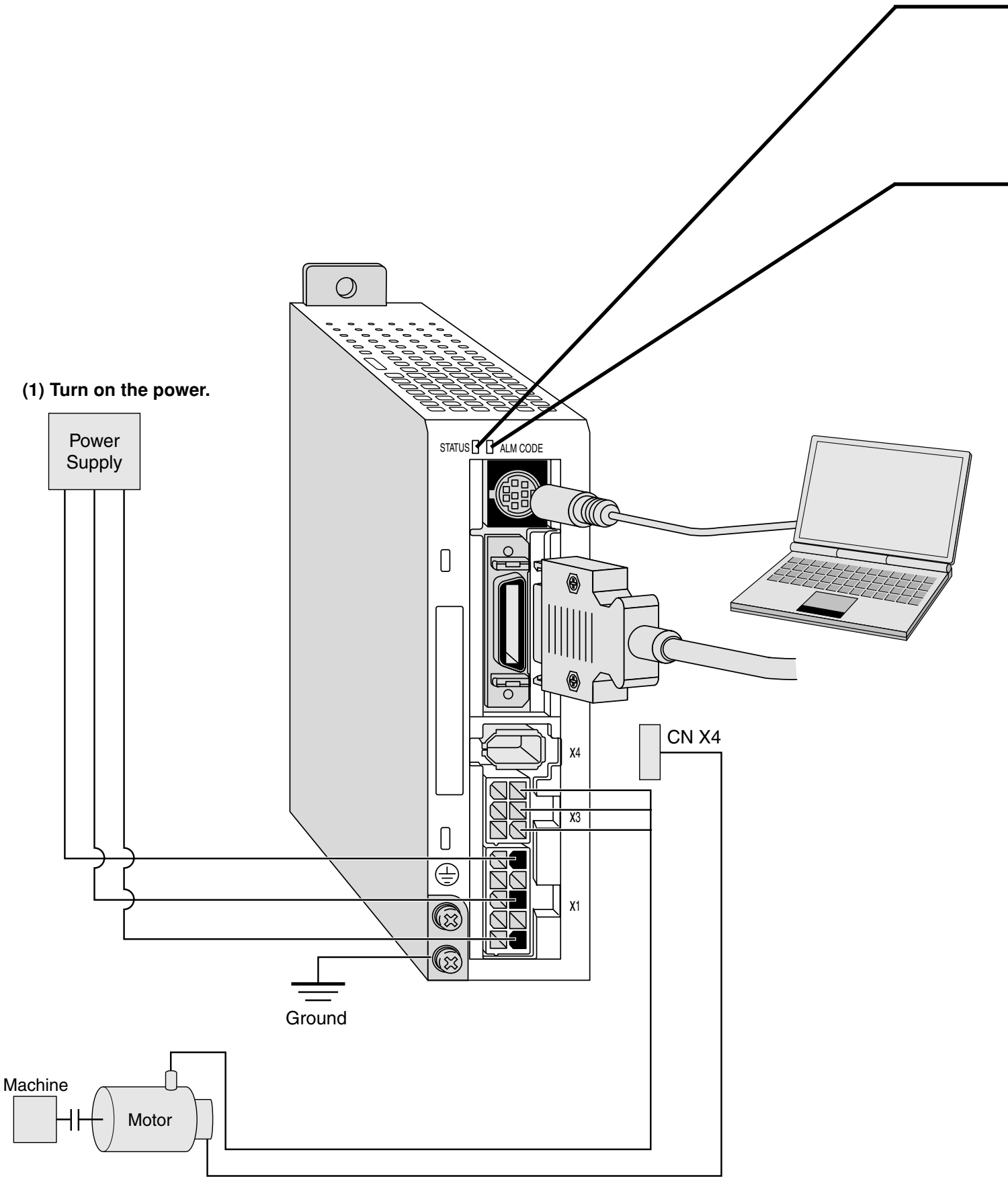
	Encoder Pulse
	2500P/r
$\frac{\boxed{\text{Pr46}} \times 2^{\boxed{\text{Pr4A}}}}{\boxed{\text{Pr4B}}}$	$\frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$
Theory	From your controller to the driver, enter command that the motor rotates 60 degrees with 10000 pulses.
Determination of the parameter	$\frac{365}{18} \times \frac{10000}{10000} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$



* Also refer to "Description on Dividing/Multiplier Ratio" on Page 178 of Reference edition.

Test Run in Position Control Mode

Basic Operations and LED Display



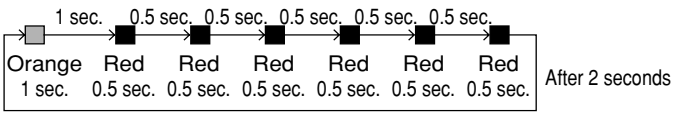
(2) Check LED status.

Color of LED Status	Description
□ Green	The main power is turned ON. The driver is switched ON.
▒ Orange	The LED flashes (for 1 second) when a warning is issued. (Abnormal overload, regeneration, and fan rotation speed)
■ Red	Alarm output.

Check that alarm code LED does not flash? (It is out during normal operation).

It starts flashing in case of an alarm.
An alarm code (refer to pages 145 to 148) indicates the alarm code number by the number of flashes of orange and red lights.
Orange: 10 digit Red: 1 digit

(Example)
When overload (alarm code No.16) occurs and the motor stops:
The orange light flashes once and red one flashes 6 times.



(3) Setting the parameter

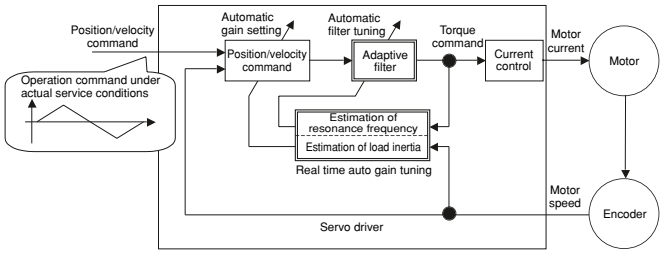
Prepare for a personal computer and “PANATERM®”. Or prepare for a console.

(4) Enter a command that matches the control mode.

Real time Auto Gain Tuning

Outline

Load inertia of the machine is real-time estimated, and based on the result of estimation, optimum gain is automatically set. In addition, an adaptive filter automatically suppresses vibration due to resonance.



Scope

- Real time auto gain tuning is valid in all control modes.
- You can use an adaptive filter only when Pr02=2: high function positioning control.

Cautions

Under the following conditions, real time auto gain tuning may not properly function. In such a case, use either normal auto gain tuning (Refer to Page 132) or manual gain tuning (Refer to Page 136).

	Conditions that Hinder Real time Auto Gain Tuning from Functioning
Load Inertia	• When load inertia is smaller or greater than rotor inertia (i.e., 3 times or less or 20 times or more). • When load inertia changes quickly (less than 10 [s]).
Load	• When mechanical stiffness is extremely low. • When there is play such as backlash.
Operation Pattern	• When the motor runs at a continuous low speed below 100 [r/min]. • When acceleration/deceleration is gradual, e.g., 2000 [r/min] or less in 1 [s]. • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque. • When the time that meets conditions of speed/acceleration is short, e.g., less than 40 [ms].

Operating Instruction

(1) Stop the motor (Servo-OFF).

(2) Set Pr21 (Real time auto tuning set-up) to 1 to 6.

A default setup is 1.

Setting value	Real time Auto Tuning	Degree of Load Inertia Changes in Service	Adaptive Filter (When Pr02=2)
0	Not used	—	No
[1]	Used	Little change	Yes
2		Gradual change	
3		Sharp change	
4		Little change	No
5		Gradual change	
6		Sharp change	
7	Not used	—	Yes

When load inertia changes widely, set Pr21 to 3 or 6.
If there is possibly effect of resonance, select “adaptive filter Yes”.

(3) Turn the servo on to operate the machine as usual.

(4) If you wish to improve responsiveness, gradually increase Pr22 (Machine stiffness at auto tuning). In addition, if any abnormal noise or oscillation occurs, set a value lower (e.g. 0 to 3).

(5) If you wish to save result, write it into EEPROM.

<Remarks>

Any change to Pr21 (Real time auto tuning set-up) will become valid when you turn on the power and when Servo-OFF switches to Servo-ON.

Thus, to disable real time auto tuning, set Pr21 (Real time auto tuning mode setting) to 0, and then switch from Servo-OFF to Servo-ON. Similarly, when you enable real time auto tuning, set Pr21 to any value other than 0 and 7 and then switch from Servo-OFF to Servo-ON.

Insert the connector of console into CNX6 of the driver, and then turn on the power of the driver. → `r 0`

Setting parameter Pr21

Press (S SET). → `dP_SPd`

Press (M MODE). → `PA_ 00`

Select the parameter to be set with (▲) and (▼). → `PA_ 21`

(In this case, select Pr21.)

Press (S SET). → `1`

Change the value with (▲) or (▼).

Press (S SET). → `PA_ 21`

Setting parameter Pr22

Select Pr22 with (▲). → `PA_ 22`

Press (S SET). → `4` (Default Setup Value)

When you press (▲), a value increases, and when you press (▼), it decreases.

Now writing into EEPROM

Press (M MODE). → `EE_SEt`

Press (S SET). → `EEP -`

Keep pressing (▲) (about 5 seconds). Then, the number of bars in creases as shown on the right. → `EEP --` → `------`

Start of write (indicated momentarily). → `StArt`

End → `FinISh` (Write finishes) / `rESEt` / `Error` (Write error occurs)

After finishing write, return to Selection Display referring to "Structure of Each Mode" (Page 48 and 49).

Adaptive Filter

An adaptive filter will be enabled when Pr02=2 (high function positioning control mode) and Pr21 (Real time auto tuning set-up) is 1 to 3 or 7.
The adaptive filter reduces resonance point vibration, by estimating resonance frequency from vibration component that appears in motor speed in operation, and removing resonance component from a torque command through automatic setting of a coefficient of a notch filter.
The adaptive filter may not function normally under the following conditions. In such a case, take resonance measures using the 1st notch filter (Pr1D, 1E) and according to the manual tuning procedure.
For details on the notch filter, refer to "To Reduce Mechanical Resonance" on Page 140.

	Conditions that Hinder an Adaptive Filter from Functioning
Resonance Point	• When the resonance frequency is 300 [Hz] or lower. • When resonance peak or control gain is low, which does not affect the motor speed • When there is more than one resonance point
Load	• When the motor speed having high frequency component fluctuates due to nonlinear element such as backlash, etc.
Command Pattern	• When acceleration or deceleration is exponential such as 30000 [r/min] or more in 1 [s]

Parameters to be Set Automatically

The following parameters are tuned automatically. The following parameters are also set up to the following fixed values automatically.

PrNo.	Name
10	1st position loop gain
11	1st velocity loop gain
12	1st velocity loop integration time constant
13	1st velocity detection filter
14	1st torque filter time constant
18	2nd position loop gain
19	2nd velocity loop gain
1A	2nd velocity loop integration time constant
1B	2nd velocity detection filter
1C	2nd torque filter time constant
20	Inertia ratio
2F	Adaptive filter frequency

PrNo.	Name	Setting
15	Velocity feed forward	300
16	Feed forward filter time constant	50
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
33	Position control switching level	50
34	Position control switching hysteresis	33
35	Position loop gain switching time	20

<Remarks>
When real time auto tuning is enabled, you are not allowed to change any parameter to be automatically tuned.

Cautions

(1) After startup, immediately following a first Servo-ON or when you increase Pr22 (Machine stiffness at real time auto tuning), you may have abnormal noise or oscillation before you identify load inertia or an adaptive filter is stabilized. However, this doesn't constitute abnormality if it disappears in no time. If oscillation or noise persists over 3 reciprocating operations, you should take any of the following measures in any possible order:
  1) Write into EEPROM parameters used during normal operation.
  2) Decrease Pr22 (Machine stiffness at real time auto tuning).
  3) Once set Pr21 (Real time auto tuning set-up) to 0 and disable an adaptive filter. Then, enable real time auto tuning again (To disable inertia estimation/resetting of adaptive operation, or real time auto tuning, refer to "Cancellation of the Automatic Gain Tuning" on Page 135).
  4) Manually set a notch filter (Refer to "To Reduce Mechanical Resonance" on Page 140).

(2) In some cases, after abnormal noise or oscillation is generated, Pr20 (Inertia ratio) or Pr2F (Adaptive filter frequency) may change to an extreme value. Even in such a case, you should take the measures described above.

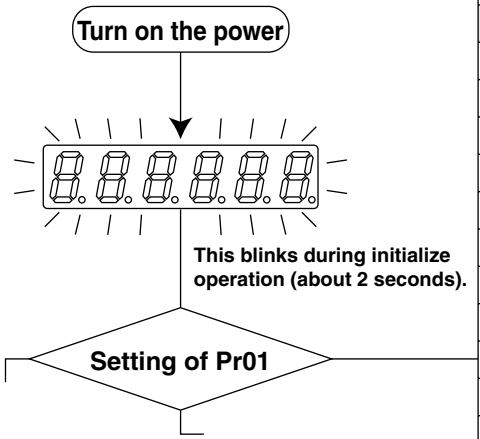
(3) Among results of real time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are written into EEPROM every 30 minutes. When you power ON again, auto tuning will be carried out using the data as an initial value.

Parameter Setting

Parameter for Selection of Functions

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
00	**Axis address**	0 - 15 [1]	In communications with a host such as a personal computer that uses RS232C with multiple axes, you should identify to which axis the host is accessing. With this parameter, you can see an axis name by number.
01	**LED for console, initial condition display**	0 - 15	In the initial state after power-on, you can select any type of data displayed by 7 segment LEDs on the console.



Settings	Content
0	Position deviation
[1]	Motor rotation speed
2	Torque output
3	Control mode
4	Input/output signal condition
5	Error factor, history
6	To be used by the manufacturer
7	Warning
8	Regenerative Load Ratio
9	Overload factor
10	Inertia ratio
11	Feedback pulse total
12	Command pulse total
13	Not available
14	Not available
15	Checking if there is motor automatic recognition function

For details of displays, refer to “Monitoring Mode” on Page 51 of Preparation edition.

02	**Control mode set up**	0 - 2	The parameter sets a control mode to be used.

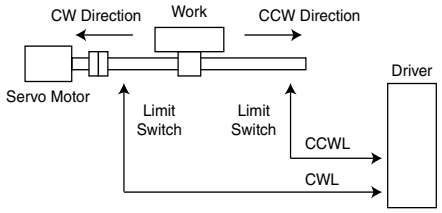
Setting	Control Mode
0	High velocity response positioning control (pulse)
1	Internal velocity control
[2]	High function positioning control (pulse)

<Remarks>

Parameter No. (Pr□□)	Parameter Name	High velocity response positioning control	High function positioning control
02	Control mode set-up	0	2
1D	1st notch frequency	Conditional	Validated
2B	Damping frequency	Conditional	Validated
21	Real time auto tuning mode set up	Conditional	Validated
2F	Adaptive filter frequency	Invalidated	Validated

In high velocity response positioning control, simultaneous use of the 1st notch frequency, vibration damping frequency, real time auto tuning mode setting is not allowed. A parameter entered earlier takes precedence.
(Example) If real time auto tuning has been set, the first notch frequency will be forcibly set to 1500 (invalidated) on the driver side, even when you enter it.

Standard Default Setup: [ ]

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>04</td><td>Overtravel Input inhibit</td><td>0 - 1</td><td>In the case of linear driving, in particular, limit switches should be provided on both ends of the axis, as illustrated in the figure below, to prevent any mechanical damage due to overshoot of a work, and inhibit driving in the direction in which the switches operate.
 

<table>
<tr><th rowspan="2">Settings</th><th rowspan="2">CCWL/ CWLInput</th><th colspan="2">Operation</th></tr>
<tr><th>Input</th><th>Connection with COM-</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enabled</td><td rowspan="2">CCWL (CN pin X5-8)</td><td>Connected</td><td>This shows normal state in which the limit switch on CCW side does not operate.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, and CW direction allowed.</td></tr>
<tr><td rowspan="2">CWL (CN pin X5-7)</td><td>Connected</td><td>This shows normal state in which the limit switch on CCW side does not operate.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, and CW direction allowed.</td></tr>
<tr><td>[1]</td><td>Disabled</td><td colspan="2">CCWL and CWL inputs are ignored, and driving is not inhibited (allowed) in both CCW and CW directions.</td></tr>
</table>
<Cautions>
1. When you set Pr04 to 0, and do not connect CCWL/CWL input to COM- (OFF), it will be judged as abnormality in which limits are simultaneously exceeded in both CCW and CW directions, and the driver will trip due to “Overtravel input error”.
2. You can set whether to activate a dynamic brake during deceleration when CCW overtravel inhibit input (CCWL) or CW overtravel inhibit input (CWL) works. For details, refer to descriptions on Pr66 (Deceleration and stop set-up at overtravel inhibit input).
3. In some cases, after you turn off the limit switch located above a work on the vertical axis, a work repeatedly moves up and down since there is no longer upward torque. In this case, don’t use this function, and carry out limit process on the host controller side.</td></tr>
<tr><td>06</td><td>ZEROSPD/TC input selection</td><td>0 - 2</td><td>The parameter is used to select functions of speed zero clamp input (ZEROSPD)/ torque limit switching (TC) input (connector) CN X5 pin 5.
<table>
<tr><th>Setting</th><th>Speed Zero Clamp</th><th>Torque Limit Switching Input</th></tr>
<tr><td>0</td><td>Disabled</td><td>Disabled</td></tr>
<tr><td>[1]</td><td>Enabled</td><td>Disabled</td></tr>
<tr><td>2</td><td>Disabled</td><td>Enabled</td></tr>
</table>
<Remarks>
If you wish to use torque limit switching input, also set Pr5E, Pr63, and Pr70 to 73 all at once. If settings of Pr70 and Pr73 remain 0, the error No.26 acceleration protection will occur.</td></tr>
<tr><td>09</td><td>Warning output selection</td><td>0 - 6</td><td>This parameter is to allocate functions of warning output(WARN:CN X5 pin 12).
<table>
<tr><th>Setting</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output during torque limit</td><td rowspan="8">For detailed information on functions of respective outputs listed in the left, refer to “Wiring to Connector CN X5” on Page 72.</td></tr>
<tr><td>1</td><td>Zero speed detection output</td></tr>
<tr><td>[2]</td><td>Over-regeneration/overload/fan rotation speed abnormality</td></tr>
<tr><td>3</td><td>Over-regeneration warning output</td></tr>
<tr><td>4</td><td>Overload warning output</td></tr>
<tr><td>5</td><td>To be displayed, but not functioning.</td></tr>
<tr><td>6</td><td>Fan rotation speed abnormality warning output</td></tr>
</table>
<Caution>
If you ignore output of warning and continue to use, the motor or driver may fail/be damaged.</td></tr>
</table>

Parameter Setting

Standard Default Setup: [ ]

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>0C</td><td>Baud rate set-up of RS232C</td><td>0 - 2</td><td>
<table>
<tr><th>Settings</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table>
</td></tr>
</table>

Parameters for Adjustment of Time Constants of Gains/Filters

PrNo.	Parameter Name	Range of Settings	Unit	Function/Content
10	**1st position loop gain**	0 - 32767 [63]*	1/s	• The parameter determines responsiveness of the position control system. If you can set a position gain higher, positioning time will be shorter.
11	**1st velocity loop gain**	1 - 3500 [35]*	Hz	• The parameter determines responsiveness of the velocity loop. To improve responsiveness of the entire servo system by setting the position loop gain high, you should be able to set this velocity loop gain higher.
12	**1st velocity loop integration time constant**	1 - 1000 [16]*	ms	• This is an integration element provided to velocity loop, and works to drive minute speed deviation after shutdown to zero. The smaller setting is, the faster the parameter drives it zero. • If it is set to "1000", there will be no effect of integration.
13	**1st speed detection filter**	0 - 5 [0]*	–	• The parameter is used to set a time constant of the low pass filter (LPF) entered after the block capable of conversion from an encoder signal to a speed signal in 6 phases (0 to 5). • As you increase a setting, the time constant will also rise. Thus, although you can reduce noise from the motor, we recommend you set it to 4 or less usually.
14	**1st torque filter time constant**	0 - 2500 [65]*	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into torque command unit. • This might take effect on suppression of vibration due to torsional resonance.
15	**Velocity feed forward**	–2000 - 2000 [300]*	0.1%	The parameter sets velocity feed forward volume in position control. If you set it to 100%, position deviation in operation at given speed will be almost 0. Although position deviation will be smaller when you set this higher, and thus responsiveness will be improved, overshoot is liable to occur more often. Thus, be careful.
16	**Feed forward filter time constant**	0 - 6400 [50]*	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the velocity feed forward unit. • With the feed forward feature included, the filter might improve speed overshoot/undershoot and thus chattering of positioning completion signal.
18	**2nd position loop gain**	0 - 32767 [73]*	1/s	• A position loop, velocity loop, speed detection filter, and torque command filter have 2 pairs of gains or time constants (1st and 2nd), respectively. • The functions/descriptions of respective gains/time constants are same as the first gain/time constants. • For details on switching of the 1st/2nd gain, and time constants, refer to Page 127 of Adjustment edition. * When Pr20 inertia ratio is set correctly, Pr11 and Pr19 will be set in (Hz).
19	**2nd velocity loop gain**	1 - 3500 [35]*	Hz	
1A	**2nd velocity loop integration time constant**	1 - 1000 [1000]*	ms	
1B	**2nd speed detection filter**	0 - 5 [0]*	–	
1C	**2nd torque filter time constant**	0 - 2500 [65]*	0.01ms	
1D	**1st notch frequency**	100 - 1500 [1500]	Hz	• The parameter sets notch frequency of a resonance suppression notch filter. • Set the parameter about 10% lower than resonance frequency of the mechanical system that has been found by the frequency characteristic analysis feature of "PANATERM®, the setup support software. • Setting this parameter to "1500" disables functions of the notch filter.
1E	**1st notch width selection**	0 - 4 [2]	–	• The parameter sets width of notch frequency of a resonance suppression notch filter in 5 stages. The higher setting is, the wider filter width will be. • Usually, use a default set-up value.

<Remarks>

Parameters having standard default setup value with "*" mark are automatically set while real time auto gain tuning is running. To change to manual, refer to "Cancellation of the Automatic Gain Tuning" on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

Parameters for Auto Gain Tuning

Standard Default Setup: [ ]

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 - 10000
[100]*</td><td>%</td><td>• The parameter sets a ratio of load inertia to rotor inertia of the motor.
Pr20 = (Load inertia/rotor inertia) x 100 [%]
• When you execute auto gain tuning, load inertia is estimated and the result will be reflected in the parameter.
If inertia ratio has been set correctly, Pr11 and Pr19 will be set in (Hz). When Pr20 inertia ratio is greater than actual value, setting unit of the velocity loop gain will be greater. If inertia ratio is smaller than actual value, setting unit of the velocity loop will be smaller.
• The inertia ratio estimated during execution of real time auto tuning is saved in EEPROM every 30 minutes.</td></tr>
<tr><td>21</td><td>Real time auto tuning set-up</td><td>0 - 7</td><td>–</td><td>• The parameter sets an operation mode of real time auto tuning. As you set this to a higher value such as 3, 6…, inertia change during operation will be quickly responded. However, operation may become unstable, depending on the operation pattern. Thus, we recommend that you usually set the parameter to 1 or 4.
• When you sent the adaptive filter to disabled, Pr2F adaptive filter frequency will be reset to 0.
• The adaptive filter will be enabled only when Pr02=2 (in high function positioning control mode).
<table>
<tr><th>Settings</th><th>Real time auto tuning</th><th>Degree of changes in load inertia during operation</th><th>Adaptive filter</th></tr>
<tr><td>0</td><td>Not used</td><td>————</td><td>No</td></tr>
<tr><td>[1]</td><td rowspan="6">Used</td><td>Little change</td><td rowspan="3">Yes
(When Pr02=2)</td></tr>
<tr><td>2</td><td>Gradual change</td></tr>
<tr><td>3</td><td>Sharp change</td></tr>
<tr><td>4</td><td>Little change</td><td rowspan="3">No</td></tr>
<tr><td>5</td><td>Gradual change</td></tr>
<tr><td>6</td><td>Sharp change</td></tr>
<tr><td>7</td><td>Not used</td><td>————</td><td>(When Pr02=2)</td></tr>
</table>
• Any change to this parameter will be valid when Servo-OFF switches to Servo-ON.
<Remarks>
For Pr02 = 0 (in high velocity response positioning control mode), setting will be possible only when both first notch filter and vibration damping filter are set to disabled.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto turning</td><td>0 - 15
[4]</td><td>–</td><td>• The parameter sets mechanical stiffness during execution of real time auto tuning in 16 stages.
Low ← Mechanical stiffness→ High
Low ←Servo gain→ High
Pr22 | 0 • 1- - - - - - - - - - - - 14 • 15
Low ←Responsiveness→ High
• If you change a setting sharply and abruptly, gain will vary suddenly, thus giving impact to the machine. Be sure to start with a small setting and gradually increase it while observing how the machine is running.</td></tr>
</table>

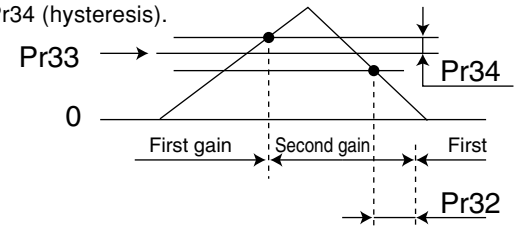
<Remarks>

Parameters having standard default setup value with "*" mark are automatically set while real time auto gain tuning is running. To change to manual, refer to "Cancellation of the Automatic Gain Tuning" on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>25</td><td>Normal auto tuning motion set-up</td><td>0 - 7</td><td>–</td><td>• The parameter sets operation patterns of normal auto gain tuning.
<table>
<tr><th>Settings</th><th>Number of Rotations</th><th>Rotation Direction</th></tr>
<tr><td>[0]</td><td rowspan="4">2 rotations</td><td>CCW →CW</td></tr>
<tr><td>1</td><td>CW →CCW</td></tr>
<tr><td>2</td><td>CCW →CCW</td></tr>
<tr><td>3</td><td>CW →CW</td></tr>
<tr><td>4</td><td rowspan="4">1 rotations</td><td>CCW → CW</td></tr>
<tr><td>5</td><td>CW →CCW</td></tr>
<tr><td>6</td><td>CCW →CCW</td></tr>
<tr><td>7</td><td>CW →CW</td></tr>
</table></td></tr>
<tr><td>26</td><td>Software limit setup</td><td>0 - 1000
[10]</td><td>0.1rev</td><td>Set the motor operational range for the corresponding position command range.
If this parameter is set to “0”, then the software limit protection detection will be disabled.
When using it, refer to “Software limit function”, Troubleshooting on page 148.</td></tr>
<tr><td>2B</td><td>Damping frequency</td><td>0 - 5000
[0]</td><td>0.1Hz</td><td>• The parameter sets vibration damping frequency for anti-vibration control that suppresses vibration at leading ends of load.
• The parameter measures frequency of vibration at leading ends of load, and sets it in [0.1Hz].
• Set minimum frequency is 100 [0.1Hz]. Even though you set it to 0 to 99, it will be ignored.
When you use this parameter, also see “Anti-Vibration Control” on Page 142 of Adjustment edition.
<Remarks>
For Pr02=0 (high velocity response positioning control mode), you can set the parameter only when both first notch filter and real time auto tuning are disabled.</td></tr>
<tr><td>2C</td><td>Damping filter setting</td><td>–200 - 2500
[0]</td><td>0.1Hz</td><td>• You should set the parameter to a small value if torque saturation results from setting of Pr2B damping frequency. Set it to a great value if you wish to expedite positioning operation.
• We recommend that you usually set it to 0. Also see “Anti-Vibration Control” on Page 142 of Adjustment edition.</td></tr>
<tr><td>2F</td><td>Adaptive filter frequency</td><td>0 - 64</td><td>–</td><td>• The parameter indicates Table No. that corresponds to frequency of the adaptive filter (See Page 135).
• This parameter is automatically set when the adaptive filter is enabled (i.e., when Pr21 real time auto tuning set-up is 1 to 3.7) and a user is not allowed to change it.
[0]: Filter disabled 1-64: Filter enabled
• When the adaptive filter is enabled, this parameter is saved in EEPROM every 30 minutes. If the adaptive filter is enabled next time you power up, adaptive operation will start with the data contained in EEPROM as an initial value.
• Should operation be wrong, clear the parameter. If you wish to reset the adaptive operation, disable the adaptive filter, and then set it to enabled again (i.e., set Pr21 real time auto tuning set-up to any value other than 1 to 3.7).
Refer to “Manual Gain Tuning (To Reduce Mechanical Resonance” on Page 140 of Adjustment edition.</td></tr>
</table>

Parameters for Adjustment (Related to Second Gain Switching Function)

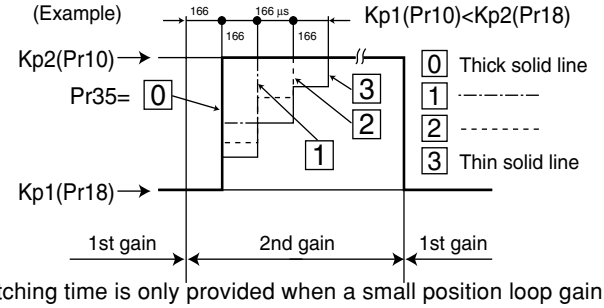
Standard Default Setup: [ ]

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>30</td><td>2nd gain action set-up</td><td>0 - 1</td><td>–</td><td>• Set the parameter when you carry out optimum tuning by using gain switching function.
<table><tr><td>Settings</td><td></td></tr><tr><td>0</td><td>Use the first gain (Pr10 to Pr14).</td></tr><tr><td>[1]</td><td>Switch between first gain (Pr10 to Pr14) and second gain (Pr18 to Pr1C).</td></tr></table>For conditions of switching of the 1st and 2nd gains, refer to “Gain Switching Function” on Page 138 of Adjustment edition.</td></tr>
<tr><td>31</td><td>Position control switching mode</td><td>0 - 10</td><td>–</td><td>• The parameter is used to select conditions of switching the 1st and 2nd gain in the position control mode.
<table><tr><td>Settings</td><td>Trigger for Switching Gains</td></tr><tr><td>0</td><td>Fixed to the 1st gain.</td></tr><tr><td>1</td><td>Fixed to the 2nd gain.</td></tr><tr><td>2</td><td>The 2nd gain switching input (GAIN) of pin 5 of CN X5 is ON (Pr30 needs setting of 1.)</td></tr><tr><td>3 *</td><td>Torque command variation</td></tr><tr><td>4</td><td>Fixed to the 1st gain.</td></tr><tr><td>5 *</td><td>Command speed</td></tr><tr><td>6 *</td><td>Position deviation</td></tr><tr><td>7 *</td><td>Position command</td></tr><tr><td>8 *</td><td>Positioning not completed</td></tr><tr><td>9 *</td><td>Motor real speed</td></tr><tr><td>[10]*</td><td>Position command + speed</td></tr></table>* For a switching level and timing, refer to “Gain Switching Function” on Page 138 of Adjustment edition.</td></tr>
<tr><td>32</td><td>Position control switching delay time</td><td>0 - 10000 [30]*</td><td>x 166µ s</td><td>• The parameter is enabled when Pr31 is 3 or 5 to 10, and sets delay time from when it no longer meets the condition of switching selected with Pr31 till actual return to the 1st gain.</td></tr>
<tr><td>33</td><td>Position control switching level</td><td>0 - 20000 [50]*</td><td>–</td><td>• The parameter is enabled when Pr31 is 3, 5, 6, 9, or 10, and sets judgment level of when the 1st and 2nd are switched. Unit may vary depending on setting of Pr31.</td></tr>
<tr><td>34</td><td>Position control switching hysteresis</td><td>0 - 20000 [33]*</td><td>–</td><td>• The parameter sets margin of hysteresis to be provided above and below the judgment level set with Pr33 mentioned above.
• The following figure illustrates definitions of Pr32 (delay), Pr33 (level) and Pr34 (hysteresis).
 

<Caution>
Settings of Pr33 (level) and Pr34 (hysteresis) are valid as absolute value (positive/negative).</td></tr>
</table>

<Remarks>

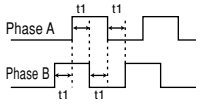
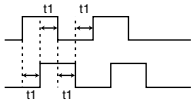
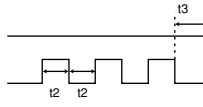
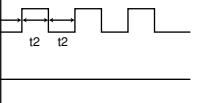
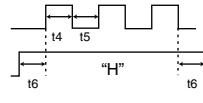
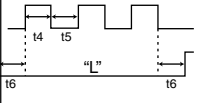
Parameters having standard default setup value with “*” mark are automatically set while real time auto gain tuning is running. To change to manual, refer to “Cancellation of the Automatic Gain Tuning” on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

PrNo.	Parameter Name	Range of Settings	Unit	Function/Content
35	**Position loop gain switching time**	0 - 10000 [20]*	(Setting value+1) x 166 ms	• With the 2nd gain switching function enabled, you can provide phased switching time only for position loop gain when gain is switched.  • Switching time is only provided when a small position loop gain is switched to a large position loop gain (Kp1 → Kp2) (in order to alleviate impact to the machine due to abrupt change in gain). • Set a value that is smaller than a difference between Kp2 and Kp1.

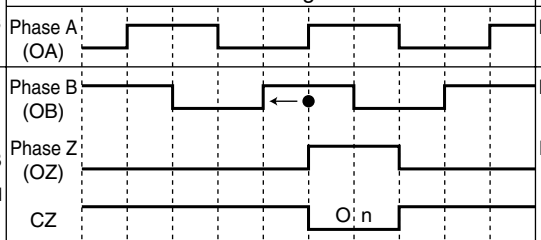
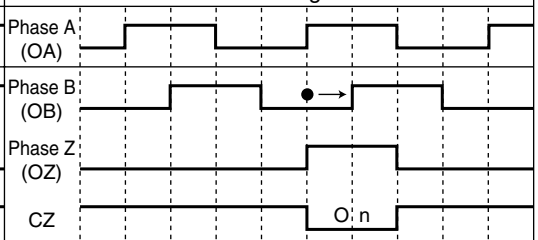
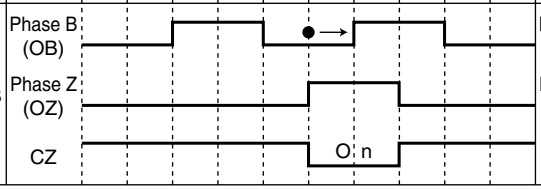
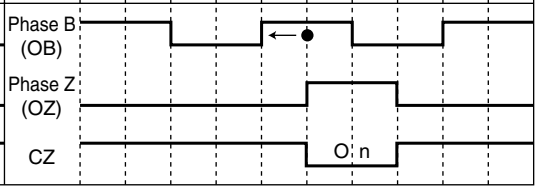
Parameters for Position Control

Standard Default Setup: [ ]

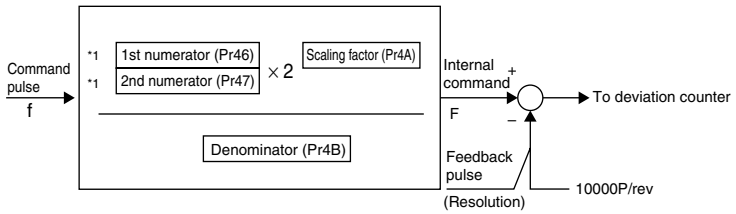
PrNo.	Parameter Name	Range of Settings	Function/Content
40	Command pulse multiplier set-up	**1 - 4**	The parameter sets a multiplier number with Pr42 (Command pulse input mode set-up) when "2 phase pulse input" is selected as a form of command pulse. Settings: 1 or 2 → Multiplier number at 2 phase pulse input: x 2 Settings: 3 or [4] → Multiplier number at 2 phase pulse input: x 4
41	Command pulse direction of rotation set-up	**0 - 3**	The parameter sets direction of rotation of the motor to the command pulse input. Settings: [0] or 3 → Direction of Rotation: The motor rotates in a direction given by the command pulse. Settings: 1 or 2 → Direction of Rotation: The motor rotates in a direction opposite to the command pulse.
42	Command pulse input mode set-up	**0 - 3**	The parameter sets input form of command pulse to be given to the driver from the host. Three input forms illustrated in the following table can be set. Select any of them according to specifications of the host.

Settings	Command pulse form	Signal Name	CCW Command	CW Command
0 or 2	90° phase difference 2 phase pulse (Phase A + Phase B)	PULS SIGN	 Phase B goes ahead of Phase A by 90°.	 Phase B delays from Phase A by 90°.
[1]	CW pulse row + CCW pulse row	PULS SIGN		
3	Pulse row + Sign	PULS SIGN		

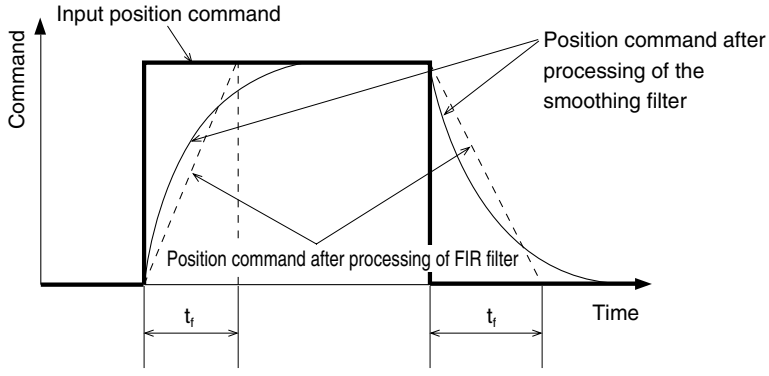
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>42
(Cont'd)</td><td>Command pulse input mode set-up
(Cont'd)</td><td>0 - 3</td><td>
Allowable input maximum frequency of command pulse input signal and minimum required time width
<table>
<tr><td rowspan="2">Input I/F of PULS/ SIGN signal</td><td rowspan="2">Allowable input maximum frequency</td><td colspan="6">Minimum required time width[μs]</td></tr>
<tr><td>t_1</td><td>t_2</td><td>t_3</td><td>t_4</td><td>t_5</td><td>t_6</td></tr>
<tr><td>Line driver interface</td><td>500kpps</td><td>2</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Open collector interface</td><td>200kpps</td><td>5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td></tr>
</table>
Set rise/fall time of command pulse input signal to 0.1 μs or lower.
</td></tr>
<tr><td>44</td><td>Output pulses per single turn</td><td>1 - 16384
[2500]</td><td>The parameter sets the number of pulses per rotation of the encoder pulse to be output to the host. Pulse should be set with dividing.
Directly set the number of pulses per rotation, in [Pulse/rev], necessary for a device/system on your side.
Any value that exceeds the encoder pulse will be disabled.</td></tr>
<tr><td>45</td><td>Pulse output logic inversion</td><td>0 - 1</td><td>A phase relation of output pulses from the rotary encoder is as follows: Phase B pulse is behind Phase A pulse during rotation in CW direction (Phase B pulse is ahead of Phase A pulse during rotation in CCW direction).

Reversing logic of Phase B pulse with this parameter, you can reverse the phase relation of Phase B to Phase A.
<table>
<tr><td>Settings</td><td>When the motor is rotating in CCW direction</td><td>When the motor is rotating in CW direction</td></tr>
<tr><td>[0]
Phase B
Noninverted</td><td> 
</td><td> 
</td></tr>
<tr><td>1
Phase B
Inverted</td><td> 
</td><td> 
</td></tr>
</table>
Phase Z is in sync with Phase A. You cannot reverse Phase Z.
Even by dividing, Phase Z outputs 1 pulse per rotation.
</td></tr>
</table>

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
	Related to command pulse dividing multiplier function (Pr46, 47, 4A, 4B)		
46	**Numerator of 1st command pulse ratio**	1 - 10000 [10000]	Command pulse dividing multiplier (electronic gear) function • Purposes of Use (1) To arbitrarily set rotation/motion of the motor per a unit input command pulse. (2) To increase apparent command pulse frequency, by using multiplier function, when the pulse oscillation capacity (maximum frequency that can be output) of the host is limited and thus required motor speed cannot be obtained. • Block Diagram of Dividing Multiplier Unit  • A calculated value of a numerator shall be up to 2621440. Even though you set a value greater than this upper limit, setting will be invalid. Note that 2621440 will be a numerator. Selection of command multiplier dividing “numerator” *1: Select 1 or 2 with command dividing multiplier input switching (DIV:CN X5 pin 6). DIV OFF — Select a 1st numerator (Pr46). DIV ON — Select a 2nd numerator (Pr47). <Example of Setting> • It is essential that “the motor rotates once with command input (f) for resolution of the encoder”, when the diving multiplier ratio = 1. Thus, in order to rotate the motor once as an example when the encoder resolution is 10000 P/r, you should enter f =5000 Pulse for double multiplier, and f=40000 Pulses in 1/4 dividing. • Set Pr46, 4A and 4B so that internal command (F) after dividing multiplier will be equal to resolution of the encoder (10000). $F = f \times \frac{Pr46 \times 2^{Pr4A}}{Pr4B} = 10000$ F: Number of internal command pulses for one rotation of the motor f: Number of command pulses for one rotation of the motor Resolution of Encoder: 10000 (2500P/r x 4) Example 1 — Set command input (f) to 5000 per one rotation of the motor: Pr 46 [10000] x 2 / Pr 4B [5000], Pr 4A [0] Example 2 — Set command input (f) to 40000 per one rotation of the motor: Pr 46 [2500] x 2 / Pr 4B [10000], Pr 4A [0]
47	**Numerator of 2nd command pulse ratio**	1 - 10000 [10000]	
4A	**Multiplier of numerator of command pulse ratio**	0 - 17 [0]	
4B	**Denominator of command pulse ratio**	1 - 10000 [10000]	

Standard Default Setup: [ ]

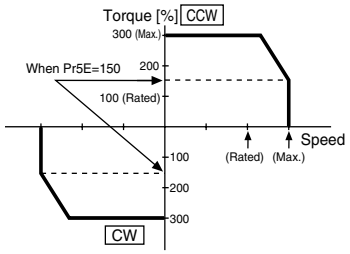
PrNo.	Parameter Name	Range of Settings	Function/Content
4C	**Smoothing filter set-up**	0 - 7	A smoothing filter is the primary delay filter inserted after command dividing multiply part of the command pulse input part. Purpose of smoothing filter • Its primary purpose is to reduce stepping motion of the motor when a command pulse is rough. • To give actual examples of rough command pulse: (1) When you set a high multiplier ratio (i.e., 10 times or more) in command dividing multiplier (2) When the command pulse frequency is low • With Pr4C, you can set a time constant of the smoothing filter in 8 steps: Settings: 0 = No filtering function; **[1]** = Low time constant; ↓; 7 = High time constant
4E	**FIR filter set-up**	0 - 31 [0]	• The parameter selects a time constant of FIR filter to be subjected to command pulse. • When setting is higher, a command will be smoother. • Note that any change to this parameter will only be enabled after you reset the power supply.  t_f = (Pr4E+1) x control cycle The control cycle is 166 μs for Pr02=0 (high velocity response positioning control) and 333 μs for Pr02=2 (high function positioning control).

Parameters for Internal Velocity Control

Standard Default Setup: [ ]

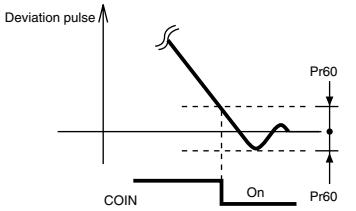
PrNo.	Parameter Name	Range of Settings	Function/Content
57	**JOG internal speed set-up**	0 - 500 [300]	The parameter directly sets in [r/min] JOG speed during JOG operation in “motor test run mode”. For details of JOG function, refer to “Test Run (JOG)” on Page 60 of Preparations edition.

Parameters for Torque Limits

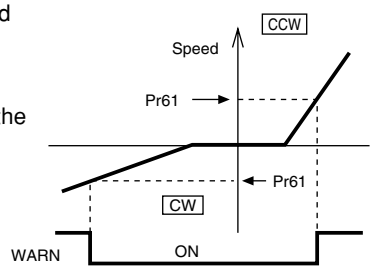
PrNo.	Parameter Name	Range of Settings	Function/Content
5E	**1st torque limit set-up**	0 - 500	• With this parameter set, maximum torque of the motor is limited in the driver. • Normal specification allows torque about 3 times as large as rated torque, if in an instant. We recommend that you limit the maximum torque with this parameter if the tripled torque might cause trouble to intensity of the motor load (machine). • You can give setting as a percentage (%) value to rated torque. • The right figure shows an example in which it is limited to 150%. • Pr5E limits the maximum torque of both CW and CCW directions simultaneously.  **<Remarks>** With torque limit switching function enabled (Pr06=2), this parameter is a value of the 1st torque limit. **<Cautions>** You cannot set to this parameter a value that exceeds a default setup value with “Maximum Output Torque Setting” of the system parameter (i.e., factory default parameters that cannot be changed through manipulation of PANATERM® and console). A default setup value may differ depending on a combination of a motor and driver. For detailed information, refer to “Setting of 1st Torque Limit” on Page 45 of Preparation edition.

Parameters for Sequences

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
60	**In-position range**	0 - 32767 [10]	• The parameter sets timing to output a positioning completion signal (COIN:CN X5 pin 10) when movement of the motor (work) is complete after input of command pulse ends. • The positioning completion signal (COIN) is output when the number of pulses of the deviation counter falls within ± (setting). • A basic unit of deviation pulse is “resolution” of an encoder to be used. Thus, in the case of E series, it will be: 4 x 2500P/rev=10000  <Cautions> 1. Setting of too small a value to Pr60 might extend time before COIN signal is output, or generate chattering during output. 2. Setting of “In-position range” does not affect precision of final positioning.

Standard Default Setup: [ ]

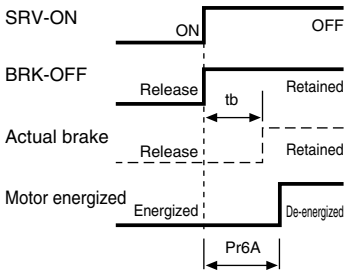
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>61</td><td>Zero speed</td><td>0 - 20000 [50]</td><td>
• The parameter directly sets in [r/min] timing to output zero speed detection output signal (WARN: CN X5 pin 12).
You need to set parameter warning output selection (Pr09) to 1.
• The zero speed detection signal (WARN) will be output when the motor speed falls below the set speed of this parameter Pr61.
• Setting of Pr61 acts on both CW and CCW directions, irrespective of the direction of motor rotation.
• There is hysteresis of 10 rpm. Set the parameter 10 or more.


</td></tr>
<tr><td>63</td><td>1st position over-deviation set-up</td><td>0 - 32767 [1875]</td><td>
• The parameter sets a detection level for determining excessive deviation of “protection against excessive position deviation” feature, by using the number of retained pulses of the deviation counter.
• Calculate setting according to the expression shown below:
$$\text{Setting} = \frac{\text{Level for Determining Excessive Position Deviation [PULSE]}}{256}$$
<Cautions>
Be careful because the protection against excessive position deviation may work although there is no abnormality, in particular, when you not only set position gain low but also set Pr63 low.
</td></tr>
<tr><td>64</td><td>Position over-deviation invalidation</td><td>0 - 1</td><td>
This parameter can disable the “protection against excessive position deviation” function.
<table>
<tr><th>Setting</th><th>Protection against excessive position deviation</th></tr>
<tr><td>[0]</td><td>Enabled</td></tr>
<tr><td>1</td><td>Disabled. The operation continues without causing abnormality even when retained pulse exceeds the level for judgment set with Pr63.
Runaway may occur if you make a mistake in the sequence of phases of the motor or wiring of the encoder. Install a failsafe in the device to prevent runaway.</td></tr>
</table>
</td></tr>
<tr><td>66</td><td>Deceleration and stop set-up at overtravel inhibit</td><td>0 - 2</td><td>
The parameter sets the deceleration and stop operation after the overtravel inhibit input (CCWL: Connector CNx58 pin or CWL: Connector CNx57 pin) activates and becomes enabled.
<table>
<tr><th>Setting</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>Invalidate torque in the overtravel inhibit direction, and activate the dynamic brake.</td></tr>
<tr><td>1</td><td>Invalidate torque in the overtravel inhibit direction, and have the motor free run.</td></tr>
<tr><td>2</td><td>In the position control mode, servo lock is decelerated and stopped, and in the internal velocity control mode, speed zero clamp deceleration and stop is actuated.</td></tr>
</table>
</td></tr>
</table>

Standard Default Setup: [ ]

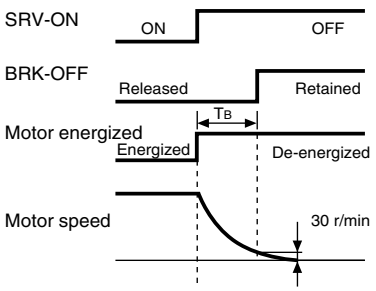
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>68</td><td>Sequence at alarm</td><td>0 - 3</td><td>The parameter sets driving conditions during deceleration after alarm is generated as a result of activation of any of protective functions of the driver, or after the motor stops.
<table>
<tr><th rowspan="2">Settings</th><th colspan="2">Driving Conditions</th><th rowspan="2">State of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After stop</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Cleared</td></tr>
<tr><td>1</td><td>Free run</td><td>DB</td><td>Cleared</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Cleared</td></tr>
<tr><td>3</td><td>Free run</td><td>Free</td><td>Cleared</td></tr>
</table>
(DB: Dynamic Brake operation)
Also see Timing Chart “After an Alarm event” on Page 33 of Preparation edition.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 - 7
[0]</td><td>The parameter sets the following:
1) Driving conditions during deceleration or after stop
2) Clear operation of the deviation counter
after Servo-OFF (SRV-ON signal: CN X5 pin 2 turns on→ off) is turned on.
<table>
<tr><th rowspan="2">Settings</th><th colspan="2">Driving Conditions</th><th rowspan="2">State of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After stop</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Cleared</td></tr>
<tr><td>1</td><td>Free run</td><td>DB</td><td>Cleared</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Cleared</td></tr>
<tr><td>3</td><td>Free run</td><td>Free</td><td>Cleared</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retained</td></tr>
<tr><td>5</td><td>Free run</td><td>DB</td><td>Retained</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retained</td></tr>
<tr><td>7</td><td>Free run</td><td>Free</td><td>Retained</td></tr>
</table>
(DB: Dynamic Brake operation)
Also see Timing Chart “Servo-ON/OFF Operation When the Motor is Stopped” on Page 34 of Preparation edition.</td></tr>
<tr><td>6A</td><td>Mech. break action set-up at motor standstill</td><td>0 - 100
[0]</td><td>The parameter enables you to set time from when the brake release signal (BRK-OFF:CN X5 pin 11) turns off until the motor becomes de-energized (servo free), when you turn on Servo-OFF while the motor is stopped.

In order to prevent subtle travel/drop of the motor (work) due to the action delay time (tb) of the brake, set as follows:
Setting of Pr6A ≥ tb
Pr6A is set in the unit of (setting) × 2ms.
Refer to Timing Chart of “Servo-ON/OFF Operation When the Motor is Stopped” on Page 34.



Also see Timing Chart “Servo-ON/OFF Operation When the Motor is Rotating” on Page 34 of Preparation edition.</td></tr>
</table>

Standard Default Setup: [ ]

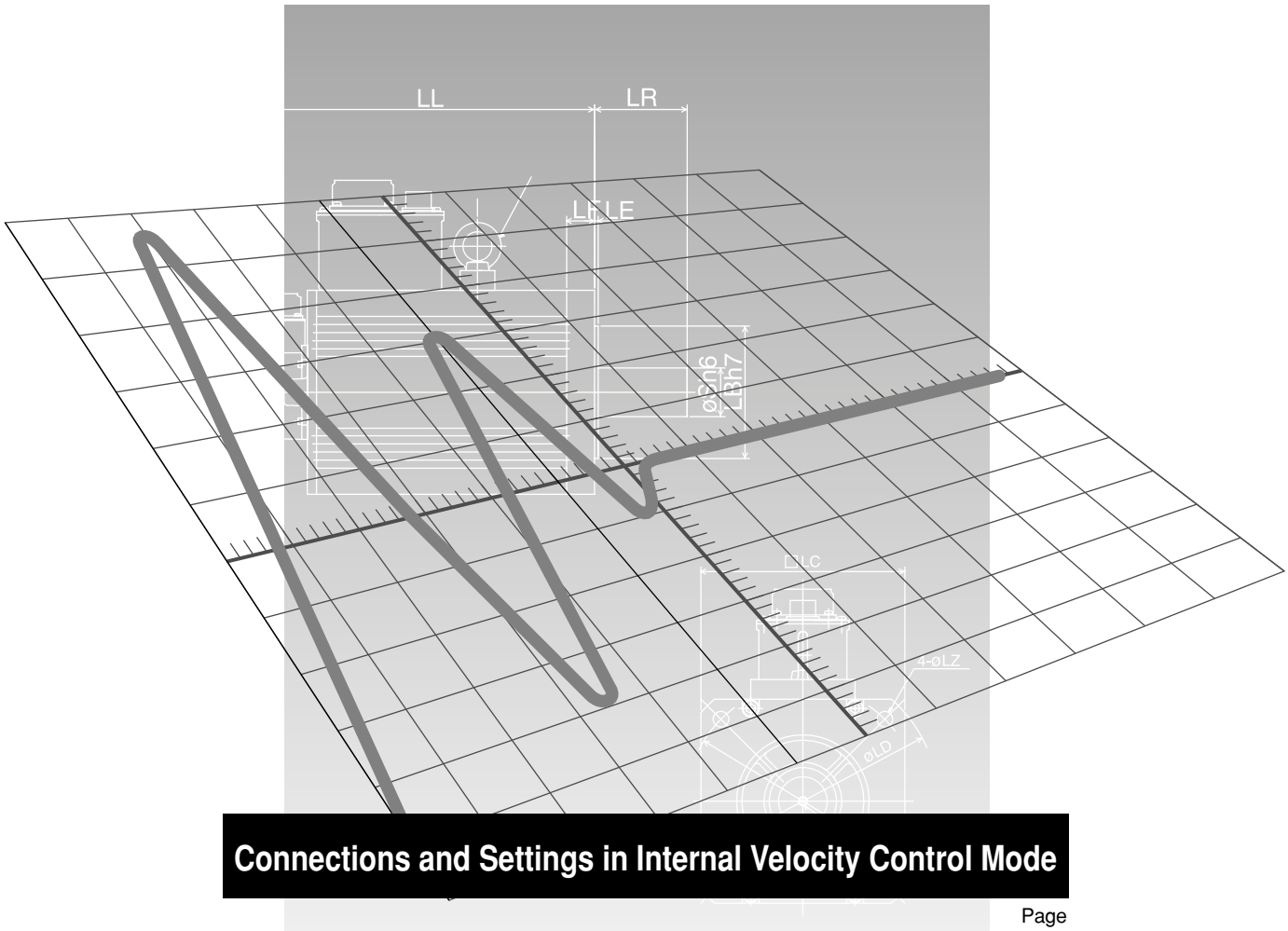
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>6B</td><td>Mech. break action set-up at motor in motion</td><td>0 - 100 [0]</td><td>Unlike Pr6A, Pr6B sets time from when the motor is de-energized (servo free) until the brake release signal (BRK-OFF:CN X5 pin 11) turns off (i.e., brake retained), when Servo-OFF is activated while the motor is still rotating.
• The parameter is set to prevent deterioration of the brake to be cause by rotation of the motor.
• In servo-off operation while the motor is still running, time TB shown in the right figure is time set by Pr6B or time before rotation speed of the motor falls below about 30r/min, whichever is shorter.
• Pr6B is displayed in terms of (setting) x 2ms.
• Refer to the timing chart of “Servo-ON/OFF Operation When the Motor is Rotating” on Page 34.
 

Also see timing chart “Servo-ON/OFF Operation When the Motor is Stopped” on Page 34 of Preparation edition.</td></tr>
<tr><td>6C</td><td>External regenera-tive discharge resister selection</td><td>0 - 3</td><td>If you install a regenerative resistor externally, set this parameter to any value other than 0 or 3 and connect the regenerative resistor between P (pin 5) and B (pin 3) of the connector CN X1.
<table>
<tr><th>Settings</th><th>Regenerative resistors to be used</th><th>Protection against overload of regenerative resistors</th></tr>
<tr><td>0</td><td>–</td><td>As regeneration processing circuit does not run, a built-in condenser handles all of regenerative power.</td></tr>
<tr><td>1</td><td>Externally instaled resistor</td><td>With the operating limit of an externally installed resistor set to 10% duty, activate protection against overload of regenerative resistors (alarm code 18).</td></tr>
<tr><td>2</td><td>Externally installed resistor</td><td>The protection against regenerative overload does not work.</td></tr>
<tr><td></td><td>–</td><td>As regeneration processing circuit does not run, a built-in condenser handles all of regenerative power.</td></tr>
</table>
<Note>
When you use an external regenerative resistor, be sure to install such an external safeguard as a temperature fuse, etc.
Otherwise, protection of a regenerative resistor may be lost, resulting in abnormal heat generation and burnout of the regenerative resistor.
<Cautions>
Do not touch an external regenerative resistor.
Otherwise, an external regenerative resistor will be hot and may cause burn injury.</td></tr>
</table>

<Note>
- **An optional external regenerative resistor has a built-in temperature fuse for safety reasons. The built-in temperature fuse may be disconnected depending on heat dissipation conditions, range of use temperatures, supply voltage, and fluctuations of load.**
- **Configure the machine so that surface temperature of a regenerative resistor is kept below 100˚C, even when regeneration is apt to occur and the machine is placed under poor conditions (i.e., high supply voltage, high load inertia, and short deceleration time). Also be sure to check that it can run properly.**

70	**1st over-speed level set-up**	0 - 6000 [0]	Pr06=2 The parameter sets a 1st overspeed level when torque limit switching input is enabled. If rotation speed of the motor exceeds this setting when the 1st torque limit is selected, overspeed error will be generated. The unit is [r/min]. This parameter will be invalid when the torque limit switching input is disabled.
71	**2nd torque limit set-up**	0 - 500 [0]	Pr06=2 The parameter sets a 2nd torque limit when torque limit switching input is enabled. This setting will be a limit value of the motor output torque when the 2nd torque limit is selected. Set this in terms of [%] to rated torque of the motor. This parameter will be invalid when the torque limit switching input is disabled.
72	**2nd position over-deviation set-up**	1 - 32767 [1875]	Pr06=2 The parameter sets a second excessive position deviation range when torque limit switching input is enabled. The unit is [256 x resolution]. This parameter will be invalid when the torque limit switching input is disabled.
73	**2nd over-speed level set-up**	0 - 6000 [0]	Pr06=2 The parameter sets a 2nd overspeed level when torque limit switching input is enabled. If rotation speed of the motor exceeds this setting when the 2nd torque limit is selected, overspeed error will be generated. The unit is [r/min]. This parameter will be invalid when the torque limit switching input is disabled.

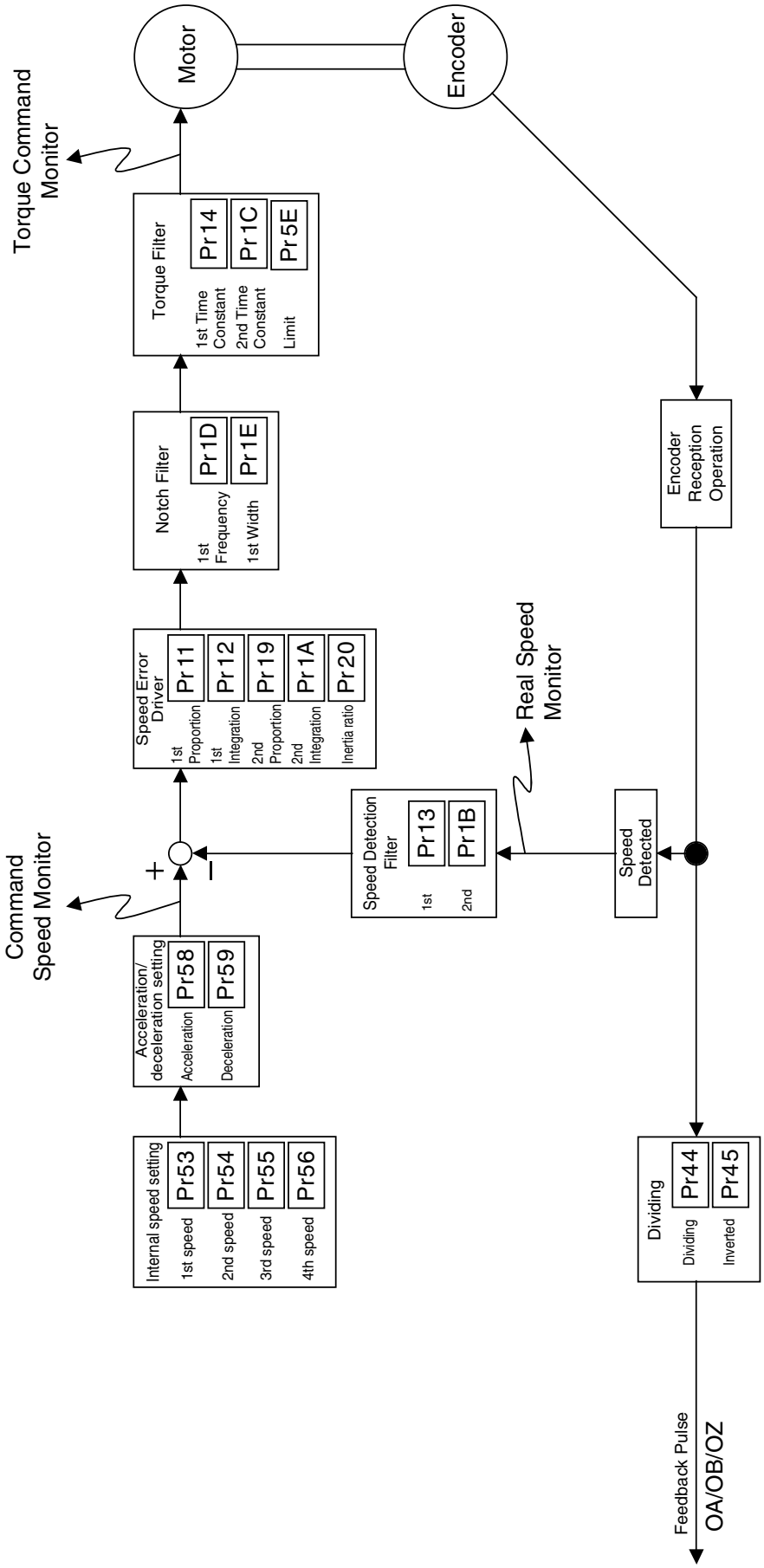
<Remarks>
For any use example of hit-and-stop initialization or press load pressing control using Pr70 to Pr73, see Pages 207 and 208 of Reference edition.



Connections and Settings in Internal Velocity Control Mode

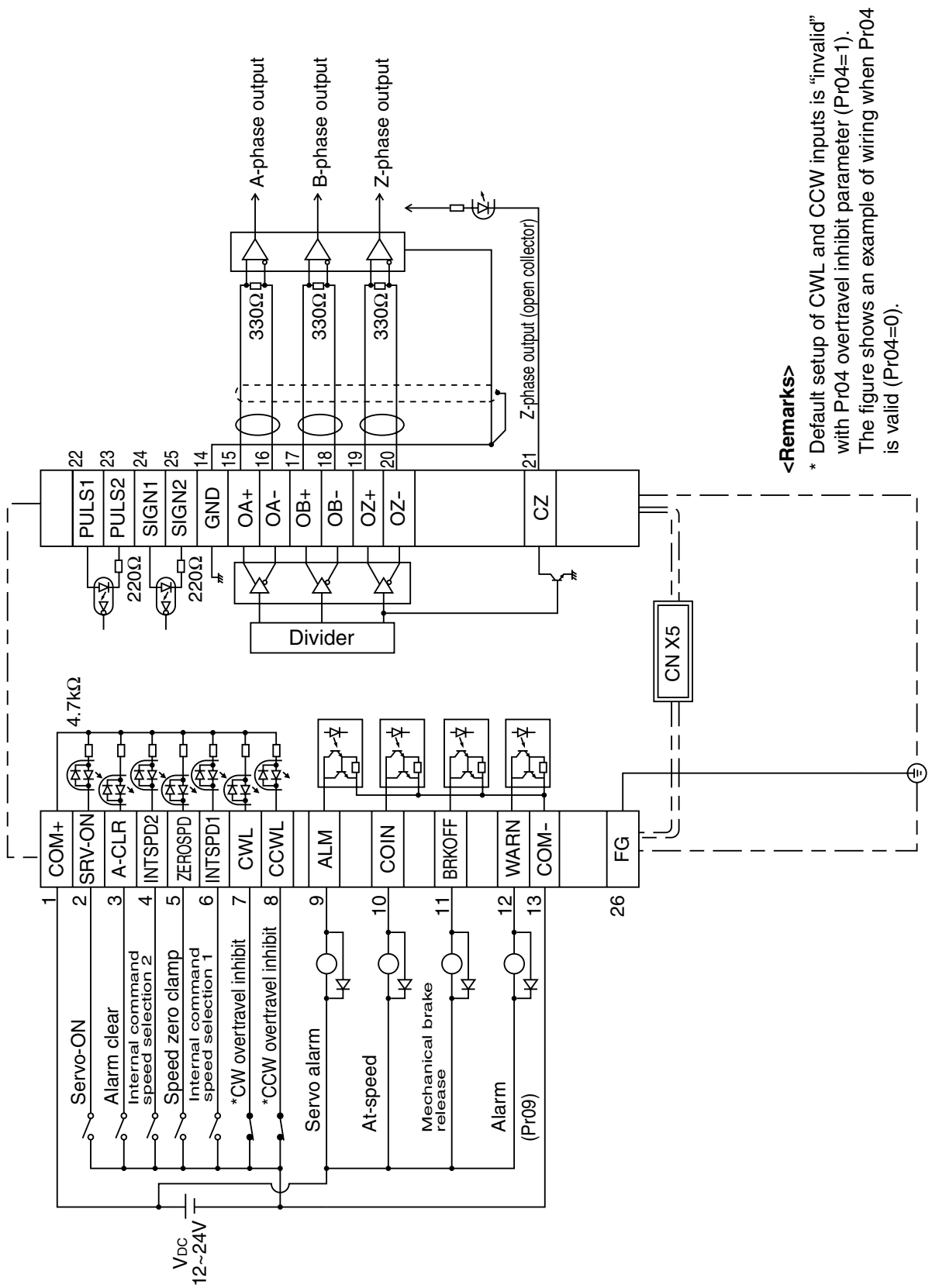
Control Block Diagram in Internal Velocity Control Mode

■ When Pr02, parameter for setting internal control mode is [1]:



Example of Wiring to Connector CN X5

Example of Wiring in Internal Velocity Control Mode



<Remarks>

* Default setup of CWL and CCW inputs is "invalid" with Pr04 overtravel inhibit parameter (Pr04=1). The figure shows an example of wiring when Pr04 is valid (Pr04=0).

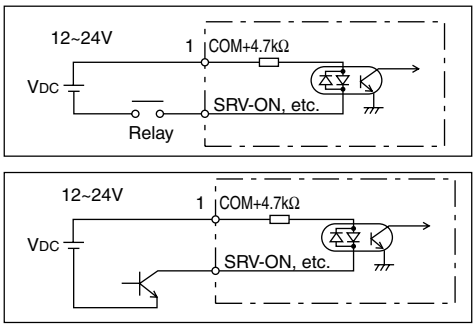
Wiring to Connector CN X5

Interface Circuit

Input Circuit

SI **Connection with Sequence Input Signal**

- Connect to a contact of switch and relay, or a transistor of an open collector output.
- When you plan to use a contact input, use switch and relay for minute electric current so as to avoid poor contact.
- In order to secure appropriate level of primary current of the photo coupler, set lower limit voltage of the power supply (12 to 24 V) above 11.4V.



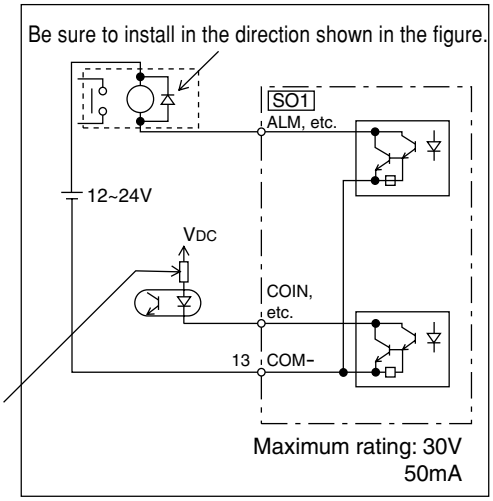
Output Circuit

SO1 **Sequence Output Circuit**

- This output circuit is configured with a Darlington connection transistor output of open collector. It is connected to a relay or photo coupler.
- Due to Darlington connection of the output transistor, there exists a collector-to-emitter voltage V_{CE} (SAT) of approx. 1V upon power-ON of the transistor. Note that normal TTLIC cannot be directly connected since it does not meet V_{IL} requirement.
- When a recommended value of primary current of a photo coupler to be used is 10mA, determine a resistance value with the following formula:

$$R\ [k\Omega] = \frac{V_{DC}[V] - 2.5[V]}{10}$$

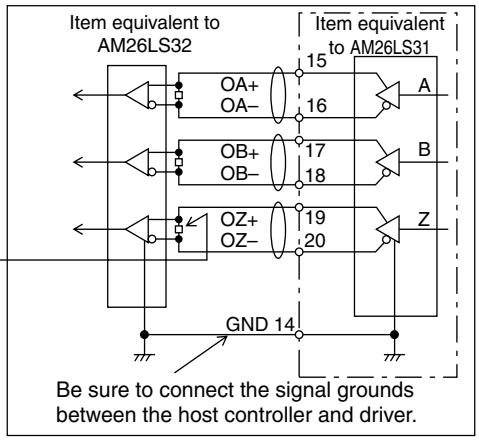
For a recommended primary current value, check the data sheets of equipment or photo coupler you plan to use.



PO1 **Line Driver (Differential Output) Output**

- Provide differential outputs of encoder signal output (Phases A, B and Z) after dividing operation is performed, by respective line drivers.
- On the host controller side, receive signals with a line receiver. Then, be sure to install termination resistor (approx. 330Ω) between inputs of the line receivers.
- This is non-insulated output.

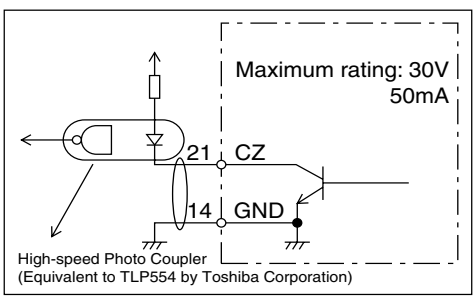
This represents a twisted pair cable.



PO2 **Open Collector Output**

- Among signals from the encoder, output phase Z signals with the open collector. This is non-insulated output.
- On the host controller side, use a high-speed photo coupler for reception, since pulse width of phase Z signal is usually narrow.

This represents a twisted pair cable.



Input Signal and Pin No. of Connector CN X5

Input signals (common) and their functions

Signal Name	Pin No.	Symbol	Function	I/F Circuit
Control Signal Power Supply Input (+)	**1**	COM+	• Connect positive (+) pole of external DC power supply (12 to 24V). • Total supply voltage should range from 12V ± 5% to 24V ± 5%.	——
Control Signal Power Supply Input (—)	**13**	COM–	• Connect negative (-) pole of external DC power supply (12 to 24V). • The voltage source capacity varies depending on configuration of input/output circuits to be used. We recommend 0.5A or greater.	
Servo-ON input	**2**	SRV-ON	• When this signal is connected to COM-, the driver will be enabled (Servo-ON) (motor energized). <Cautions> 1. The signal will become valid about 2 seconds after power-ON. (See the timing chart.) 2. Don't use Servo ON/OFF signal to drive/stop the motor. Refer to "Dynamic Brake" on Page 36 of Preparation edition. • Take the time of 100 ms or longer before entering a command on speed, pulse, etc., after transition to Servo-ON. • When you open the connection with COM-, the driver will be disabled (Servo-OFF) and the current flow to the motor will be cut off. • You can select dynamic brake operation during Servo-OFF and clear operation of the deviation counter by using Pr69 (sequence during Servo-OFF).	SI Page 106
Alarm Clear Input	**3**	A-CLR	• If this signal is connected to COM- for 120 ms or longer, it will clear alarm status. • There are some alarms that this signal cannot release. For details, refer to "Protective Functions" on Page 144 of Edition of When You Have Trouble.	SI Page 106
Deviation Counter Clear/Internal Command Speed Selection 2 Input	**4**	CL/ INTSPD2	The control mode changes functions. Position Control: • Input of this signal is to clear the deviation counter. • When the signal is connected to COM- for 2 ms or longer, it will clear the deviation counter. Internal Velocity Control: • With input of internal command speed selection 2 (INTSPD2), four-speed can be set in combination with INTSPD1 input. • For details on settings of control mode, refer to Page 117.	SI Page 106

Wiring to Connector CN X5

<table>
<tr><th>Signal Name</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F Circuit</th></tr>
<tr><td>Gain Switching/
Speed Zero Clamp/
Torque Limit
Switching Input</td><td>5</td><td>GAIN
/ZEROSPD
/TC</td><td>• Settings of Pr06 and control mode can change functions.

<table>
<tr><th>Pr06</th><th>Control Mode</th><th>Content</th></tr>
<tr><td rowspan="2">0, 1</td><td>When position control Pr02 is 0 or 2</td><td>• The following 2 functions can be used with settings of Pr30.
• Gain switching input (GAIN) switches P1/P operation and first/second gain.
<table>
<tr><th>Setting of Pr30</th><th>Setting of Pr31</th><th>Connection with COM-</th><th>Content</th></tr>
<tr><td rowspan="2">0
[default value]</td><td rowspan="2">–</td><td>Open</td><td>Velocity loop: P1 (proportional/integral) operation</td></tr>
<tr><td>Connected</td><td>Velocity loop: P (proportion) operation</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">2</td><td>Open</td><td>1st gain selected (Pr10,11,12,13,14)</td></tr>
<tr><td>Connected</td><td>2nd gain selected (Pr18,19,1A,1B,1C)</td></tr>
</table>
For details on the 2nd gain switching function, refer to Page 138.</td></tr>
<tr><td>When internal velocity control Pr02 is 1</td><td>• With speed zero clamp input (ZEROSPD), velocity command is opened when connection with COM- is opened.
• You can override this input with Pr06.
• A default value of Pr06 is 1, and this input is valid. When connection with COM- is opened, speed will be zero.
<table>
<tr><th>Pr06</th><th>Content</th></tr>
<tr><td>0</td><td>ZEROSPD input is invalid.</td></tr>
<tr><td>1 [default value]</td><td>ZEROSPD input is valid.</td></tr>
</table></td></tr>
<tr><td>2</td><td>Position Control/ Internal Velocity Control</td><td>With torque limit switching input, parameters of acceleration level, torque limit, excessive position deviation can be switched.
<table>
<tr><th>Connection with COM-</th><th>Content</th></tr>
<tr><td>Open</td><td>1st setting value selected. (Pr70,5E,63)</td></tr>
<tr><td>Connected</td><td>2nd setting value selected. (Pr71,72,73)</td></tr>
</table></td></tr>
</table></td><td>SI
Page 106</td></tr>
<tr><td>Command Dividing Multiplier Switching/
Internal Command Speed Selection 1 Input</td><td>6</td><td>DIV
/INTSPD1</td><td>The control mode can change functions.

<table>
<tr><td>Position Control</td><td>• Input to switch dividing multiply of command pulse
• When this signal is connected to COM-, it will switch a command dividing multiply numerator from Pr46 (Numerator of 1st command pulse ratio) to Pr47 (Numerator of 2nd command pulse ratio).
<Caution>
You must not enter any command pulse for 10 ms before or after switching.</td></tr>
<tr><td>Internal Velocity Control</td><td>• With internal command speed selection 1 (INTSPD1), four-speed can be set in combination with INTSPD 2.
• For details on settings of control mode, refer to Page 117.</td></tr>
</table></td><td>SI
Page 106</td></tr>
<tr><td>CW Overtravel Inhibit Input</td><td>7</td><td>CWL</td><td>• If you open connection with COM- when a moving part of the machine exceeds the movable range in CW direction, no torque will be generated in CW direction.</td><td>SI
Page 106</td></tr>
<tr><td>CCW Overtravel Inhibit Input</td><td>8</td><td>CCWL</td><td>• If you open connection with COM- when a moving part of the machine exceeds the movable range in CCW direction, no torque will be generated in CCW direction.
• If you set 1 to Pr04 (Invalid Overtravel Inhibit Input), CWL/ CCWL inputs will be invalid. A default value is invalid (1).
• Setting of Pr66 (DB inaction during driving prohibition) can activate the dynamic brake when CWL/CCWL input is valid. According to a default value, the dynamic brake will run (Pr66 is 0).</td><td>SI
Page 106</td></tr>
</table>

Output Signal and Pin No. of Connector CN X5

Output Signals (Common) and their Functions

<table>
<tr><th>Signal Name</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F Circuit</th></tr>
<tr><td>Servo Alarm Output</td><td>9</td><td>ALM</td><td>• The output transistor turns OFF when an alarm is generated.</td><td>SO1
Page 106</td></tr>
<tr><td>Positioning Completion/ Achieved Speed Output</td><td>10</td><td>COIN</td><td>• The control mode changes functions.
<table><tr><td>Position Control</td><td>• Positioning completion output
• The output transistor turns ON when the deviation pulse does not exceed setting of Pr60 (In-position range).</td></tr><tr><td>Internal Velocity Control</td><td>• Achieved Speed Output
• The output transistor turns ON when motor speed exceeds Pr62 (At-speed).</td></tr></table></td><td>SO1
Page 106</td></tr>
<tr><td>Brake Release Signal Output</td><td>11</td><td>BRK-OFF</td><td>• This signal is used to release the electromagnetic brake of the motor.
• The output transistor turns ON when the brake is released.
• Refer to “Timing Chart” on Page 32 of Preparation edition.</td><td>SO1
Page 106</td></tr>
<tr><td>Warning Output</td><td>12</td><td>WARN</td><td>• A signal selected with Pr09 (warning output selection) is output.
<table><tr><th>Settings</th><th>Functions</th></tr><tr><td>0</td><td>The output transistor turns ON while torque is limited.</td></tr><tr><td>1</td><td>The output transistor turns ON when the speed falls below setting of Pr61 (zero speed).</td></tr><tr><td>2* [default value]</td><td>The output transistor turns ON when any of the following 3 warning functions is activated: regenerative/overload/fan rotation speed abnormality.</td></tr><tr><td>3*</td><td>With the regenerative warning function activated (85% of the regenerative abnormality detection level is exceeded), the output transistor turns ON.</td></tr><tr><td>4*</td><td>With overload warning function activated (effective torque exceeds 85% when the detection level of overload protection is considered 100%), the output transistor turns ON.</td></tr><tr><td>5*</td><td>Displays may appear but do not function.</td></tr><tr><td>6</td><td>With the abnormal fan rotation speed warning function activated (the fan stops), the output transistor turns ON.</td></tr></table>* With settings of 2 to 6, once a warning is detected, the output transistor turns ON for at least 1 second.</td><td>SO1
Page 106</td></tr>
<tr><td>Phase-A Output</td><td>15</td><td>OA+</td><td rowspan="5">• This signal provides differential output of the encoder signal (Phases A/B/Z) that undergoes dividing process (RS 422 phase, etc.).
• The logical relation between phases A and B can be selected with Pr45 (Pulse output logic inversion).
• Not insulated</td><td rowspan="5">PO1
Page 106</td></tr>
<tr><td></td><td>16</td><td>OA–</td></tr>
<tr><td>Phase-B Output</td><td>17</td><td>OB+</td></tr>
<tr><td></td><td>18</td><td>OB–</td></tr>
<tr><td>Phase-Z Output</td><td>19</td><td>OZ+</td></tr>
<tr><td></td><td>20</td><td>OZ–</td><td></td><td></td></tr>
<tr><td>Phase-Z Output</td><td>19</td><td>CZ</td><td>• Phase Z signal output in an open collector
• Not insulated</td><td>PO2
Page 106</td></tr>
</table>

Output Signals (Others) and their Functions

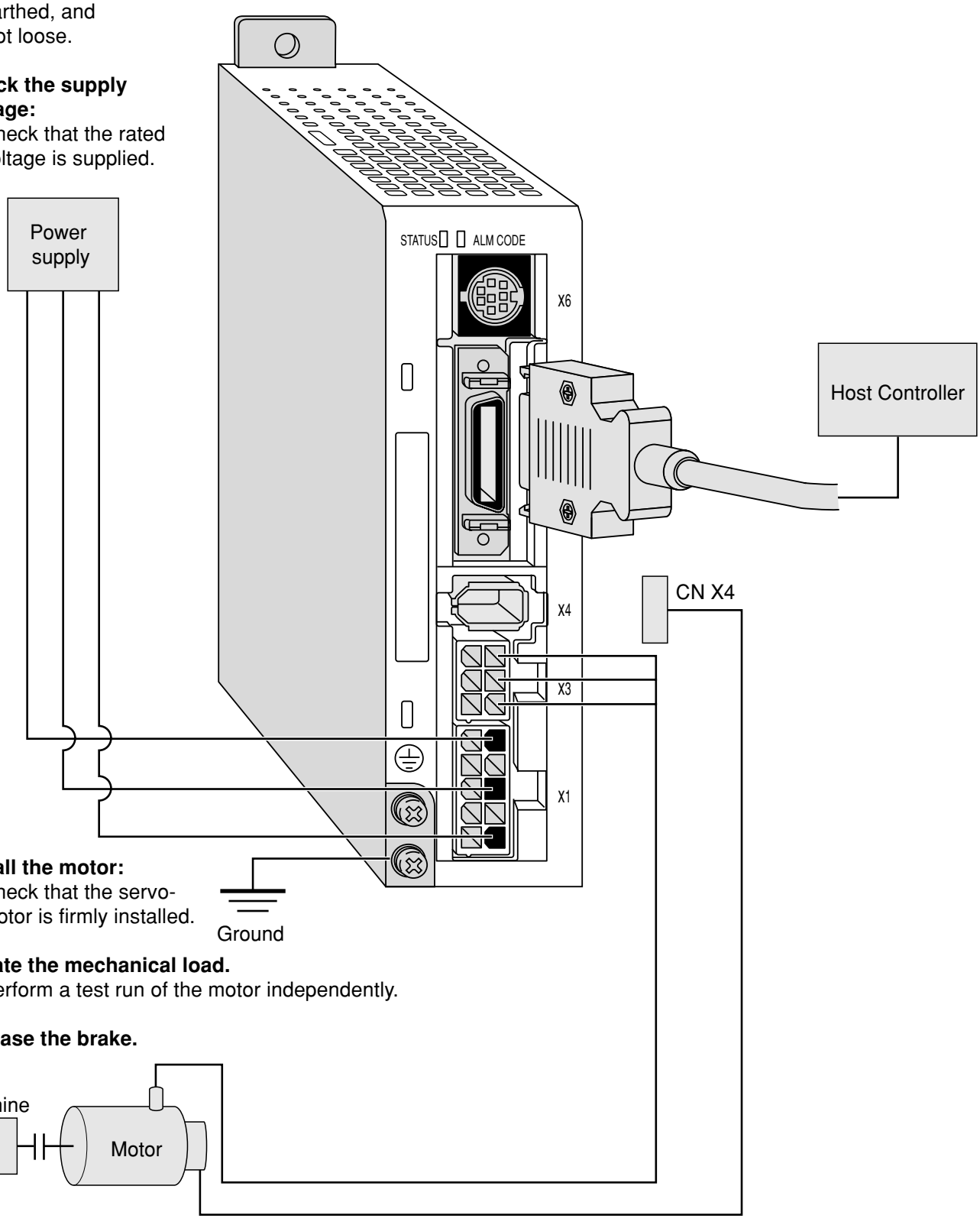
Signal Name	Pin No.	Symbol	Function	I/F Circuit
Signal Ground	**14**	GND	• Signal ground in the driver • Insulated from the control signal power supply (COM-) in the driver.	—
Frame Ground	**26**	FG	• Connected with the earth terminal in the driver.	—

Test Run in Internal Velocity Control Mode

Inspection prior to Test Run

(1) Check the wirings:
- Connected correctly (especially power supply connection and motor connection),
- Not shorted and properly earthed, and
- Not loose.

(2) Check the supply voltage:
- Check that the rated voltage is supplied.



(3) Install the motor:
- Check that the servo-motor is firmly installed.

(4) Isolate the mechanical load.
- Perform a test run of the motor independently.

(5) Release the brake.

Test Run with Connector CN X5 Connected

(1) Connect CN X5.

(2) Connect the control signal (COM+/COM-) to the power supply (12 to 24 VDC).

(3) Turn on the power (of the driver).

(4) Change the control mode to internal velocity control mode (Pr02=1).

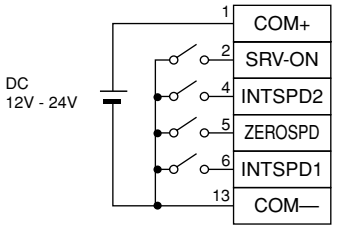
(5) Activate Servo-ON by connecting Servo-ON input SRV-ON (CN X5 pin 2) and COM- (CN X5 pin 13). Then, with switch of speed zero clamp input ZEROSPD (CN X5 pin 5) closed, run the motor. It will rotate at a speed selected by combining internal command speed selection 1 INTSPD 1 (CN X5 pin 6) and internal command speed selection 2 INTSPD 2 (CN X5 pin 4).

(6) Check rotation speed of the motor either on the monitor screen of PANATERM® or that of the console.
- Check that the motor rotates at a correct rate and in a correct direction.

(7) Ensure that the motor will stop when you open the speed zero clamp input ZEROSPD.

(8) If you wish to change rotation speed or rotation direction, reset the following parameters: See Pr53 to 56, speed setting, 1st to 4th speed, on Page 117.

Wiring Diagram



The motor runs when ZEROSPD switch is closed, while it stops when the switch is open.

Parameters

PrNo.	Parameter Name	Settings	Default setup value
Pr02	Control mode setup	1	2
Pr04	Overtravel input inhibit	1	1
Pr06	ZEROSPD input selection	1	1
Pr53 ≀ Pr56	1st speed setting to 4th speed	Set this, as necessary	0
Pr58	Acceleration time		0
Pr59	Deceleration time		0

Internal velocity	INTSPD1 (Pin 6)	INTSPD2 (Pin 4)
1st speed (Pr53)	Open	Open
2nd speed (Pr54)	Closed	Open
3rd speed (Pr55)	Open	Closed
4th speed (Pr56)	Closed	Closed

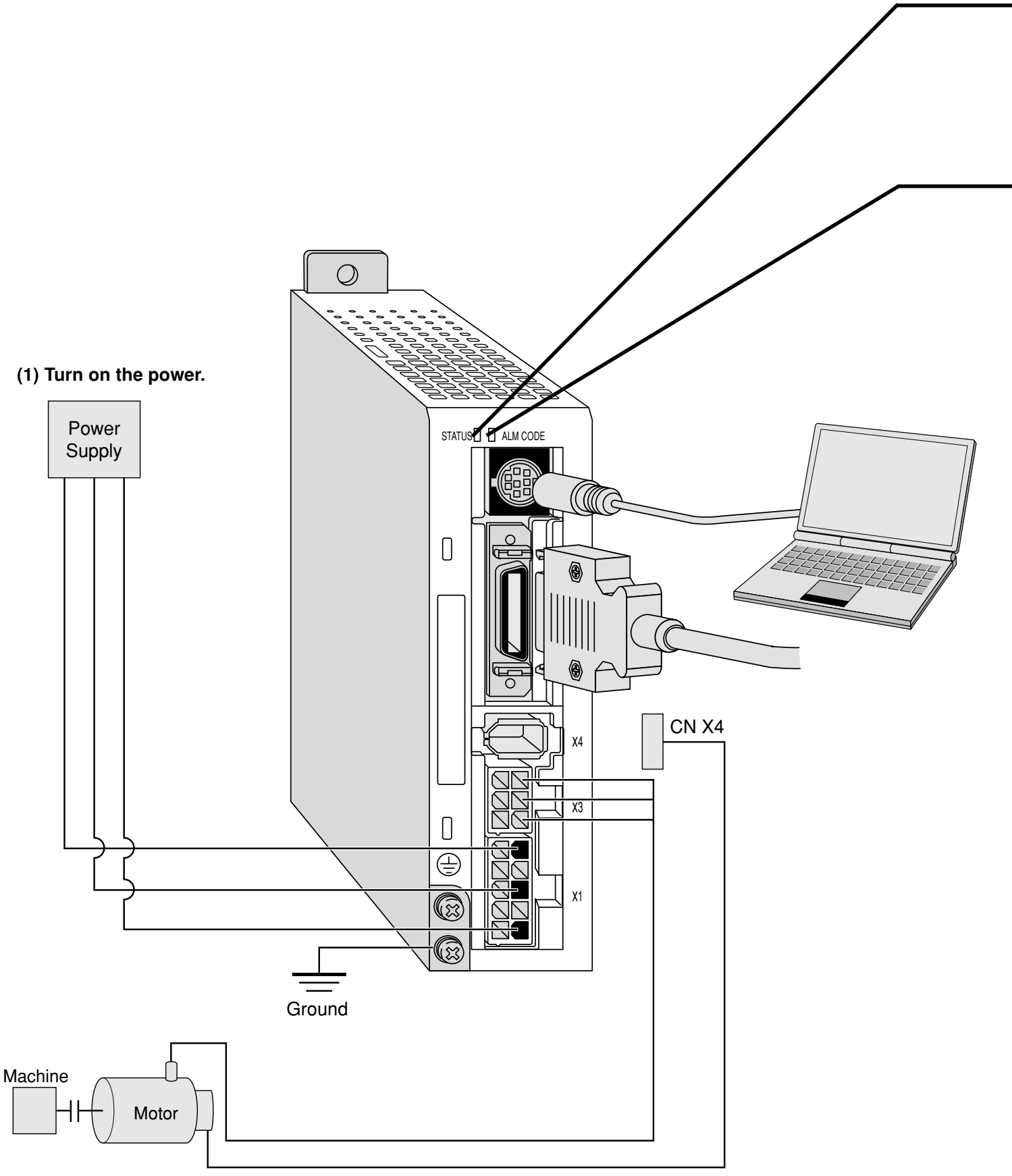
Input Signal Status

Signal No.	Input Signal Name	Monitor Display
00	Servo-ON	+ A
05	Speed zero clamp	— (Stop at +A.)

Test Run in Internal Velocity Control Mode

Basic Operations and LED Display

(1) Turn on the power.



(2) Check LED status.

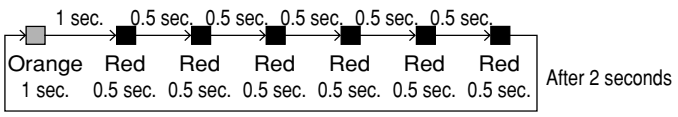
Color of LED Status	Description
□ Green	The main power is turned ON. The driver is switched on.
▒ Orange	The LED flashes (for 1 second) when a warning is issued. (Abnormal overload, regeneration, and fan rotation speed)
■ Red	Alarm output.

Check that alarm code LED does not flash? (It is out during normal operation).

It starts flashing in case of an alarm.
An alarm code (refer to pages 145 to 148) indicates the alarm code number by the number of flashes of orange and red lights.
Orange: 10 digit Red: 1 digit

(Example)
When overload (alarm code No.16) occurs and the motor stops:

The orange light flashes once and red one flashes 6 times.



(3) Setting the parameter

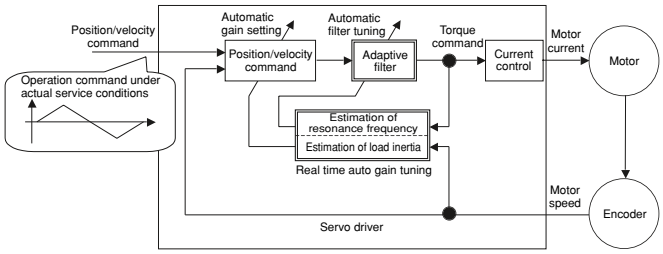
Prepare for a personal computer and “PANATERM®”.

(4) Enter a command that matches the control mode.

Real time Auto Gain Tuning

Outline

Load inertia of the machine is real time estimated, and based on the result of estimation, optimum gain is automatically set. In addition, an adaptive filter automatically suppresses vibration due to resonance.



Scope

- Real time auto gain tuning is valid in all control modes.
- You can use an adaptive filter only when Pr02=2: high function positioning control.

Cautions

Under the following conditions, real time auto gain tuning may not properly function. In such a case, use either normal auto gain tuning (Refer to Page 132) or manual gain tuning (Refer to Page 136).

	Conditions that Hinder Real time Auto Gain Tuning from Functioning
Load Inertia	• When load inertia is smaller or greater than rotor inertia (i.e., 3 times or less or 20 times or more). • When load inertia changes quickly (less than 10 [s]).
Load	• When mechanical stiffness is extremely low. • When there is play such as backlash.
Operation Pattern	• When the motor runs at a continuous low speed below 100 [r/min]. • When acceleration/deceleration is gradual, e.g., 2000 [r/min] or less in 1 [s]. • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque. • When the time that meets conditions of speed/acceleration is short, e.g., less than 40 [ms].

Operating Instruction

(1) Stop the motor (Servo-OFF).

(2) Set Pr21 (Real time auto tuning set-up) to 1 to 6.
A default setup is 1.

Setting value	Real time Auto Tuning	Degree of Load Inertia Changes in Service	Adaptive Filter
0	Not used	—	No (Always disabled in internal velocity control mode.)
[1]	Used	Little change	
2		Gradual change	
3		Sharp change	
4		Little change	
5		Gradual change	
6		Sharp change	
7	Not used	—	

When load inertia changes widely, set Pr21 to 3 or 6.
If there is possibly effect of resonance, select “adaptive filter Yes”.

(3) Turn the servo on to operate the machine as usual.

(4) If you wish to improve responsiveness, gradually increase Pr22 (Machine stiffness at auto tuning). In addition, if any abnormal noise or oscillation occurs, set a value lower (e.g. 0 to 3).

(5) If you wish to save result, write it into EEPROM.

<Remarks>

Any change to Pr21 (Real time auto tuning set-up) will become valid when you turn on the power and when Servo-OFF switches to Servo-ON.

Thus, to disable real time auto tuning, set Pr21 (Real time auto tuning mode setting) to 0, and then switch from Servo-OFF to Servo-ON. Similarly, when you enable real time auto tuning, set Pr21 to any value other than 0 and 7 and then switch from Servo-OFF to Servo-ON.

Insert the connector of console into CNX6 of the driver, and then turn on the power of the driver. → `r 0`

Setting parameter Pr21

Press (SET). → `dP_SPd`

Press (MODE). → `PA_ 00`

Select the parameter to be set with ▲ and ▼. → `PA_ 21`

(In this case, select Pr21.)

Press (SET). → `1`

Change the value with ▲ or ▼.

Press (SET). → `PA_ 21`

Setting parameter Pr22

Select Pr22 with ▲. → `PA_ 22`

Press (SET). → `4` (Default Setup Value)

When you press ▲, a value increases, and when you press ▼, it decreases.

Now writing into EEPROM

Press (MODE). → `EE_SEt`

Press (SET). → `EEP -`

Keep pressing ▲ (about 5 seconds). Then, the number of bars in creases as shown on the right. → `EEP --` → `------`

Start of write (indicated momentarily). → `StArt`

End → `FinISh` (Write finishes) / `rESEt` / `Error` (Write error occurs)

After finishing write, return to Selection Display referring to "Structure of Each Mode" (Page 48 and 49).

Parameters to be Set Automatically

The following parameters are tuned automatically. The following parameters are also set up to the following fixed values automatically.

PrNo.	Name
11	1st velocity loop gain
12	1st velocity loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
19	2nd velocity loop gain
1A	2nd velocity loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio

PrNo.	Name	Setting
30	2nd gain action set-up	1

<Remarks>

When real time auto tuning is enabled, you are not allowed to change any parameter to be automatically tuned.

Cautions

(1) After startup, immediately following a first Servo-ON or when you increase Pr22 (Machine stiffness at real time auto tuning), you may have abnormal noise or oscillation before you identify load inertia or an adaptive filter is stabilized. However, this doesn't constitute abnormality if it disappears in no time. If oscillation or noise persists over 3 reciprocating operations, you should take any of the following measures in any possible order:
   1) Write into EEPROM parameters used during normal operation.
   2) Decrease Pr22 (Machine stiffness at real time auto tuning).
   3) Once set Pr21 (Real time auto tuning set-up) to 0 and disable an adaptive filter. Then, enable real time auto tuning again (To disable inertia estimation/resetting of adaptive operation, or real time auto tuning, refer to "Releasing Automatic Tuning Function" on Page 135).
   4) Manually set a notch filter (Refer to "To Reduce Mechanical Resonance" on Page 140).

(2) In some cases, after abnormal noise or oscillation is generated, Pr20 (Inertia ratio) or Pr2F (Adaptive filter frequency) may change to an extreme value. Even in such a case, you should take the measures described above.

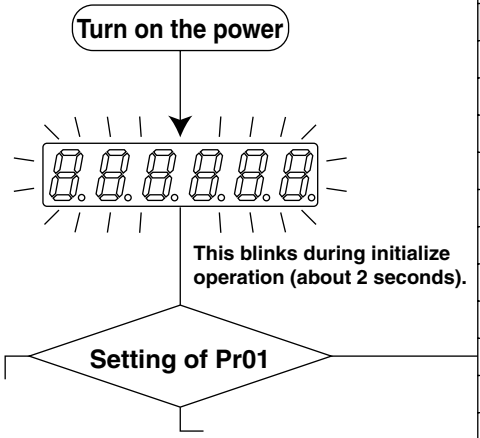
(3) Among results of real time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are written into EEPROM every 30 minutes. When you power ON again, auto tuning will be carried out using the data as an initial value.

Parameter Setting

Parameter for Selection of Functions

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
00	**Axis address**	0 - 15 [1]	In communications with a host such as a personal computer that uses RS232C with multiple axes, you should identify to which axis the host is accessing. With this parameter, you can see an axis name by number.
01	**LED for console, initial condition display**	0 - 15	In the initial state after power-on, you can select any type of data displayed by 7 segment LEDs on the console.



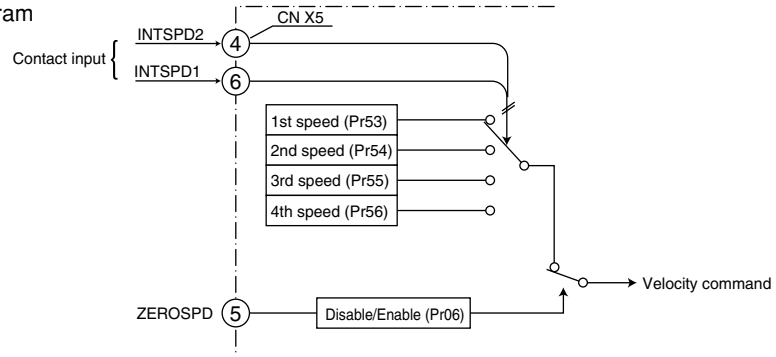
Setting	Content
0	Position deviation
[1]	Motor rotation speed
2	Torque output
3	Control mode
4	Input/output signal condition
5	Error factor, history
6	To be used by the manufacturer
7	Warning
8	Regenerative Load Ratio
9	Overload factor
10	Inertia ratio
11	Feedback pulse total
12	Command pulse total
13	Not available
14	Not available
15	Checking if there is motor automatic recognition function

For details of displays, refer to “Monitor Mode” on Page 51 of Preparation edition.

PrNo.	Parameter Name	Range of Settings	Function/Content
02	**Control mode set up**	0 - 2	

Setting	Control Mode
[0]	High velocity response positioning control (pulse row)
1	Internal velocity control
2	High function positioning control (pulse row)

- The internal velocity control mode has the internal speed setting function that can easily implement speed control through contact input.
- There are four types of internal velocity commands, each having command data set to Pr53 (1st speed), Pr54 (2nd speed), Pr55 (3rd speed) and Pr56 (4th speed), respectively.
- Internal block diagram



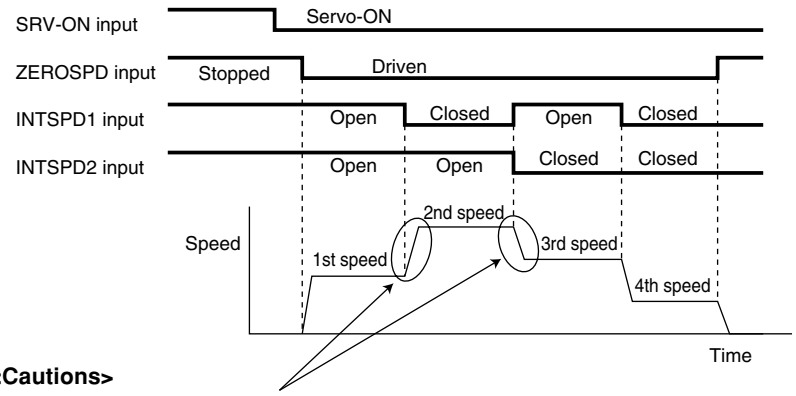
- The four types of internal velocity commands can be switched by using the following two contact inputs.

(1) INTSPD 1 (CN X5 pin 6): Internal command speed selection 1 input

(2) INTSPD 2 (CN X5 pin 4): Internal command speed selection 2 input

Internal commands	INTSPD1 (Pin 6)	INTSPD2 (Pin 4)
1st speed (Pr53)	Open	Open
2nd speed (Pr54)	Closed	Open
3rd speed (Pr55)	Open	Closed
4th speed (Pr56)	Closed	Closed

- Example of 4 shift operation through internal velocity commands:
  In addition to INTSPD1 and INTSPD 2, you should also activate speed zero clamp input (ZEROSPD) and Servo-ON input (SRV-ON) for controlling motor driving/stopping.



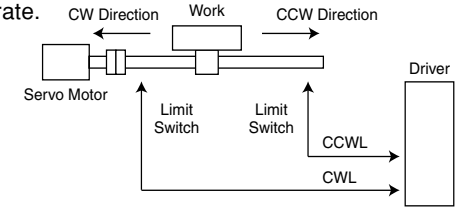
<Cautions>

You can set acceleration and deceleration time separately with the parameters. See:

Pr58 of this chapter: acceleration time set-up

Pr59 of this chapter: deceleration time set-up

Standard Default Setup: [ ]

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>04</td><td>Overtravel Input inhibit</td><td>0 - 1</td><td>In the case of linear driving, in particular, limit switches should be provided on both ends of the axis, as illustrated in the figure below, to prevent any mechanical damage due to overshoot of a work, and inhibit driving in the direction in which the switches operate.
 

<table>
<tr><th rowspan="2">Settings</th><th rowspan="2">CCWL/ CWLInput</th><th colspan="2">Operation</th></tr>
<tr><th>Input</th><th>Connection with COM-</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enabled</td><td rowspan="2">CCWL (CN pin X5-8)</td><td>Connected</td><td>This shows normal state in which the limit switch on CCW side does not operate.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, and CW direction allowed.</td></tr>
<tr><td rowspan="2">CWL (CN pin X5-7)</td><td>Connected</td><td>This shows normal state in which the limit switch on CCW side does not operate.</td></tr>
<tr><td>Open</td><td>CW direction inhibited, and CCW direction allowed.</td></tr>
<tr><td>[1]</td><td>Disabled</td><td colspan="3">CCWL and CWL inputs are ignored, and driving is not inhibited (allowed) in both CCW and CW directions.</td></tr>
</table>
<Cautions>
1. When you set Pr04 to 0, and do not connect CCWL/CWL input to COM- (OFF), it will be judged as abnormality in which limits are simultaneously exceeded in both CCW and CW directions, and the driver will trip due to “overtravel input error”.
2. You can set whether to activate a dynamic brake during deceleration when CCW overtravel inhibit input (CCWL) or CW overtravel inhibit input (CWL) works. For details, refer to descriptions on Pr66 (Deceleration and stop set-up at overtravel inhibit).</td></tr>
<tr><td>06</td><td>ZEROSPD/TC input selection</td><td>0 - 2</td><td>The parameter is used to select functions of speed zero clamp input (ZEROSPD)/ torque limit switching (TC) input (connector) CN X5 pin 5.
<table>
<tr><th>Setting</th><th>Speed Zero Clamp</th><th>Torque Limit Switching Input</th></tr>
<tr><td>0</td><td>Disabled</td><td>Disabled</td></tr>
<tr><td>[1]</td><td>Enabled</td><td>Disabled</td></tr>
<tr><td>2</td><td>Disabled</td><td>Enabled</td></tr>
</table>
<Remarks>
If you wish to use torque limit switching input, also set Pr5E, Pr63, and Pr70 to 73 all at once. If settings of Pr70 and Pr73 remain 0, the error No.26 acceleration protection will occur.</td></tr>
<tr><td>09</td><td>Warning output selection</td><td>0 - 6</td><td>This parameter is to allocate functions of warning output(WARN:CN X5 pin 12).
<table>
<tr><th>Setting</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output during torque limit</td><td rowspan="7">For detailed information on functions of respective outputs listed in the left, refer to “Wiring to Connector CN X5” on Page 109.</td></tr>
<tr><td>1</td><td>Zero speed detection output</td></tr>
<tr><td>[2]</td><td>Over-excessive regeneration/overload/fan rotation speed abnormality</td></tr>
<tr><td>3</td><td>Over-excessive regeneration warning output</td></tr>
<tr><td>4</td><td>Overload warning output</td></tr>
<tr><td>5</td><td>To be displayed, but not functioning.</td></tr>
<tr><td>6</td><td>Fan rotation speed abnormality warning output</td></tr>
</table>
<Caution>
If you ignore output of warning and continue to use, the motor or driver may fail/ be damaged.</td></tr>
<tr><td>0C</td><td>Baud rate set-up of RS232C</td><td>0 - 2</td><td>
<table>
<tr><th>Settings</th><th>Baud Rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td>[2]</td><td>9600bps</td></tr>
</table>
</td></tr>
</table>

Parameters for Adjustment of Time Constants of Gains/Filters

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Unit	Function/Content
11	**1st velocity loop gain**	1 - 3500 [35]*	Hz *	• The parameter determines responsiveness of the velocity loop. To improve responsiveness of the entire servo system by setting the position loop gain high, you should be able to set this velocity loop gain higher.
12	**1st velocity loop integration time constant**	1 - 1000 [16]*	ms	• This is an integration element provided to velocity loop, and works to drive minute speed deviation after shutdown to zero. The smaller setting is, the faster the parameter drives it zero. • If it is set to “1000”, there will be no effect of integration.
13	**1st speed detection filter**	0 - 5 [0]*	–	• The parameter is used to set a time constant of the low pass filter (LPF) entered after the block capable of conversion from an encoder signal to a speed signal in 6 phases (0 to 5). • As you increase a setting, the time constant will also rise. Thus, although you can reduce noise from the motor, we recommend you set it to 4 or less usually.
14	**1st torque filter time constant**	0 - 2500 [65]*	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into torque command unit. • This might take effect on suppression of vibration due to torsional resonance.
19	**2nd velocity loop gain**	1 - 3500 [35]*	Hz	• A position loop, velocity loop, speed detection filter, and torque command filter have 2 pairs of gains or time constants (1st and 2nd), respectively. • The functions/descriptions of respective gains/time constants are same as the 1st gain/time constants. • For details on switching of the 1st/2nd gain, and time constants, refer to Page 127 of Adjustment edition. * When Pr20 inertia ratio is set correctly, Pr11 and Pr19 will be set in (Hz).
1A	**2nd velocity loop integration time constant**	1 - 1000 [1000]*	ms	
1B	**2nd speed detection filter**	0 - 5 [0]*	–	
1C	**2nd torque filter time constant**	0 - 2500 [65]*	0.01ms	
1D	**1st notch frequency**	100 - 1500 [1500]	Hz	• The parameter sets notch frequency of a resonance suppression notch filter. • Set the parameter about 10% lower than resonance frequency of the mechanical system that has been found by the frequency characteristic analysis feature of “PANATERM®”, the setup support software. • Setting this parameter to “1500” disables functions of the notch filter.
1E	**1st notch width selection**	0 - 4 [2]	–	• The parameter sets width of notch frequency of a resonance suppression notch filter in 5 stages. The higher setting is, the wider filter width will be. • Usually, use a default set-up value.

<Remarks>

Parameters having standard default set-up value with “*” mark are automatically set while real time auto gain tuning is running. To change to manual, refer to “Cancellation of the Automatic Gain Tuning” on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

Parameters for Auto Gain Tuning

Standard Default Setup: [ ]

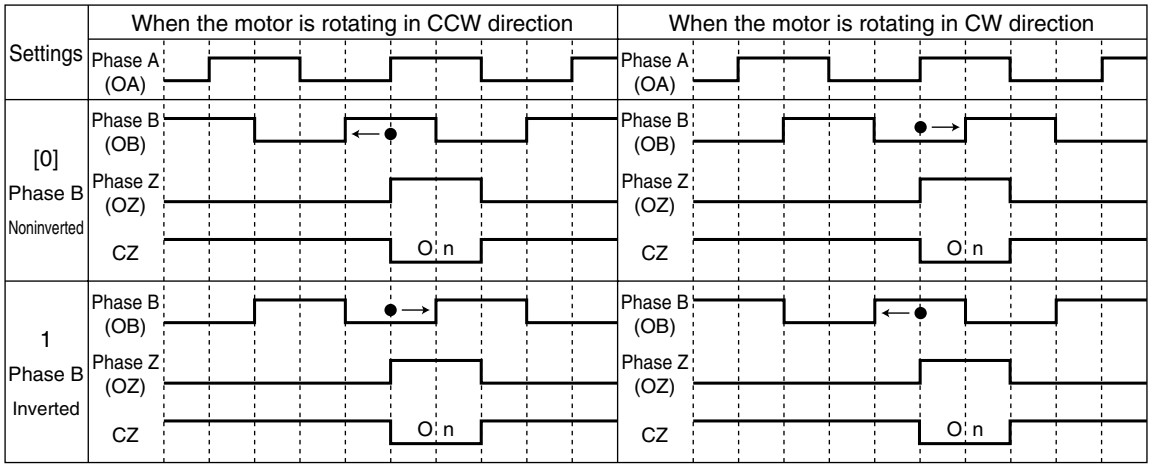
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 - 10000
[100]*</td><td>%</td><td>• The parameter sets a ratio of load inertia to rotor inertia of the motor.
Pr20 = (Load inertia/rotor inertia) x 100 [%]
• When you execute auto gain tuning, load inertia is estimated and the result will be reflected in the parameter.
If inertia ratio has been set correctly, Pr11 and Pr19 will be set in (Hz). When Pr20 inertia ratio is greater than actual value, setting unit of the velocity loop gain will be greater. If inertia ratio is smaller than actual value, setting unit of the velocity loop will be smaller.
• The inertia ratio estimated during execution of real time auto tuning is saved in EEPROM every 30 minutes.</td></tr>
<tr><td>21</td><td>Real time auto tuning set-up</td><td>0 - 7</td><td>–</td><td>• The parameter sets an operation mode of real time auto tuning. As you set this to a higher value such as 3, 6…, inertia change during operation will be quickly responded. However, operation may become unstable, depending on the operation pattern. Thus, we recommend that you usually set the parameter to 1 or 4.
• In internal velocity control mode, the adaptaive filter function is disalbed, and thus Pr2F adaptive filter frequency will be reset to 0.
<table>
<tr><th>Settings</th><th>Real time auto tuning</th><th>Degree of changes in load inertia during operation</th><th>Adaptive filter</th></tr>
<tr><td>0</td><td colspan="2">Not used</td><td rowspan="9">No</td></tr>
<tr><td>[1]</td><td rowspan="6">Used</td><td>Little change</td></tr>
<tr><td>2</td><td>Gradual change</td></tr>
<tr><td>3</td><td>Sharp change</td></tr>
<tr><td>4</td><td>Little change</td></tr>
<tr><td>5</td><td>Gradual change</td></tr>
<tr><td>6</td><td>Sharp change</td></tr>
<tr><td>7</td><td colspan="2">Not used</td></tr>
</table>
• Any change to this parameter will be valid when Servo-OFF switches to Servo-ON.
<Remarks> For Pr02=1 (in internal velocity control mode), you can set the parameter only when the first notch filter is set as disabled.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto turning</td><td>0 - 15
[4]</td><td>–</td><td>• The parameter sets mechanical stiffness during execution of real time auto tuning in 16 stages.
Low ← Mechanical stiffness →High
Low ← Servo gain → High
Pr22 | 0 • 1- - - - - - - - - - - - 14 • 15
Low ← Responsiveness → High
• If you change a setting sharply and abruptly, gain will vary suddenly, thus giving impact to the machine. Be sure to start with a small setting and gradually increase it while observing how the machine is running.</td></tr>
<tr><td>25</td><td>Normal auto tuning motion set-up</td><td>0 - 7</td><td>–</td><td>• The parameter sets operation patterns of normal auto gain tuning.
<table>
<tr><th>Settings</th><th>Number of Rotations</th><th>Rotation Direction</th></tr>
<tr><td>[0]</td><td rowspan="4">2 rotations</td><td>CCW → CW</td></tr>
<tr><td>1</td><td>CW → CCW</td></tr>
<tr><td>2</td><td>CCW → CCW</td></tr>
<tr><td>3</td><td>CW → CW</td></tr>
<tr><td>4</td><td rowspan="4">1 rotation</td><td>CCW → CW</td></tr>
<tr><td>5</td><td>CW → CCW</td></tr>
<tr><td>6</td><td>CCW → CCW</td></tr>
<tr><td>7</td><td>CW → CW</td></tr>
</table></td></tr>
</table>

<Remarks>
Parameters having standard default setup value with "*" mark are automatically set while real time auto gain tuning is running. To change to manual, refer to "Cancellation of the Automatic Gain Tuning" on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

Parameters for Position Control

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
44	**Output pulses per single turn**	1 - 16384 [2500]	The parameter sets the number of pulses per rotation of the encoder pulse to be output to the host. Pulse should be set with dividing. Directly set the number of pulses per rotation, in [Pulse/rev], necessary for a device/system on your side. Any value that exceeds the encoder pulse will be disabled.
45	**Pulse output logic inversion**	0 - 1	A phase relation of output pulses from the rotary encoder is as follows: Phase B pulse is behind Phase A pulse during rotation in CW direction (Phase B pulse is ahead of Phase A pulse during rotation in CCW direction). Reversing logic of Phase B pulse with this parameter, you can reverse the phase relation of Phase B to Phase A.



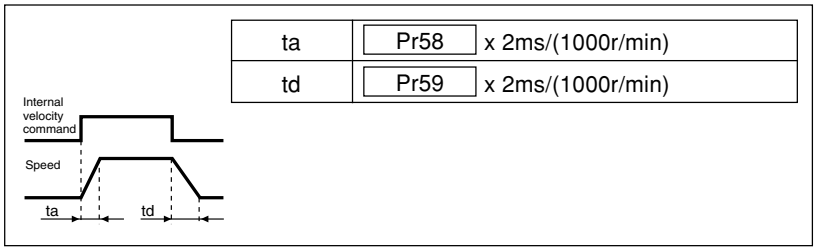
Phase Z is in sync with Phase A. You cannot reverse Phase Z.
Even by dividing, Phase Z outputs 1 pulse per rotation.

<Remarks>

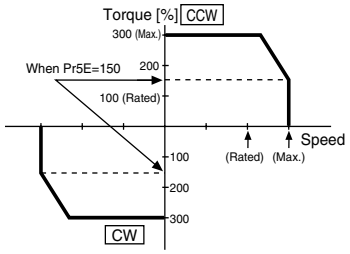
Parameters having standard default setup value with "*" mark are automatically set while real time auto gain tuning is running. To change to manual, refer to "Cancellation of the Automatic Gain Tuning" on Page 135 of Adjustment edition, disable real time auto gain tuning and then set.

Parameters for Internal Velocity Control

Standard Default Setup: [ ]

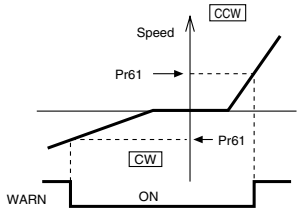
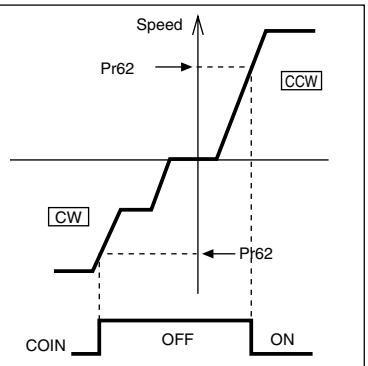
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>53</td><td>1st internal speed set-up</td><td>–20000 - 20000 [0]</td><td rowspan="4">These parameters directly set, in terms of [r/min], the first to fourth internal command speed of when internal speed setting is enabled with the parameter “internal/external speed set-up switching” (Pr05) to Pr53 to Pr56.
<Caution>
Polarity of setting constitutes that of internal command speed.
<table><tr><td>+</td><td>Rotating in CCW direction, viewed from a shaft end.</td></tr><tr><td>–</td><td>Rotating in CCW direction, viewed from a shaft end.</td></tr></table>Set the parameter in a usable range of rotation speed of the motor.</td></tr>
<tr><td>54</td><td>2nd internal speed set-up</td><td>–20000 - 20000 [0]</td></tr>
<tr><td>55</td><td>3rd internal speed set-up</td><td>–20000 - 20000 [0]</td></tr>
<tr><td>56</td><td>4th internal speed set-up</td><td>–20000 - 20000 [0]</td></tr>
<tr><td>58</td><td>Acceleration time set-up</td><td>0 - 5000 [0]</td><td rowspan="2">In internal velocity control mode, you can implement velocity control by applying acceleration/deceleration to velocity commands in the driver.
When you plan to use with internal speed setting, you can obtain soft-start and stop operations.
 
</td></tr>
<tr><td>59</td><td>Deceleration time set-up</td><td>0 - 5000 [0]</td></tr>
</table>

Parameters for Torque Limits

PrNo.	Parameter Name	Range of Settings	Function/Content
5E	1st torque limit set-up	0 - 500	• With this parameter set, maximum torque of the motor is limited in the driver. • Normal specification allows torque about 3 times as large as rated torque, if in an instant. We recommend that you limit the maximum torque with this parameter if the tripled torque might cause trouble to intensity of the motor load (machine). • You can give setting as a percentage (%) value to rated torque. • The right figure shows an example in which it is limited to 150%. • Pr5E limits the maximum torque of both CW and CCW directions simultaneously.  **<Remarks>** With torque limit switching function enabled (Pr06=2), this parameter is a value of the 1st torque limit. **<Cautions>** You cannot set to this parameter a value that exceeds a default setup value with "Maximum Output Torque Setting" of the system parameter (i.e., factory default parameters that cannot be changed through manipulation of PANATERM® and console). A default may differ depending on a combination of a motor and driver. For detailed information, refer to "Setting of 1st Torque Limit" on Page 45 of Preparation edition.

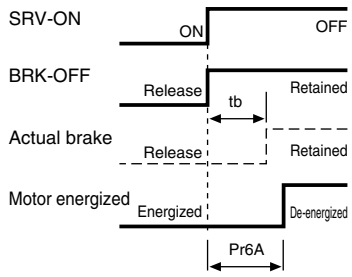
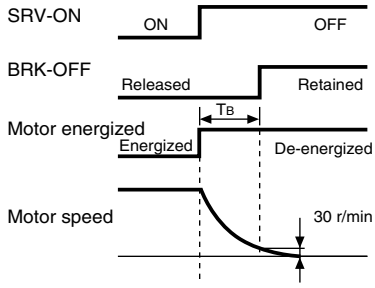
Parameters for Sequences

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
61	Zero speed	0 - 20000 [50]	• The parameter directly sets in [r/min] timing to output zero speed detection output signal (WARN: CN X5 pin 12). You need to set parameter warning output selection (Pr09) to 1. • The zero speed detection signal (WARN) will be output when the motor speed falls below the set speed of this parameter Pr61. • Setting of Pr61 acts on both CW and CCW directions, irrespective of the direction of motor rotation. • There is hysteresis of 10 rpm. Set the parameter 10 or more. 
62	At-speed	0 - 20000 [1000]	• In internal velocity control mode, the parameter sets timing to output achieved speed signal (COIN: CN X5 pin 10) with rotation speed [r/min]. • The achieved speed signal will be output when the motor speed exceeds the speed set by this parameter Pr62. • Setting of Pr62 works on both CW and CCW directions, irrespective of rotation direction of the motor. • There is hysteresis of 10 rpm. Set the parameter 10 or more. 

<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>66</td><td>Deceleration and stop set-up at overtravel inhibit</td><td>0 - 2</td><td>The parameter sets the deceleration and stop operation after the drive inhibit input (CCWL: Connector CNx58 pin or CWL: Connector CNx57 pin) activates and becomes enabled.
<table>
<tr><th>Setting</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>Invalidate torque in the driving inhibited direction, and activate the dynamic brake.</td></tr>
<tr><td>1</td><td>Invalidate torque in the driving inhibited direction, and have the motor free run.</td></tr>
<tr><td>2</td><td>In the position control mode, servo lock is decelerated and stopped, and in the internal velocity control mode, speed zero clamp deceleration and stop is actuated.</td></tr>
</table></td></tr>
<tr><td>68</td><td>Sequence at alarm</td><td>0 - 3</td><td>The parameter sets driving conditions during deceleration after alarm is generated as a result of activation of any of protective functions of the driver, or after the motor stops.
<table>
<tr><th rowspan="2">Settings</th><th colspan="2">Driving Conditions</th><th rowspan="2">State of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After stop</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Cleared</td></tr>
<tr><td>1</td><td>Free run</td><td>DB</td><td>Cleared</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Cleared</td></tr>
<tr><td>3</td><td>Free run</td><td>Free</td><td>Cleared</td></tr>
</table>
(DB: Dynamic Brake operation)
Also see Timing Chart “After an Alarm event” on Page 33 of Preparation edition.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 - 7
[0]</td><td>The parameter sets the following:
1) Driving conditions during deceleration or after stop
2) Clear operation of the deviation counter
after Servo-OFF (SRV-ON signal: CN X5 pin 2 turns on → off) is turned on.
<table>
<tr><th rowspan="2">Settings</th><th colspan="2">Driving Conditions</th><th rowspan="2">State of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After stop</th></tr>
<tr><td>[0]</td><td>DB</td><td>DB</td><td>Cleared</td></tr>
<tr><td>1</td><td>Free run</td><td>DB</td><td>Cleared</td></tr>
<tr><td>2</td><td>DB</td><td>Free</td><td>Cleared</td></tr>
<tr><td>3</td><td>Free run</td><td>Free</td><td>Cleared</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retained</td></tr>
<tr><td>5</td><td>Free run</td><td>DB</td><td>Retained</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retained</td></tr>
<tr><td>7</td><td>Free run</td><td>Free</td><td>Retained</td></tr>
</table>
(DB: Dynamic Brake operation)
Also see Timing Chart “Servo-ON/OFF Operation When the Motor is Stopped” on Page 34 of Preparation edition.</td></tr>
</table>

Standard Default Setup: [ ]

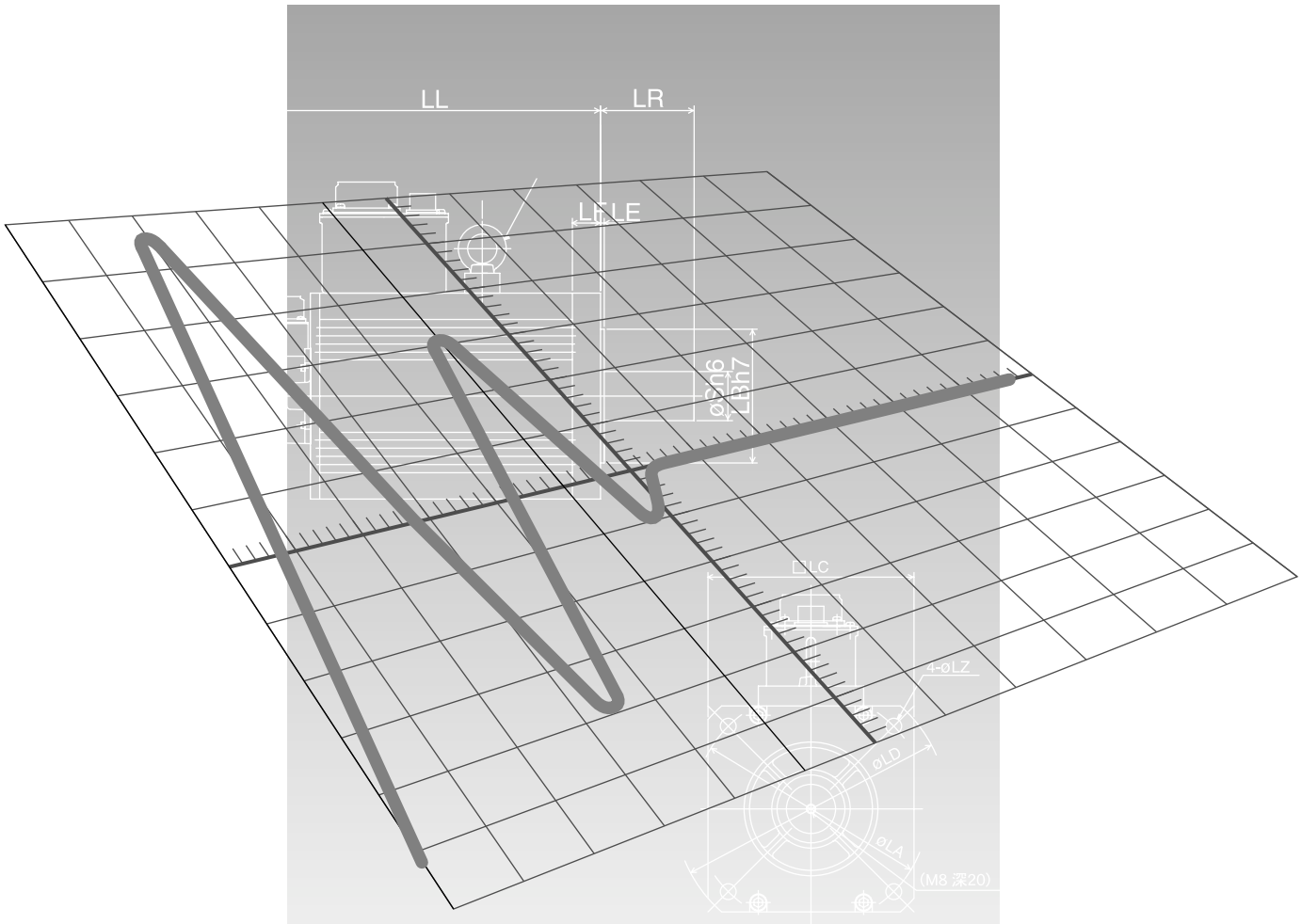
<table>
<tr><th>PrNo.</th><th>Parameter Name</th><th>Range of Settings</th><th>Function/Content</th></tr>
<tr><td>6A</td><td>Mech. break action set-up at motor standstill</td><td>0 - 100 [0]</td><td>The parameter enables you to set time from when the brake release signal (BRK-OFF:CN X5 pin 11) turns off until the motor becomes de-energized (servo free), when you turn on Servo-OFF while the motor is stopped.
• In order to prevent subtle travel/drop of the motor (work) due to the action delay time (tb) of the brake, set as follows:
Setting of Pr6A ≥ tb
• Pr6A is set in the unit of (setting) × 2ms.
• Refer to Timing Chart of “Servo-ON/OFF Operation When the Motor is Stopped” on Page 34.
 
Also see Timing Chart “Servo ON/OFF Operation When the Motor is Rotating” on Page 34 of Preparation edition.</td></tr>
<tr><td>6B</td><td>Mech. break action set-up at motor in motion</td><td>0 - 100 [0]</td><td>Unlike Pr6A, Pr6B sets time from when the motor is de-energized (servo free) before the brake release signal (BRK-OFF:CN X5 pin 11) turns off (i.e., brake retained), when Servo-OFF is activated while the motor is still rotating.
• The parameter is set to prevent deterioration of the brake to be cause by rotation of the motor.
• In servo-off operation while the motor is still running, time TB shown in the right figure is time set by Pr6B or time before rotation speed of the motor falls below about 30r/min, whichever is shorter.
• Pr6B is displayed in terms of (setting) x 2ms.
• Refer to the timing chart of “Servo ON/OFF Operation When the Motor is Rotating” on Page 34.
 
Also see timing chart “Servo ON/OFF Operation When the Motor is Stopped” on Page 34 of Preparation edition.</td></tr>
<tr><td>6C</td><td>External regenerative discharge resister selection</td><td>0 - 3</td><td>If you install a regenerative resistor externally, set this parameter to any value other than 0 or 3 and connect the regenerative resistor between P (pin 5) and B (pin 3) of the connector CN X1.
<table>
<tr><th>Settings</th><th>Regenerative resistors to be used</th><th>Protection against overload of regenerative resistors</th></tr>
<tr><td>0</td><td>–</td><td>As regeneration processing circuit does not run, a built-in condenser handles all of regenerative power.</td></tr>
<tr><td>1</td><td>Externally instaled resistor</td><td>With the operating limit of an externally installed resistor set to 10% duty, activate protection against overload of regenerative resistors (alarm code 18).</td></tr>
<tr><td>2</td><td>Externally installed resistor</td><td>The protection against regenerative overload does not work.</td></tr>
<tr><td>[3]</td><td>–</td><td>As regeneration processing circuit does not run, a built-in condenser handles all of regenerative power.</td></tr>
</table>
<Note>
When you use an external regenerative resistor, be sure to install such an external safeguard as a temperature fuse, etc.
Otherwise, protection of a regenerative resistor may be lost, resulting in abnormal heat generation and burnout of the regenerative resistor.
<Cautions>
Do not touch an external regenerative resistor.
Otherwise, an external regenerative resistor will be hot and may cause burn injury.</td></tr>
</table>

<Note>
- **An optional external regenerative resistor has a built-in temperature fuse for safety reasons. The built-in temperature fuse may be disconnected depending on heat dissipation conditions, range of use temperatures, supply voltage, and fluctuations of load.**
- **Configure the machine so that surface temperature of a regenerative resistor is kept below 100°C, even when regeneration is apt to occur and the machine is placed under poor conditions (i.e., high supply voltage, high load inertia, and short deceleration time). Also be sure to check that it can run properly.**

Standard Default Setup: [ ]

PrNo.	Parameter Name	Range of Settings	Function/Content
70	**1st over-speed level set-up**	0 - 6000 [0]	Pr.06=2 The parameter sets a 1st overspeed level when torque limit switching input is enabled. If rotation speed of the motor exceeds this setting when the first torque limit is selected, overspeed error will be generated. The unit is [r/min]. This parameter will be invalid when the torque limit switching input is disabled.
71	**2nd torque limit set-up**	0 - 500 [0]	Pr.06=2 The parameter sets a 2nd torque limit when torque limit switching input is enabled. This setting will be a limit value of the motor output torque when the second torque limit is selected. Set this in terms of [%] to rated torque of the motor. This parameter will be invalid when the torque limit switching input is disabled.
72	**2nd position over-deviation set-up**	1 - 32767 [1875]	Pr.06=2 The parameter sets a 2nd excessive position deviation range when torque limit switching input is enabled. The unit is [256 x resolution]. This parameter will be invalid when the torque limit switching input is disabled.
73	**2nd over-speed level set-up**	0 - 6000 [0]	Pr.06=2 The parameter sets a 2nd overspeed level when torque limit switching input is enabled. If rotation speed of the motor exceeds this setting when the second torque limit is selected, overspeed error will be generated. The unit is [r/min]. This parameter will be invalid when the torque limit switching input is disabled.

<Remarks>
For any use example of hit-and-stop initialization or press load pressing control using Pr70 to Pr73, see Pages 207 and 208 of Reference edition.



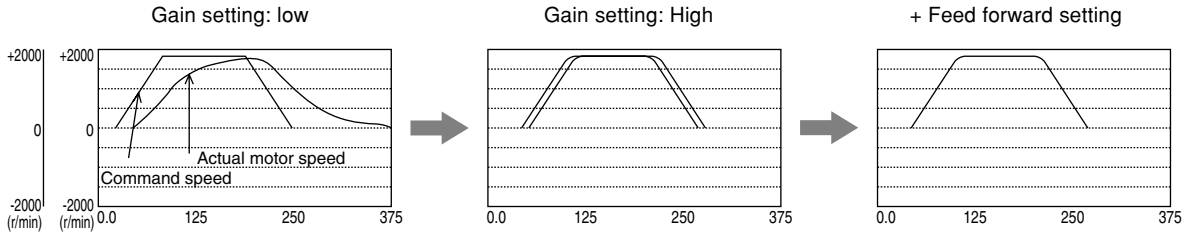
Adjustment

Gain Adjustment

Objective of Gain Adjustment

It is necessary that the motor runs with the least delay time and in response to a command from the driver. Hence, we need to adjust the gain of the motor to perform command, in order to maximize the performance of the machine.

<Example: Ball Screw>



Gain setting: low		Gain setting: High		+ Feed forward setting	
Position loop gain	: 20	Position loop gain	:100	Position loop gain	:100
Velocity loop gain	:100	Velocity loop gain	: 50	Velocity loop gain	: 50
Velocity loop integration time constant	: 50	Velocity loop integration time constant	: 50	Velocity loop integration time constant	: 50
Velocity feed forward	: 0	Velocity feed forward	: 0	Velocity feed forward	:500
Inertia ratio	:100	Inertia ratio	:100	Inertia ratio	:100

Types of Gain Adjustment

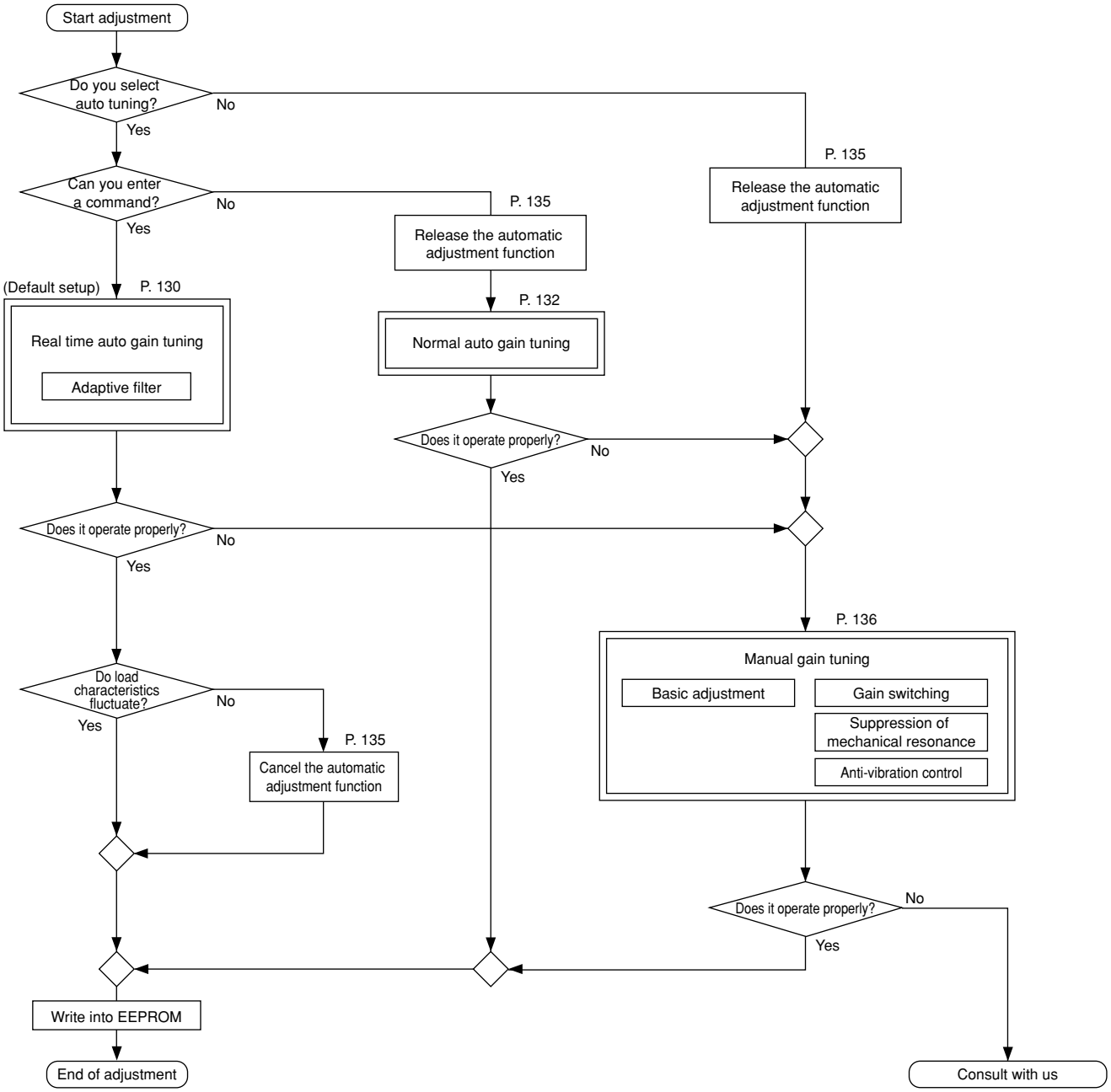
	Functions		Descriptions	Refer to:
Automatic adjustment	Real time auto gain tuning		Estimates the load inertia of a machine at real-time, and automatically sets the optimum gain based on the result of estimation.	P.130
		Adaptive filter	Reduces resonance point vibration, by estimating the resonance frequency from vibration component that appears in the motor speed and automatically sets the notch filter.	P.131
	Normal auto gain tuning		Actuates the motor in a command pattern generated by the driver, estimates the load inertia based on the torque required, and automatically sets the appropriate gain.	P.132
	Cancellation of automatic gain tuning		Cautions need to be followed when you disable real time auto gain tuning or the adaptive filter.	P.135
Manual adjustment	Manual gain tuning (basic)		Manually adjust when you cannot execute the auto gain tuning due to constraints such as operating pattern/load conditions, etc., or when you wish to ensure ultimate responsiveness appropriate to the individual loads.	P.136
	Manual gain tuning (application)		If you cannot satisfy the specifications through the basic adjustment, you can aim to improve performance by using the following applied functions:	P.138
		Gain switching function	You can execute the gain switching with internal data or external signal as a trigger. This shows the effects of reduced vibration under suspension, shortened stabilization time, improved command trackability, etc.	P.138
		Suppression of mechanical resonance	You are not able to set a high gain when the mechanical stiffness is low or when vibration or noise is generated due to resonance that results from the twist of the shaft. In such case, you can suppress the resonance by using a torque filter or notch filter.	P.140
		Anti-vibration control	Reduces vibration at edge of the device, by removing the components of the vibration frequency by the position command.	P.142

<Note>

- Pay adequate attention to safety.
- In case of oscillation (i.e., abnormal noise/vibration), promptly cut off the power or activate Servo-OFF.

Procedures of Gain Adjustment

The following flow chart illustrates the entire process of the gain adjustment:



Relationship between Gain Adjustment and Mechanical Stiffness

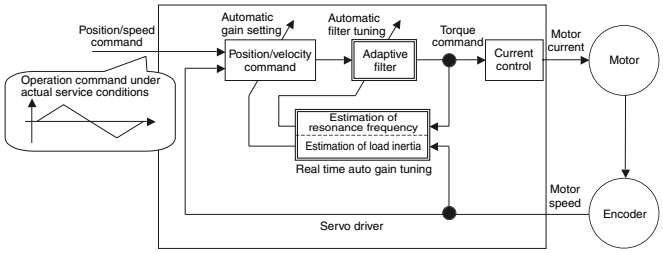
- Vibration inherent in a mechanical system (i.e., resonance frequency) substantially affects the gain adjustment of a servo. It is impossible to set high responsiveness for servo systems, for machine of low resonance frequency (= low mechanical stiffness).

- Hence, in order to increase mechanical stiffness, check that:
  (1) the machine has been installed on solid grounding and assembled fimly.
  (2) the coupling in use is highly stiff and designed for a servo.
  (3) a wide timing belt is used, and that tensile force has been set within the range of allowable axial load of the motor.
  (4) a gear with less backlash is used.

Real time Auto Gain Tuning

Outline

Load inertia of the machine is real-time estimated, and the optimum gain is automatically set based on the result of estimation. In addition, an adaptive filter automatically suppresses vibration due to resonance.



Scope

- Real time auto gain tuning is valid in all control modes.
- You can use an adaptive filter only when Pr02=2: high function positioning control.

Cautions

Under the following conditions, real time auto gain tuning may not properly function. In such cases, use either the normal auto gain tuning (Refer to Page 132) or the manual gain tuning (Refer to Page 136).

	Conditions that Hinder Real time Auto Gain Tuning from Functioning
Load Inertia	• When load inertia is smaller or greater than rotor inertia (i.e., 3 times or less or 20 times or more). • When load inertia changes quickly (less than 10 [s]).
Load	• When mechanical stiffness is extremely low. • When there is play such as backlash.
Operation Pattern	• When the motor runs at a continuous low speed below 100 [r/min]. • When acceleration/deceleration is gradual, e.g., 2000 [r/min] or less in 1 [s]. • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque. • When the time that meets conditions of speed/acceleration is short, e.g., less than 40 [ms].

Operating Instruction

(1) Stop the motor (Servo-OFF).

(2) Set Pr21 (Real time auto tuning set-up) to 1 to 6.
A default setup is 1.

Setting value	Real time Auto Tuning	Degree of Load Inertia Changes in Service	Adaptive Filter (When Pr02=2)
0	Not used	—	No
[1]	Used	Little change	Yes
2		Gradual change	
3		Sharp change	
4		Little change	No
5		Gradual change	
6		Sharp change	
7	Not used	—	Yes

When load inertia changes widely, set Pr21 to 3 or 6.
If there is possibly effect of resonance is possible, select “adaptive filter Yes”.

(3) Turn the servo on to operate the machine as usual.

(4) If you wish to improve responsiveness, gradually increase Pr22 (Machine stiffness at auto tuning). In addition, if any abnormal noise or oscillation occurs, set a value lower (e.g. 0 to 3).

(5) If you wish to save the result, write it into EEPROM.

<Remarks>

Any change to Pr21 (Real time auto tuning set-up) will become valid when you turn on the power and when Servo-OFF switches to Servo-ON.

Thus, to disable real time auto tuning, set Pr21 (Real time auto tuning mode setting) to 0, and then switch from Servo-OFF to Servo-ON. Similarly, when you activate the real time auto tuning, set Pr21 to any value other than 0 and 7, and switch from Servo-OFF to Servo-ON.

Insert the connector of console into CNX6 of the driver, and then turn on the power of the driver. → `r 0`

Setting parameter Pr21

Press (S SET). → `dP_SPd`

Press (M MODE). → `PA_ 00`

Select the parameter to be set with (▲) and (▼). → `PA_ 21`

(In this case, select Pr21.)

Press (S SET). → `1`

Change the value with (▲) or (▼).

Press (S SET). → `PA_ 21`

Setting parameter Pr22

Select Pr22 with (▲). → `PA_ 22`

Press (S SET). → `4` (Default Setup Value)

When you press (▲), a value increases, and when you press (▼), it decreases.

Now writing into EEPROM

Press (M MODE). → `EE_SEt`

Press (S SET). → `EEP -`

Keep pressing (▲) (about 5 seconds). Then, the number of bars in creases as shown on the right. → `EEP --` → `------`

Start of write (indicated momentarily). → `StArt`

End → `FinISh` (Write finishes) / `rESEt` / `Error` (Write error occurs)

After finishing write, return to Selection Display referring to "Structure of Each Mode" (Page 48 and 49).

Adaptive Filter

Filters are effective when Pr02=2 (high-grade position control mode) and Pr21 is 1 to 3 or 7.
The adaptive filter reduces the resonance point vibration, by estimating resonance frequency from the vibration component that appears at the motor operation, and removes the resonance component by torque command through automatic setting of a coefficient of a notch filter.
The adaptive filter may not function normally under the following conditions. In such cases, use the anti-resonance measures of 1st notch filter (Pr1D, 1E) according to the manual tuning procedure.
For details of the notch filter, refer to "To Reduce Mechanical Resonance" in Page 140.

	Conditions that Hinder an Adaptive Filter from Functioning
Resonance Point	• When the resonance frequency is 300 [Hz] or lower. • When resonance peak or control gain is low, which does not affect the motor speed • When there is more than one resonance point
Load	• When the motor speed having high frequency component fluctuates due to nonlinear element such as backlash, etc.
Command Pattern	• When acceleration or deceleration is exponential such as 30000 [r/min] or more in 1 [s]

Parameters to be Set Automatically

The following parameters are tuned automatically. The following parameters are also set up to the following fixed values automatically.

PrNo.	Name
10	1st position loop gain
11	1st velocity loop gain
12	1st velocity loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
18	2nd position loop gain
19	2nd velocity loop gain
1A	2nd velocity loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio
2F	Adaptive filter frequency

PrNo.	Name	Setting
15	Velocity feed forward	300
16	Feed forward filter time constant	50
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
33	Position control switching level	50
34	Position control switching hysteresis	33
35	Position loop gain switching time	20

<Remarks>
When real time auto tuning is in effect, you are not allowed to change any parameter to be automatically tuned.

Cautions

(1) After startup, immediately following the first Servo-ON or when you increase Pr22 (auto tuning), you may have abnormal noise or oscillation before you identify load inertia or an adaptive filter is stabilized. However, this doesn't constitute abnormality if it disappears in no time. If oscillation or noise persists over 3 reciprocating operations, you should take any of the following measures in any possible order:
   1) Write into EEPROM parameters used during normal operation.
   2) Decrease Pr22 (auto tuning).
   3) Once set Pr21 (real time auto tuning mode setting) to 0 and disable an adaptive filter. Then, enable real time auto tuning again (To disable inertia estimation/resetting of adaptive operation, or real time auto tuning, refer to "Cancellation of the Automatic Gain Tuning" on Page 135).
   4) Manually set a notch filter (Refer to "To Reduce Mechanical Resonance" on Page 140).

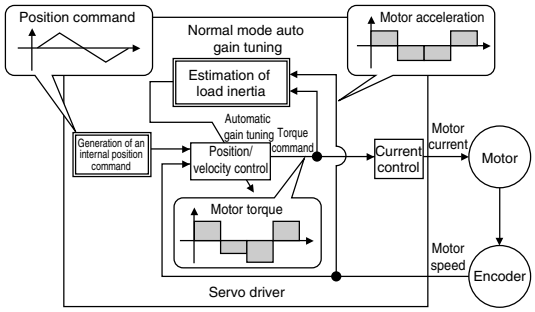
(2) In some cases, after abnormal noise or oscillation is generated, Pr20 (inertia ratio) or Pr2F (adaptive filter frequency) may change to an extreme value. In such cases, you should take the measures described above.

(3) Among results of real time auto gain tuning, Pr20 (inertia ratio) and Pr2F (adaptive filter frequency) are written into EEPROM every 30 minutes. When you power up again, auto tuning will be carried out using the data as an initial value.

Normal Auto Gain Tuning

Outline

In normal auto gain tuning, the motor runs at a command pattern automatically generated by the driver, load inertia is estimated based on the torque required then, and thus appropriate gain is automatically set.



Scope

This feature functions under the following conditions:

	Conditions under which normal auto gain tuning works
Control mode	• Pr02=0 (high speed response positioning control), Pr02=2 (high function positioning control), and Pr02=1 (internal velocity control) They can be used in all control modes.
Input signal	• It should be in Servo-ON state. • No deviation counter clear signal has been entered.

Cautions

Under the following conditions, normal auto gain tuning may not function properly. In such cases, set the manual gain tuning.

	Conditions that hinder operation of normal auto gain tuning
Load inertia	• When it is smaller or greater than rotor inertia (less than 3 times, or more than 30 times) • When load inertia is fluctuated.
Load	• When mechanical stiffness is extremely low. • When there is backlash or play, etc.

- If abnormal Servo-OFF/deviation counter clear occurs during auto gain tuning operation, tuning error will be generated.
- If load inertia cannot be estimated even though auto gain tuning has been executed, gain will remain unchanged, namely, same as a value prior to tuning.
- Motor output torque during auto gain tuning operation may be allowed up to output torque set with Pr5E (torque limit set-up), while CW and CCW overtravel inhibit will be ignored.

Pay adequate attention to safety. In case of oscillation, promptly cut off the power or turn on Servo-OFF and reset gain to default setup through setting of parameters.

Auto Gain Tuning Operation

(1) In normal auto tuning, responsiveness is set in terms of mechanical stiffness No.

Mechanical Stiffness No.

- The number sets level of mechanical stiffness of a user machine and is represented by a value from 0 to 15.
  The higher mechanical stiffness a machine has, the higher you can increase this number and set gain.
- Usually, set stiffness No. in ascending order and execute auto gain tuning. Use the function as far as oscillation/abnormal noise/vibration does not occur.

(2) An operating pattern you set with Pr25 (normal auto tuning motion set-up) is repeated up to 5 cycles. In addition, acceleration of operation is doubled for every cycle after a third cycle. Depending on load state, the operating pattern may end without being repeated 5 cycles, or acceleration of operation may not rise. This, however, does not constitute abnormality.

Operating Instructions

(1) Set an operating pattern with Pr25.
(2) Shift load to a position where there will be no problem if the motor executes the operating pattern set with Pr25.
(3) Do not enter a command.
(4) Activate Servo-ON.
(5) Start auto gain tuning.
Do so by using a console or PANATERM®.
For operating instructions with the console, see a next page.
(6) Adjust mechanical stiffness No. so that you can have desired response at a level that results in no vibration.
(7) If you have no problem with the result, write it into EEPROM.

Parameters to be automatically set

Auto gain tuning table

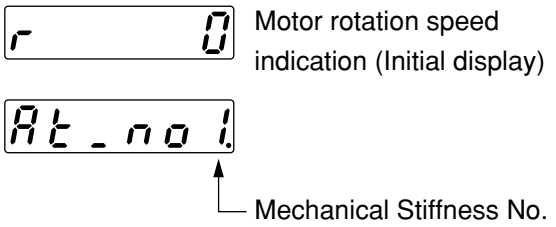
Parameter No.	Name	Stiffness Value															
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pr10	1st position loop gain	27	32	39	48	63	72	90	108	135	162	206	251	305	377	449	557
Pr11	1st velocity loop gain	15	18	22	27	35	40	50	60	75	90	115	140	170	210	250	310
Pr12	1st velocity loop integration time constant	37	31	25	21	16	14	12	11	9	8	7	6	5	4	4	3
Pr13	1st speed detection filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pr14	1st torque filter time constant	152	126	103	84	65	57	45	38	30	25	20	16	13	11	10	10
Pr15	Velocity feed forward	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Pr16	Feed forward filter time constant	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Pr18	2nd position loop gain	31	38	46	57	73	84	105	126	157	188	241	293	356	440	524	649
Pr19	2nd velocity loop gain	15	18	22	27	35	40	50	60	75	90	115	140	170	210	250	310
Pr1A	2nd velocity loop integration time constant	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Pr1B	2nd speed detection filter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pr1C	2nd torque filter time constant	152	126	103	84	65	57	45	38	30	25	20	16	13	11	10	10
Pr.20	Inertia ratio	Estimated load inertia ratio															
Pr30	2nd gain set-up	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pr31	Position control switching mode	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Pr32	Position control switching delay time	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Pr33	Position control switching level	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Pr34	Position control switching hysteresis	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
Pr35	Position loop gain switching time	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

shows parameters that are set to a fixed value. A default setup stiffness is 4.

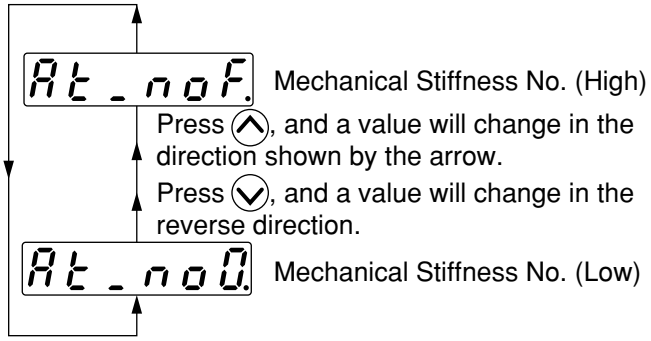
Normal Auto Gain Tuning

How to Operate with Console

(1) Switch from monitor mode to normal auto gain tuning mode, by pressing SET button and then mode switch button 3 times.
For operating instructions, refer to Normal Auto Gain Tuning Mode on Page 58 of Preparation edition.



(2) Select mechanical stiffness No. by pressing ⌄ or ⌃.



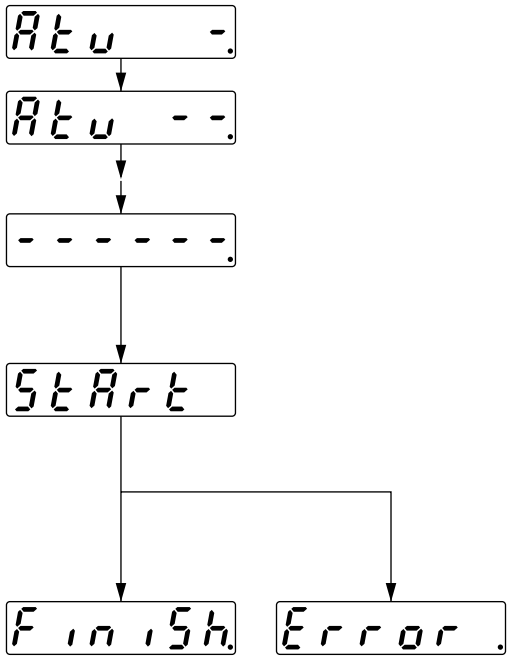
Driving method	Mechanical Stiffness No.
Direct connection with ball screw	8 - 14
Ball screw + timing belt	6 - 12
Timing belt	4 - 10
Gear, rack and pinion	2 - 8
Other machines with low stiffness	0 - 8

(3) Pressing SET ◎, shift to monitor/execution mode.

(4) Activate Servo-ON state (Do not enter a command).

(5) Operations in monitor/execution mode
Press till display of ⌃ changes to StArt.
When you keep pressing ⌃ (about 3 seconds), horizontal bars will increase, as shown in the right figure.

The motor has started to rotate. When Pr25 = 0, the motor rotates twice in CCW/CW directions for about 15 seconds, which is considered 1 cycle. The motor can repeat cycles up to 5 times. Even when it terminates before fifth cycle, it is not abnormality.



(6) Repeat steps 2 to 5 above until you receive a satisfactory response, and write a gain value to EEPROM so that it will not be lost due to cutoff of power supply.

<Caution> Do not use normal auto gain tuning with the motor/driver on a standalone basis. If you do so, Pr20 (inertia ratio) will be 0.

<Remarks>

Condition	Cause	Step to take
• Error is displayed. • The motor does not rotate.	Any of alarm, Servo-OFF or deviation counter clear has occurred.	• Remove a factor of alarm. • Activate Servo-ON. • Release the deviation counter clear.
• A value related to gain such as Pr10 remains unchanged from a value prior to execution.	Load inertia cannot be estimated.	• Decrease Pr10 to 10 and Pr11 to 50 and execute again. • Make manual adjustment.

Cancellation of the Automatic Gain Tuning [Gain Adjustment]

Outline

Cautions required when you disable the real time auto gain tuning which was unabled by default setup or an adaptive filter are stated.

Cautions

Cancel of the automatic adjustment function, at Servo-OFF.

Disabling Real time Auto Tuning

When you change Pr21 (real time auto tuning set-up) to 0 or 7 (only adaptive filter enabled), automatic estimation of Pr20 (inertia ratio) will stop and real time auto tuning will be disabled.
(Note, however, that the change will take effect when you activate Servo-ON again after turning on Servo-OFF once.)
Estimation result of Pr20 (inertia load) will be saved. Thus, if you notice this parameter has been apparently set to an extraordinary value, use normal auto tuning after disabling, or manually set a reasonable value obtained from calculation, etc.

Disabling Adaptive Filter

When you set Pr21 (real time auto tuning set-up) to 0 or 4 to 6 (only real time auto tuning enabled), the adaptive filter feature that automatically track load resonance will stop.
However, if you disable the adaptive filter while it is normally functioning, effects of resonance that have been suppressed may appear and cause abnormal noise/vibration, etc.
Therefore, if you disable the adaptive filter, do so only after manually setting Pr1D (1st notch frequency) from Pr2F (adaptive filter frequency) by means of the following table:

Pr2F	1st Notch Frequency [Hz]
0	(Disabled)
1	(Disabled)
2	(Disabled)
3	(Disabled)
4	(Disabled)
5	1482
6	1426
7	1372
8	1319
9	1269
10	1221
11	1174
12	1130
13	1087
14	1045
15	1005
16	967
17	930
18	895
19	861
20	828
21	796

Pr2F	1st Notch Frequency [Hz]
22	766
23	737
24	709
25	682
26	656
27	631
28	607
29	584
30	562
31	540
32	520
33	500
34	481
35	462
36	445
37	428
38	412
39	396
40	381
41	366
42	352
43	339

Pr2F	1st Notch Frequency [Hz]
44	326
45	314
46	302
47	290
48	279
49	269 (Disabled when Pr22 ≥ 15)
50	258 (Disabled when Pr22 ≥ 15)
51	248 (Disabled when Pr22 ≥ 15)
52	239 (Disabled when Pr22 ≥ 15)
53	230 (Disabled when Pr22 ≥ 15)
54	221 (Disabled when Pr22 ≥ 14)
55	213 (Disabled when Pr22 ≥ 14)
56	205 (Disabled when Pr22 ≥ 14)
57	197 (Disabled when Pr22 ≥ 14)
58	189 (Disabled when Pr22 ≥ 14)
59	182 (Disabled when Pr22 ≥ 13)
60	(Disabled)
61	(Disabled)
62	(Disabled)
63	(Disabled)
64	(Disabled)

<Remarks>

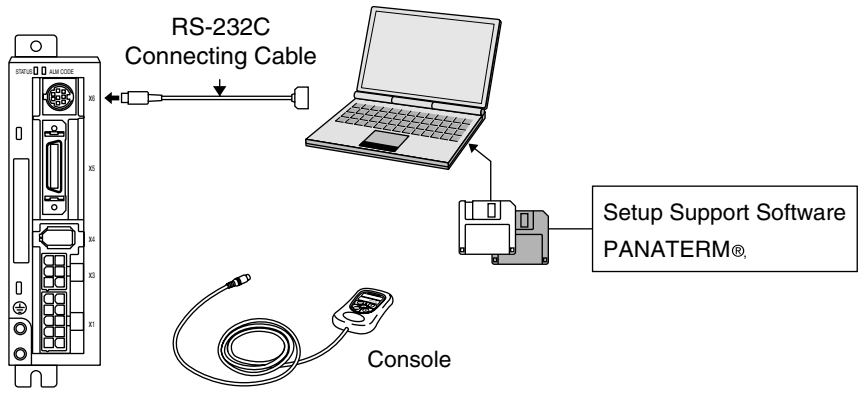
When Pr2F is 49 or higher, the adaptive filter may have been disabled automatically, depending on Pr22 (Machine stiffness at auto tuning). In such a case, you do not have to manually set Pr1D.

Manual Gain Tuning (Basic)

Although MINAS-E series is equipped with the auto gain tuning function described above, you may have to readjust when you cannot successfully adjust gain even if you execute auto gain tuning, due to some constraint such as load conditions, etc., or when you wish to have the best responsiveness or stability appropriate to individual loads.
In this section, in order to cope with such cases, we describe the manual gain tuning that allows you to adjust gain manually.

Prior to Manual Adjustment

If you use a console, you can make adjustment while checking behavior or sound of the motor (machine). However, we recommend that you conduct waveform observation by using waveform graphic function of the setup support software PANATERM® for more accurate adjustment, because it enables you to display, as waveform, a command to the motor, motor speed, torque, deviation pulse on the display screen of your personal computer. For detailed information, refer to “Outline of Setup Support Software PANATERM®” on Page 156 of Reference edition.



Functions Available in Each Control Mode

In each control mode, you can use the functions listed in the table below:

Pr02	Control Mode	Basic Adjustment	Gain Switching	Anti-Vibration Control Switching		Anti-Vibration Control Switching
				Torque Filter	Notch Filter	
0	High speed response positioning	○	○	○	△ *	△ *
1	Internal speed	○	○	○	○	×
2	High function positioning	○	○	○	○	○

<Remarks>

* In high speed response positioning control mode, simultaneous use of a notch filter and anti-vibration control is not allowed. A parameter entered earlier takes precedence.
(Example) When you set anti-vibration control, Pr1D: notch frequency will be forcibly set to 1500 (disabled) even if you enter it.

• Note that customers cannot set adjustment of current loop gain.

Method of Adjustment in Position Control Mode

(1) Set the following parameters to values listed in the table below:

Parameter No. (Pr□□)	Parameter Name	Target Value
10	1st position loop gain	27
11	1st velocity loop gain	15
12	1st velocity loop integration time constant	37
13	1st speed detection filter	0
14	1st torque filter time constant	152
15	Velocity feed forward	0
16	Feed forward filter time constant	0
18	2nd position loop gain	27
19	2nd velocity loop gain	15
1A	2nd velocity loop integration time constant	37
1B	2nd speed detection filter	0
1C	2nd torque filter time constant	152
1D	1st notch frequency	1500
1E	1st notch width selection	2

Parameter No. (Pr□□)	Parameter Name	Target Value
20	Inertia ratio	100
21	Real time auto tuning set-up	0
2B	Damping frequency	0
2C	Damping filter setting	0
30	2nd gain action set-up	0
31	Position control switching mode	0
32	Position control switching delay time	0
33	Position control switching level	0
34	Position control switching hysteresis	0
35	Position loop gain switching time	0
4C	Smoothing filter set-up	1
4E	FIR filter set-up	0

(2) Enter Pr20 inertia ratio. Measure with auto tuning or set a calculated value.

(3) Using the following table as target values, make adjustment.

Order	Parameter No. (Pr□□)	Parameter Name	Target Value	Interpretation of Adjustment
1	Pr11	1st velocity loop gain	30	You can increase a value as far as no abnormal noise/vibration is generated. If abnormal noise is heard, decrease it.
2	Pr14	1st torque filter time constant	50	If vibration is generated when you change Pr11, use a different value. Make a value of Pr11 setting x Pr14 setting smaller than 10000. If you wish to suppress vibration in halt condition, increase Pr14 and decrease Pr11. If vibration immediately before halt overshoots, decrease Pr14.
3	Pr10	1st position loop gain	50	Make adjustment while looking at positioning time. If you increase a value, positioning time will be shorter. If you set it too high, oscillation with trembling will be generated.
4	Pr12	1st velocity loop integration time constant	25	OK if there is no abnormal behavior. If you set a lower value, positioning time will be shorter. However, if you set it too low, oscillation will be generated. When you set it high, in some cases, deviation pulse will be left indefinitely without being converged.
5	Pr15	Velocity feed forward	300	You can increase a value as far as no abnormal noise/vibration is generated. If you set too much feed forward, it will lead to generation of overshoot or chattering of a positioning complete signal, and as a result, stabilization time may not be reduced. If command pulse input is not uniform, you may improve it by setting Pr16 (feed forward filter) higher.

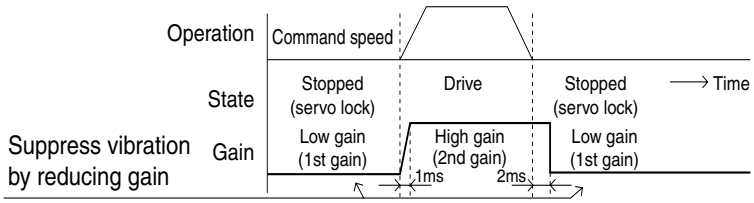
How to Adjust the Internal Velocity Control Mode

Adjustable parameters are velocity loop gain, velocity loop integration time constant, and torque filter time constant. Make adjustment in according to (3) of “Method of Adjustment in Position Control Mode” described above, Pr11 1st velocity loop gain, Pr14 1st torque filter time constant, and Pr12 1st velocity loop integration time constant.

Manual Gain Tuning (Application)

Gain Switching Function

In manual gain switching mode, you can manually set a second gain in addition to a 1st gain, and execute gain switching depending on an operating state.



- When you wish to accelerate responsiveness by increasing gain during operations
- When you wish to improve stiffness of servo lock by increasing gain in halt condition
- When you wish to switch to optimal gain, depending on an operation mode
- When you wish to decrease gain to suppress vibration under suspension

You can use the function of switching from a 1st to 2nd gain for various applications.

<Example>

This is an example of when you've noticed sound when the motor is halted (servo lock) or when you reduce noise by switching to low gain setting after the motor is stopped.

Make adjustment, also referring to Auto Gain Tuning Table (on Page 133).

Parameter No. (Pr□□)	Parameter Name	Execute manual gain tuning without gain switching.	Set Pr18 to Pr1C (2nd gain) to a same value as Pr10 to Pr 14 (1st gain).	Set Pr30 to Pr35 (gain switching conditions).	Adjust Pr11 and Pr14 in halt condition (1st gain).
Pr10	1st position loop gain	63			
Pr11	1st velocity loop gain	35			27
Pr12	1st velocity loop integration time constant	16			
Pr13	1st speed detection filter	0			
Pr14	1st torque filter time constant	65			84
Pr15		300			
Pr16		50			
Pr18	2nd position loop gain		63		
Pr19	2nd velocity loop gain		35		
Pr1A	2nd velocity loop integration time constant		16		
Pr1B	2nd speed detection filter		0		
Pr1C	2nd torque filter time constant		65		
Pr30	2nd gain action set-up	0		1	
Pr31	Position control switching mode			7	
Pr32				30	
Pr33				0	
Pr34				0	
Pr35				0	
Pr20	Inertia ratio	• Enter a numeric value when it is known by load calculation, etc. • Execute normal auto tuning to measure inertia ratio. • A default is 100.			

Setting Gain Switching Conditions

● Position Control Mode ○: Applicable parameters are enabled –: Disabled

Setting of gain switching conditions			Set parameters in position mode		
			Delay time*1	Level	Hysteresis*2
Pr31	Switching conditions	Figure	Pr32	Pr33	Pr34
0	Fixed to the 1st gain		–	–	–
1	Fixed to the 2nd gain		–	–	–
2	Gain switching input. 2nd gain when GAIN turns on		–	–	–
3	Torque command 2nd gain when there is much variation	A	○	○ *3 [0.05%/166 ms]	○ *3 [0.05%/166 ms]
4	Fixed to the 1st gain		–	–	–
5	Velocity command	C	○	○ [r/min]	○ [r/min]
6	Position deviation	D	○	○ *4[pulse]	○ *4[pulse]
7	Position command	E	○	–	–
8	Positioning not completed	F	○	–	–
9	Motor real speed	A	○	○ [r/min]	○ [r/min]
10	Command + speed	G	○	○ [r/min] *5	○ [r/min] *5

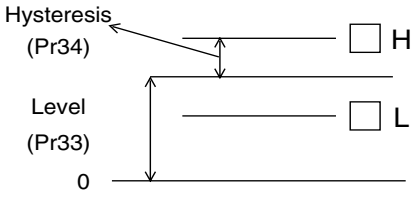
*1 Delay time (Pr32) will be validated upon return from second gain to first gain.

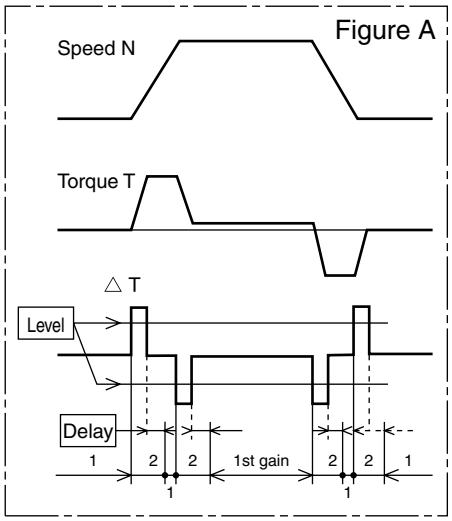
*2 Definition of hysteresis (Pr34) is as illustrated in the figure below:

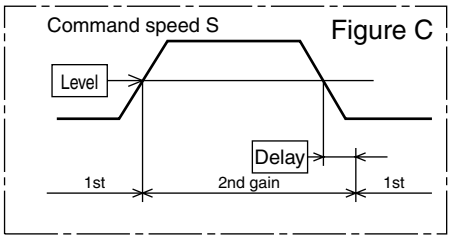
*3 If the condition that there is torque variation of 10% during 166 μs is included, setting should be 200.
10% / 166 μs = setting 200 x (0.05% / 166 μs)

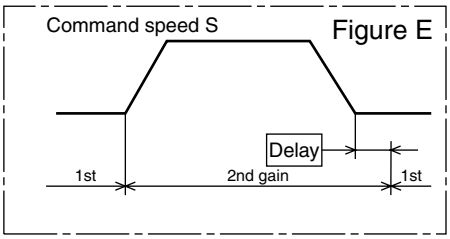
*4 Resolution of the encoder

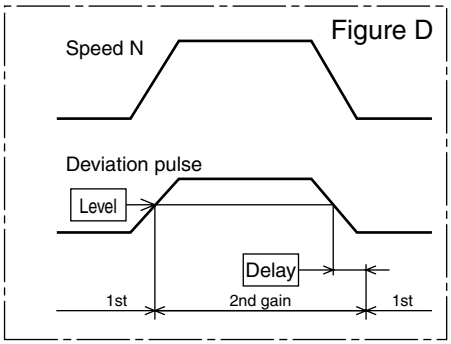
*5 When Pr31=10, delay time, level and hysteresis mean differently from usual cases (See Figure G).

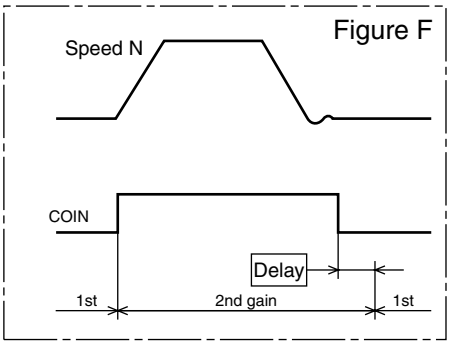


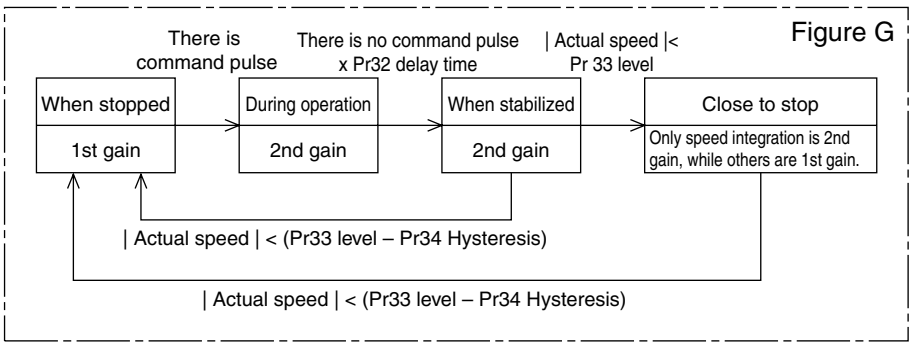












<Caution>

Any lag in gain switching timing due to hysteresis (Pr34) is not reflected in the above figure.

Manual Gain Tuning (Application)

To Reduce Mechanical Resonance

When mechanical stiffness is low, vibration or noise is generated due to the torsion of shaft, and thus you may not be able to set the gain high. In such cases, you can suppress the resonance by using the following 2 types of filters.

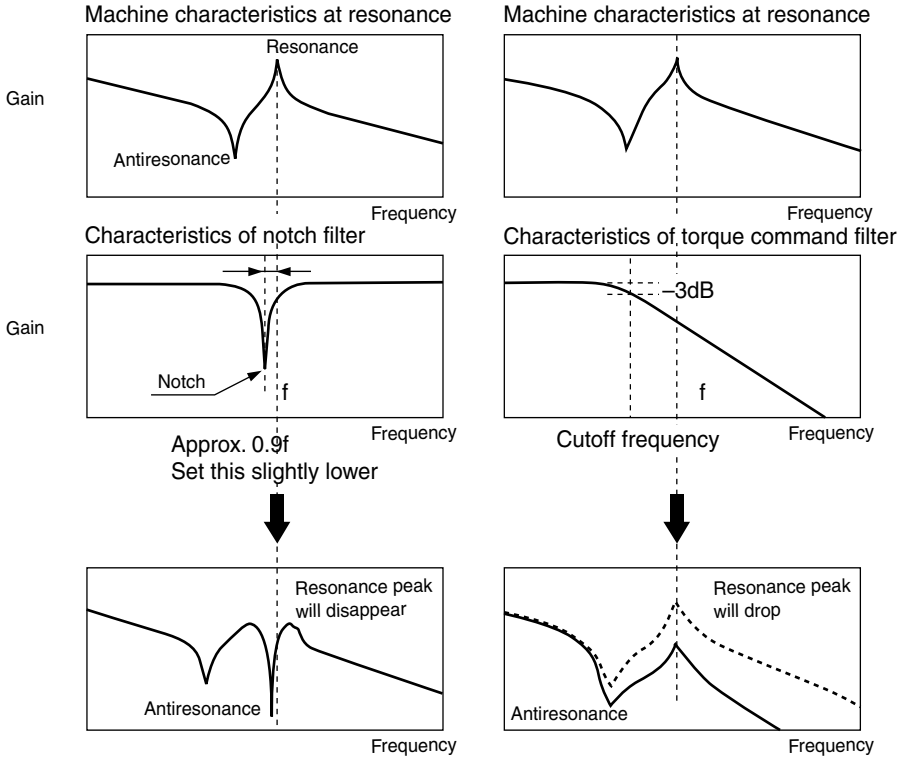
1. Torque Command Filter (Pr14, Pr1C)
   Set a filter time constant so that the attenuation will take place around the resonance frequency. You can determine the cutoff frequency with the following expression:
   Cutoff frequency (Hz) fc
   1/ (2π x parameter setting x 0.00001)

2. Notch filter
   - Adaptive filter (Pr21, Pr2F)
     By using an adaptive filter, MINAS-E series can control the vibration in load that is difficult for a conventional notch filter or torque filter to control, such as different resonance points for every device. However, you can enable the adaptive filter by setting Pr21 (Real time auto tuning set-up) to 1 to 3 or 7 when Pr02=2.

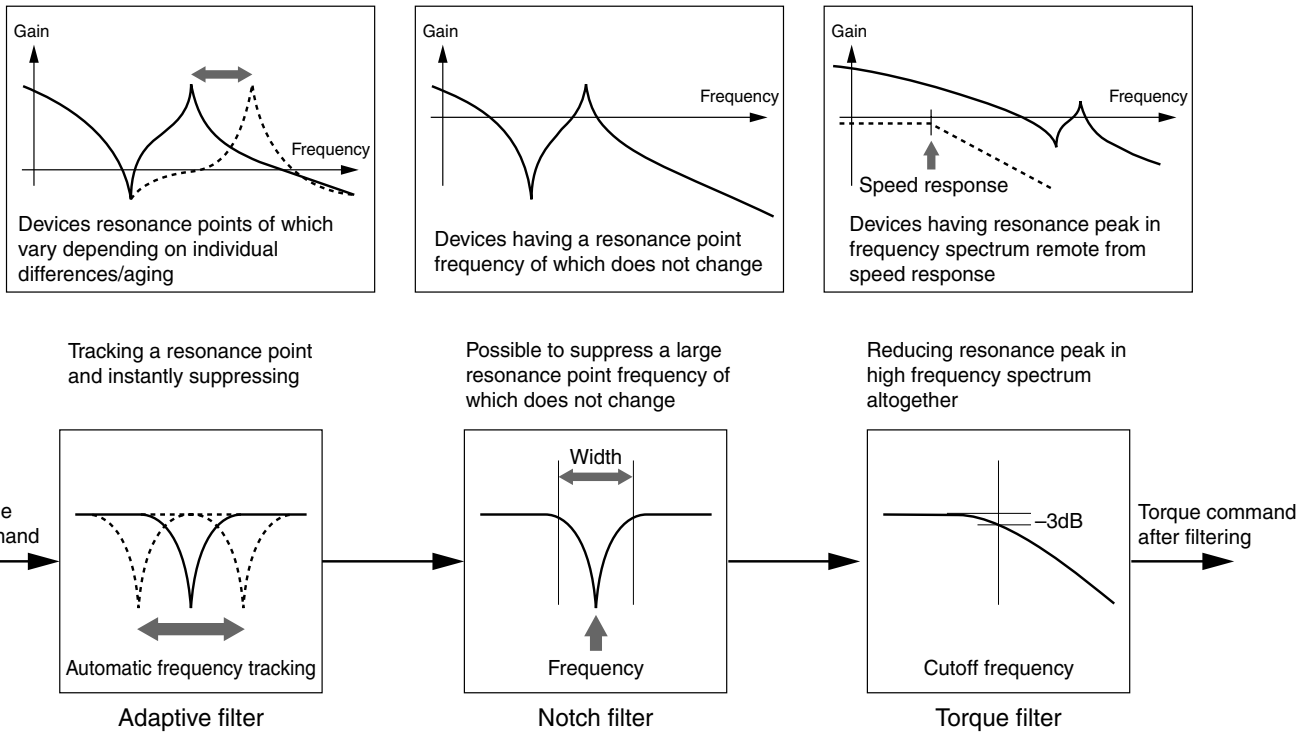
Pr21	Real time auto tuning set-up	1 - 3, 7: Adaptive filter enabled.	Pr2F	Adaptive filer frequency	It shows a table No. that corresponds to adaptive filter frequency (change prohibited).

   - 1st notch filter (Pr1D, Pr1E)
     Match notch frequency of a notch filter to mechanical resonance frequency.

Pr1D	1st notch frequency	Set this value about 10% lower than the resonance frequency measured with the frequency characteristic analysis function of PANATERM®.	Pr1E	1st notch width selection	Set this in accordance with characteristics of resonance points.



Examples of adaptive devices



Method of Checking Resonance Frequency of a Mechanical System

(1) Using “PANATERM®”, setup support software, display frequency characteristics.

(2) Set parameters and measurement conditions. Values are just benchmarks.

- Set Pr11 (1st velocity loop gain) to about 25. (By reducing gain, make resonance frequency easily identifiable.)
- Set amplitude to approximately 50 (r/min). (This is because torque cannot be saturated.)
- Set offset about 100 (r/min). (By increasing speed detection information, rotate the motor in a given direction.)
- When the polarity is positive (+), the motor rotates in CCW direction. When it is negative (-), the motor rotates in CW direction.
- Set sampling rate to 1. (Settings range from 0 to 7.)

(3) Execute frequency characteristics analysis.

<Note>

- Before starting the measurement, ensure that limit of movement must not be exceeded.
  Target rotation volume (rotation) is:
  Offset (r/min) x 0.017 x (sampling rate + 1).
  When you increase offset, you will obtain good measurement result. However, rotation volume will grow.
- When you measure, set Pr22 (Real time auto tuning set-up) to 0.

<Remarks>

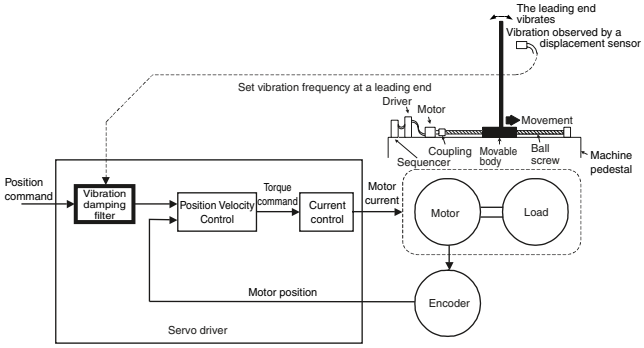
- You will have good measurement result when you set offset greater than setting of amplitude and so that the motor always turns in one direction.

Manual Gain Tuning (Application)

Anti-Vibration Control

Outline

When the leading end of a device vibrates, the function removes vibration frequency component from a command and reduces vibration.



Scope

This function cannot apply unless the following conditions are met:

	Conditions under which anti-vibration control works
Control mode	• It shall be position control. Pr02=0: In high speed response positioning control, real time auto tuning and first notch filter are disabled. Pr02=2: High function positioning control

Cautions

Change the parameter setting, after the operation stops.

The motor may not function normally or take effect under the following conditions:

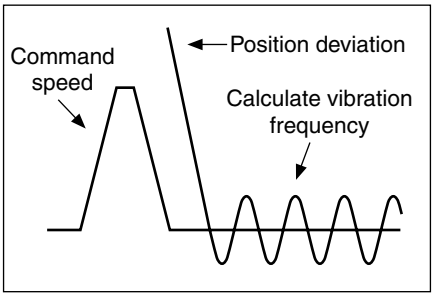
	Conditions that hinder anti-vibration control
Load	• When vibration is energized by a factor (such as external force) other than command • When the ratio of resonance frequency and antiresonance frequency is large • When vibration frequency is high (100 [Hz] or higher)

Usage

(1) Setting vibration damping frequency (Pr2B)

Measure vibration frequency at a leading end of a device. If you can directly measure vibration at leading end by means of a laser displacement gauge, etc., read vibration frequency [Hz] from the measured waveform and enter it into vibration damping frequency (Pr2B).

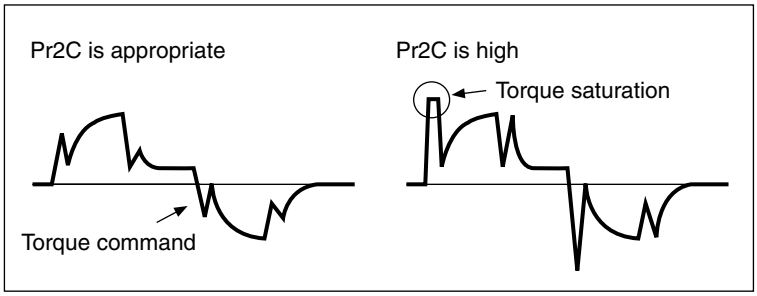
In addition, if you do not have a measuring instrument, read frequency [Hz] of residual vibration from position deviation waveform by using the waveform graphic function of our setup support software “PANATERM®”, as shown in the right figure, and set the vibtation damping frequency. Setting 0 to 99 will be disabled.

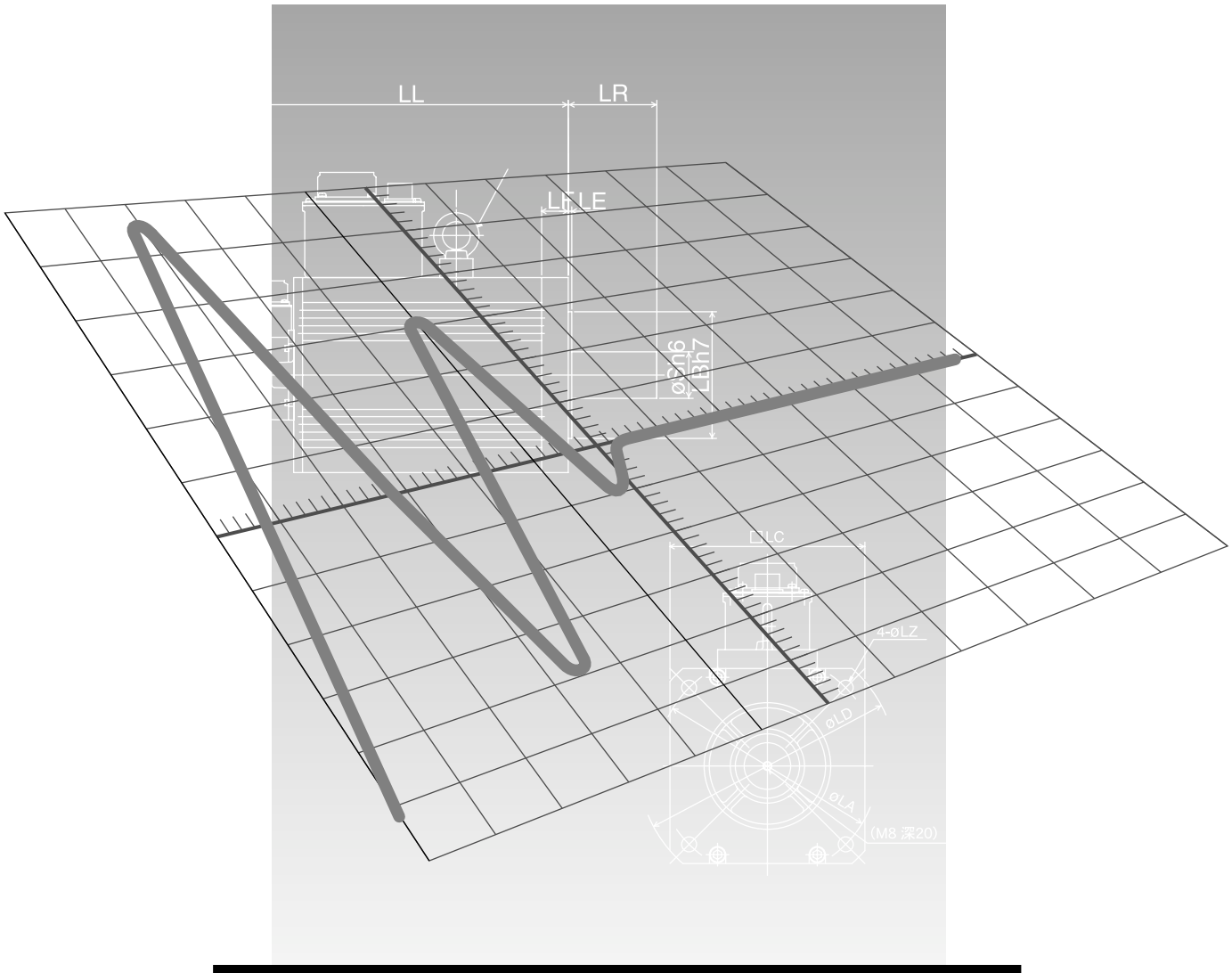


(2) Setting vibration damping filter (Pr2C)

First set it to 0.

You can shorten the stabilization time by setting a higher value. However, torque ripple increases at a command change point, as shown in the right figure. Thus, under actual use conditions, set it so that no torque saturation will occur. Occurrence of torque saturation will diminish vibration suppression effect.





Trouble Case

Troubleshooting

What are Protective Functions?

● The driver has various protective functions. If any of these functions activate, the motor stops immediately under trip condition, and simultaneously the “Servo Alarm Output” (ALM) will turn OFF (reset).

● **Counteractions against motor trip**

- When the motor trips, status display LED (STATUS) on the upper part of the front panel of the servo driver turns red, and alarm code LED (ALM CODE) blinks. You cannot activate Servo-ON on longer.
  If you are using the console, alarm code No. is displayed on the 7 segment LED display of the console and you cannot activate Servo-ON.
- You can release the tripped condition by keeping the alarm clear input (A-CLR) CN X5 pin 3 ON for 120 ms or longer.
- If the overload protective function activate, the alarm can be cleared according to Alarm Clear (A-CLR) signal after elapse of 10 sec or more since alarm output. If the driver power is switched OFF, the overload time limit characteristic (OVERLOAD) is cleared.
- The above alarms can be cleared even with the “PANATERM®”.
- Furthermore, the above alarms can be cleared even with the console.
- If any of *-marked functions in “Table of Protective Functions” acts, Alarm Clear Input (A-CLR)” is unable to be reset (cleared). In such a case, after switching OFF the driver power, search and remove the cause and thereafter re-switch ON the same power for resetting the alarm.

Checking LED Status

(1) Status LED (STATUS)

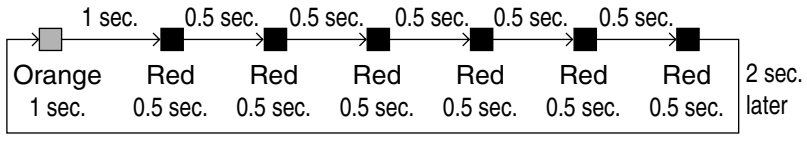
Status LED color	Content
□ Green	Power ON. The driver power is switched ON.
▒ Orange	This LED blinks (1 sec) against alarm output. (LED in blinking indicates overload/ over-regeneration/abnormal rotation of cooling fan.) This is not displayed on the LED display unit of the console.
■ Red	Alarm output

(2) Alarm Code LED (ALM CODE)

This LED blinks against alarm output. (Normally OFF)
Alarm code No. is expressed by blinking frequency in orange and red.
For alarm code No., see the next page.
Orange: 10 digit, Red: 1 digit

(Ex.) In the case Overload Alarm (Alarm code No.16) was output and the driver stopped

Orange LED blinks once and red one blinks 6 times.

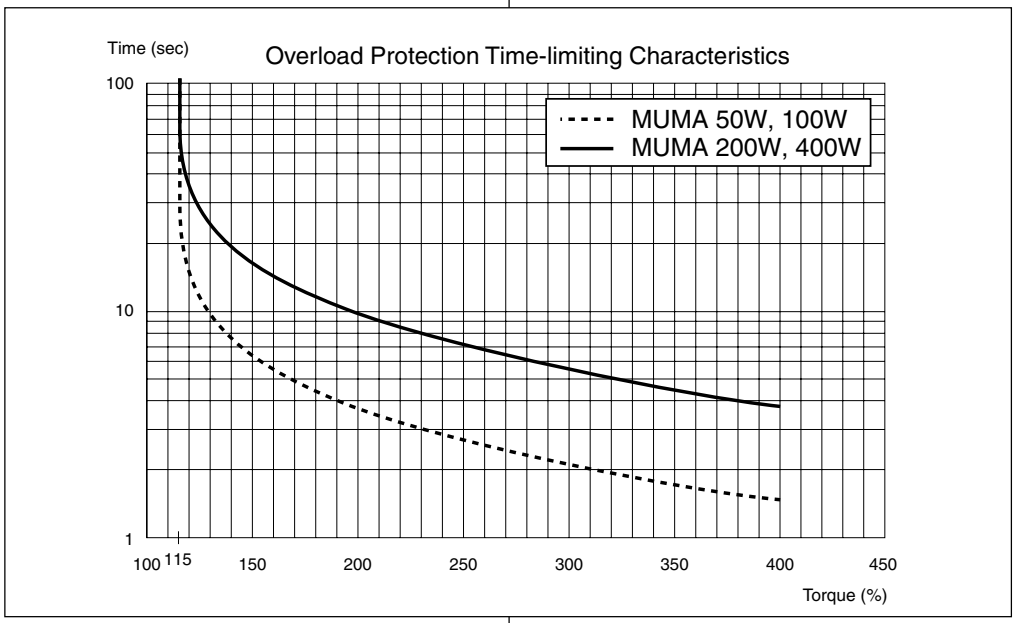


Details of Protective Functions

Protective Functions	Alarm code No.	Cause	Action
Power voltage shortage protection (LV)	**11**	During Servo-ON, voltage between P-N of the converter of the main power supply has dropped below a specified value. (1) Supply voltage is low. Momentary trip has occurred. Voltage source capacity is short. Supply voltage drops as a result of shutoff of the main power supply. The main power supply is de-energized. (2) Insufficient voltage source capacity ---Supply voltage has dropped due to inrush current generated when the main power supply was turned on. (3) Lack of phase --- The driver that has a requirement for three-phase input is run at single phase. (4) Failure of the driver (the circuit failed.)	Measure the line voltage of the connector CN X1 (L1, L2, L3). (1) Increase the supply voltage. Replace the power supply. After removing a cause of the drop of the electromagnetic contactor of power supply, power on again. (2) Increase the voltage source capacity. For voltage source capacity, refer to "List of Driver and Compatible Peripheral Equipment" on Page 26. (3) Correctly connect respective phases of supply voltage (i.e., L1, L2, and L3). Use L1 or L3 in the case of requirement for single-phase input. (4) Replace the failed driver with new one (i.e., driver that is running on other axis).
Over-voltage protection (OV)	**12**	Supply voltage exceeds allowable input voltage range. The P-N voltage of the converter unit exceeds a specified value. Supply voltage is high. Voltage surged due to the phase-advanced condenser or UPS (uninterruptible power supply). (1) Disconnection of a regenerative resistor (2) Regenerative energy cannot be absorbed due to improper selection of an external regenerative resistor. (3) Failure of the driver (the circuit failed.)	Measure the line voltage of the connector CN X1 (L1, L2, and L3). Solve the problem and supply correct voltage. Remove the phase-advanced condenser. (1) Using a tester, measure an ohmic value of the external regenerative resistor. When it is ∞, it is disconnected. Replace the regenerative resistor. (2) Change to a resistor of specified ohmic value and rated power. (3) Replace the failed driver with new one (i.e., driver that is running on other axis).
Over-current and ground fault protection (OC)	**14**	The current running through the converter exceeds a specified value. (1) Failure of the driver (Defective circuit, IGBT component, etc.) (2) Short circuit of motor wires U, V, W (3) Earth fault of the motor wire (4) Burnout of the motor (5) Poor contact of the motor wires (6) The relay for dynamic brake is melted and stuck due to frequent Servo-ON/OFF operation (7) The motor is not compatible with the driver. (8) Timing of the pulse input and Servo-ON is same or the former is faster.	(1) If a failure occurs immediately after you remove the motor wire and activate Servo-ON, replace the driver with a new one (that is running). (2) Check if U, V, or W is not shorted, in particular, whether of the lead wire of the connector has any branched out wire. Connect the motor wires correctly. (3) Measure insulation resistance between the motor wires U, V, W and earthing conductors of the motor. In case of bad insulation, replace the motor. (4) Measure respective line resistance of the motor. If they are unbalanced, replace the motor. (5) Check for falling out of connector pins for connection of U, V, and W. Securely fix loosened or fallen out pins. (6) Replace the driver. Do not start or stop the motor by turning Servo ON and OFF. (7) Check a part number (capacity) of the motor and driver on the nameplate. Change to the motor right for the driver. (8) Waiting 100ms or longer after turning on Servo-ON, activate pulse. Refer to "Timing Chart" on Page 32 of Preparation edition.
Internal resistor heating protection (ROH)	**15**	The resistor inside the driver was abnormally overheated.	Check ambient temperature and cooling conditions of the driver. Improve the surroundings appropriate to use conditions of the driver. Check operating sound of the relay at power-on. If you hear no operating sound, replace the driver.

Troubleshooting

Protective Functions	Alarm code No.	Cause	Action
Overload Protection (OL)	**16**	When an integration value of a torque command exceeds the set overload level, overload protection is activated based on time limiting characteristics. (1) Operation lasted long with more load and effective torque than rating. (2) Oscillation or hunting operation due to poorly adjusted gain. Vibration of the motor, and abnormal sound. (3) Incorrectly wired motor wires (U, V, W) and disconnection. (4) The machine collides, or suddenly gets heavy. The machine is entangled. (5) The electromagnetic brake keeps on running. (6) When more than one driver is used, motor wire is incorrectly connected to other axis.	On the waveform graphic screen of PANATERM®, check if torque (current) waveform widely oscillates up and down. Check load factor and overload warning display. (1) Increase the capacity of the motor and driver. Extend acceleration/deceleration time. Reduce load. (2) Readjust gains. (3) Connect motor wires as per the wiring diagram. Replace cables. (4) Free the machine of any tangle. Reduce the load. (5) Measure voltage of the brake terminal. Release the brake. (6) Correctly connect motor and encoder wiring to eliminate a mismatch between the wires and axes.
***Regenerative resistor overload protection (REG)**	**18**	Regenerative energy exceeds the capacity of the regenerative resistor. (1) The converter voltage increases due to energy regenerated during deceleration resulting from high load inertia. In addition, it further rises, as the regenerative resistor cannot absorb energy enough. (2) Because of high rotation speed of the motor, the regenerative resistor cannot absorb regeneration within specified deceleration time. (3) The operating limit of the external resistor is limited to 10% duty.	Check the load factor of the regenerative resistor in monitor mode. You must not use the driver for the purpose of continuous damping of regeneration. (1) Check an operating pattern (waveform graphic). Check the load factor of the regenerative resistor and display of over-regeneration warning. Increase capacity of the motor and driver and slow down deceleration time. Use an external regenerative resistor. (2) Check an operating pattern (waveform graphic). Check the load factor of the regenerative resistor and display of over-regeneration warning. Increase capacity of the motor and driver and slow down deceleration time. Reduce rotation speed of the motor. Use an external regenerative resistor. (3) Set Pr6c to 2.
		<Note> When you set Pr6C to 2, be sure to install an external safeguard such as a temperature fuse, etc. Otherwise, protection of regenerative resistor is lost, causing abnormal heat generation and burnout of the regenerative resistor.	
***Encoder communication error protection**	**21**	Due to communication breakdown between the encoder and driver, the encoder cable disconnection detecting function is activated. **<Caution>** If the above condition occurs before power-on, be careful as the motor aut omatic recognition abnormality protection (alarm code No.95) will be activated when you power on again.	Connect the encoder cable as per the wiring diagram. Correct wrong connections of the connector pins, if any.



Protective Functions	Alarm code No.	Cause	Action
***Encoder communi-cation data error protection**	**23**	Data from the encoder results in communication error, which is mainly caused by noise. Although the encoder cable is connected correctly, data results in communication error. **<Caution>** If the above condition occurs before power-on, be careful as the motor automatic recognition abnormality protection (alarm code No.95) will be activated when you power on again.	Ensure that the supply voltage of the encoder is DC5V±5% (4.75 to 5.25V). Be careful, in particular, when the encoder cable is long. If it is bundled with the motor wire, separate them. Connect the shield to FG --- See the encoder wiring diagram.
Position over-deviation protection	**24**	The position deviation pulse exceeds the position over-deviation set-up, Pr63. (1) The motor operation does not respond to a command. (2) The position over-deviation set-up Pr63 is low.	(1) Check that the motor rotates in accordance with the position command pulse. Using the torque monitor, ensure that output torque is not saturated. Adjust gains. Maximize torque limit set-up Pr5E. Correct encoder wires as per the wiring diagram. Extend acceleration/ deceleration time. Alleviate load and slow down speed. (2) Increase Pr63.
Over-velocity protection (OS)	**26**	(1) The rotation speed of the motor exceeds a specified value. (2) Torque limit switching input selection Pr06 is set to 2, and 1st and 2nd over-speed level set-up Pr70, Pr73 are set to 0.	(1) Decrease the speed to prevent over-speed command from being issued. Set dividing/ multiplier ratio so that input frequency of a command pulse is 500 kpps or less. In the event of overshoot due to poorly adjusted gains, readjust them. Connect encoder wires as per wiring diagram. (2) If you select torque limit switching input, set Pr70 and Pr73 to a value within the use range speed of the motor.
Command pulse multiplier error protection	**27**	The dividing/multiplier ratio set with the numerator of 1st and 2nd command ratio Pr46 and Pr47 is not appropriate.	Using Pr46 and Pr47, reduce the multiplier ratio. Set the dividing/multiplier ratio so that the command pulse frequency will not exceed the maximum input pulse of 500 kpps or less.
Deviation counter overflow protection	**29**	A value of the deviation counter exceeds 2^{27} (134217728).	Check that the motor rotates in accordance with the position command pulse. Using the torque monitor, ensure that output torque is not saturated. Adjust gains. Maximize torque limit set-up Pr5E. Correct encoder wires as per the wiring diagram. Extend acceleration/deceleration time. Alleviate load.
Software limit protection	**34**	The motor operation exceeds the motor operational range set in Pr26 (Software limit setting) for the position command range. (1) The gain is not appropriate. (2) The value set in Pr26 is too small.	(1) Check the gain (the balance between the position loop gain and the speed loop gain) and the inertia ratio. (2) Increase the set value in Pr26. Set Pr26 to “0” in order to disable the protection function.
***EEPROM parameter error protection**	**36**	Data in the parameter storage area is corrupt when it is read from EEPROM upon power-on.	Reset all the parameters. If the error persists, the driver may have failed. Replace it. Then, return it to the sales agent for inspection (repair).
***EEPROM check code error protection**	**37**	EEPROM write check data is corrupt when it is read from EEPROM upon power-on.	The driver may have failed. Replace it. Then, return it to the sales agent for inspection (repair).
Overtravel inhibit input protection	**38**	Both CW and CCW overtravel inhibit input turn off.	Check if limit switches, electric wires, and power supply for CW/CCW overtravel inhibit input are normal. Especially, check whether the power supply for control signal (DC12 to 24V) rises without delay. Check setting of Pr04 and correct wiring.
***ABS 1-rotation counter error protection**	**44**	The encoder detected abnormality of a single-turn counter. The encoder is defective.	The motor may have failed. Replace it. Then, return it to the sales agent for inspection (repair).
***ABS multi-rotation counter error protection**	**45**	The encoder detected abnormality of a multi-turn counter. The encoder is defective.	The motor may have failed. Replace it. Then, return it to the sales agent for inspection (repair).

Protective Functions	Alarm code No.	Cause	Action
***Encoder Z-phase error protection**	48	Missing phase Z pulse of 2500 [P/r] 5-serial encoder is detected. The encoder is defective.	The motor may have failed. Replace it. Then, return it to the sales agent for inspection (repair).
***Encoder CS signal error protection**	49	The abnormal logic of CS signal of 2500 [P/r] 5-serial encoder is detected. The encoder is defective.	The motor may have failed. Replace it. Then, return it to the sales agent for inspection (repair).
***Motor auto recognition error protection**	95	(1) The motor is not compatible with the servo driver. (2) The encoder is not connected at power-on. **<Cautions>** Before power-on, if (1) the encoder wire is disconnected, or (2) data from the encoder results in communication error, be careful as the motor automatic recognition abnormality protection (alarm code No.95) will be activated when you power on again. In case of (1) and (2) above, take action for alarm codes No.21 and No.23.	1) Change the motor to a new motor compatible with the servo driver. 2) Check connection of the encoder.
***LSI setup error protection**	96	Setting of LSI does not complete successfully due to excessive noise.	Take countermeasure against noise.
***Other trouble and error**	Nos. other than the above	The self-diagnostic function of the driver is activated and some abnormality occurs in the driver. The control circuits malfunction due to excessive noise.	Power off and on again. If the display still appears and the error is repeated, the motor and driver may have failed. Shut down the power and replace them. Then, return them to the sales agent for inspection (repair).

<Remarks>

- Load factor and regenerative resistor load factor can be checked in the monitor mode of PANATERM® or console.
- Power voltage shortage protection (Alarm Code No. 11), EEPROM parameter error protection (Alarm code No. 36), EEPROM check code error protection (Alarm code No. 37), Overtravel inhibit input protection (Alarm code No. 38), Motor auto recognition error protection (Alarm code No.95) and LSI setup error protection (Alarm code No.96) are not memorized in “Alarm History”.
- If other trouble/error occurs, STATUS LED and Alarm LED (ALM Code) could eventually turn ON simultaneously in 4 different modes given below, instead of blinking (flashing) as staged in the above Table.

STATUS LED	Alarm Code LED	Alarm content
■ Red	■ Red	Other trouble/error
■ Red	□ Orange	
□ Orange	■ Red	
□ Orange	□ Orange	

Software limit function

(1) Outline

If the motor operation exceeds the motor operational range set in Pr26 (Software limit protection) for the position command range, then the alarm can be stopped with the software limit protection (error code No. 34).

Using this function prevents the load from colliding with the edges of the machine due to the oscillation of the motor.

(2) Scope

This function can operate under the following conditions:

	Conditions under which the software limit functions
Control mode	Position control mode Pr02 = 0: High-speed response position control Pr02 = 2: Highly-functional position control
(1) Servo must be turned ON. (2) Pr26 (Software limit setting) must be set to a value other than “0”. (3) The motor’s operational range must be within 2147483647 for both CCW and CW since the position command parameter range was reset to “0”. Once the condition in (3) has been breached, then the software limit protection will be disabled until the condition for which the (5) Position command parameter range is cleared is met. If condition (1) or (2) is not met, then the position command parameter range will be cleared to “0”.	

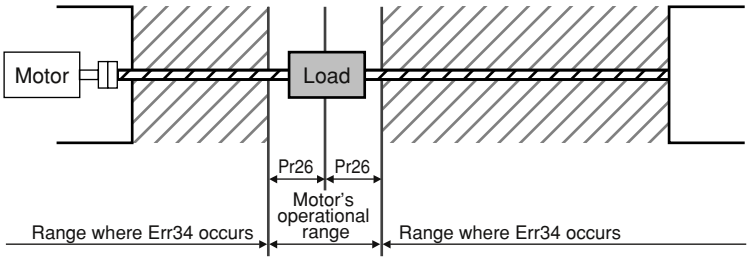
(3) Notes

- This function is not protection for abnormal position commands
- When the software limit protection is activated, the motor will slow down and then stop in accordance with Pr68 (Sequence for alarm).
- Some loads may collide with the with edges of the machine while the motor is slowing down. Set the Pr26 range allowing for this slow-down operation.
- The software limit protection is disabled when the PANATERM frequency characteristics are functioning, or in the trial (JOG) operation.

(4) Examples of operations

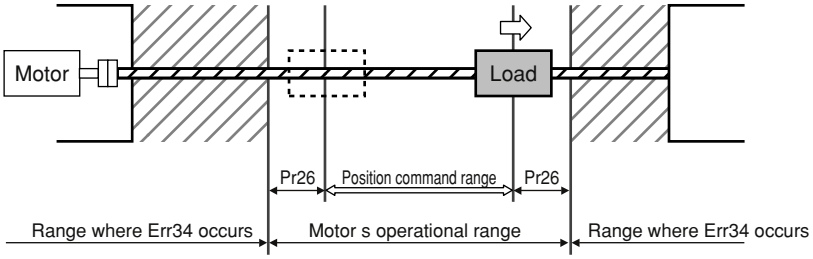
(1) When a position command is not inputted (servo ON)

The motor's operational range is the travel distance range set on both sides of the motor in Pr26 because no position commands are inputted. If the load is within in the ranges where Err34 occurs (hatched areas) due to the vibration of the motor, then the software limit protection will be activated.



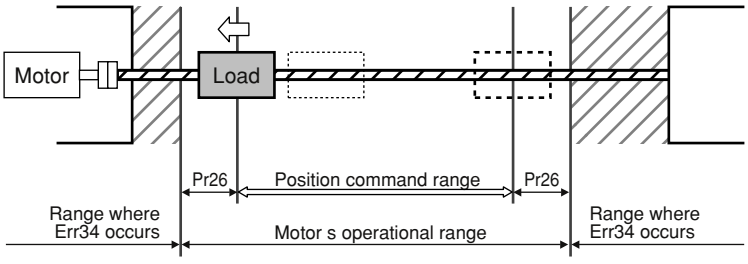
(2) When moving rightward (servo ON)

When a position command to move the load rightward is inputted, the motor's operational range will be expanded as per the commanded and will be expanded beyond the top and bottom limits of the range set in Pr26.



(3) When moving leftward (servo ON)

When a position command to move the load leftward is inputted, the motor's operational range will be expanded further.



(5) Conditions for which the position command range is cleared

The position command range will be cleared to "0" under the following conditions:

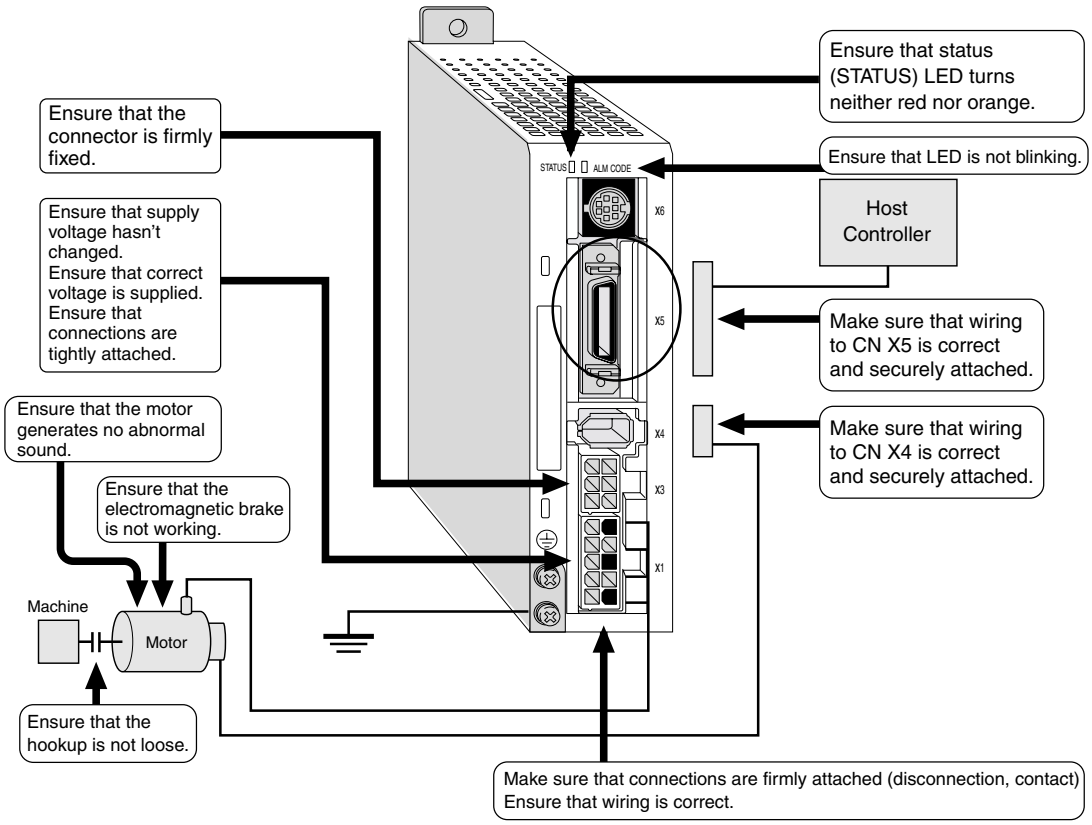
The power is turned ON.

The position deviation is cleared.

Normal auto tuning is started or completed.

Troubleshooting

Checkpoints



The motor does not rotate

Category	Cause	Action
Parameters	The control mode is not correctly selected.	Check the value of the control mode setting Pr02. 0… High velocity positioning control 1… Internal velocity control 2… High function positioning control
	The torque limit of the parameter is set to 0.	Check the value of the torque limit set-up Pr5E. Change it to a pre-shipment default of 300.
	The motor does not run because the zero speed clamp is open (OFF).	Check the value of the ZEROSPD/TC input selection Pr06, and change it to 0. Zero clamp function is enabled when it is set to 1. Otherwise, change the setting to 1 and enable the zero speed clamp input. Then, correct wiring connections so that the zero speed clamp input can turn ON successfully.
	The internal speed setting parameter hasn't been entered.	Check settings of Pr53 to Pr56. Set desired rotation speed.
Wiring	The circuit for CW/CCW overtravel inhibit input of CN X5 is open.	Check the value of Pr04. If it is 0, connect between CN X5 pins 8 and 13, and 7 and 13.
	Servo-ON signal of CN X5 has not been activated.	Short circuit (ON) between the connector CN X5 pins 2 and 13.
	The deviation counter input of CN X5 is turned ON (shorted).	Open (OFF) between the connector CN X5 pins 4 and 13.
	Command input connection is wrong when pulse input form of CW and CCW is selected in the position control mode.	Connect so that the photocoupler inside the driver is turned OFF on the side in which pulse is not input (See Pages 73 to 81).
Installation	The motor output shaft is heavy and does not turn.	Power OFF and disconnect the motor from the installation. Turn the motor shaft by hand to see if it can rotate. If the motor is provided with electromagnetic brake, turn the shaft by hand while applying voltage to the brake (DC24V). If the motor shaft does not rotate, ask the sales agent of the motor for repair.

The rotation is not stable (the rotation is not smooth)

Category	Cause	Action
Adjustment	Poor gain adjustment	Increase the value of the 1st velocity loop gain Pr11. Insert a 1st torque filter Pr14 and increase the value of Pr11 again.
	Position command (pulse row command) is unstable.	Check how the motor is running, by using the waveform graphic function of PANATERM ®. Check the wiring and connectors for poor contact. Also check the controller.
Wiring	The following input signals of CN X5 are chattering. (1) Servo-ON signal	(1) Using the I/O signal status display function, check wiring and connection between the connector CN X5 pins 2 and 13. Modify the wiring and connection so that Servo-ON signal successfully turns ON. Check the controller.
	(2) Deviation counter input signal	(2) Using the I/O signal status display function, check wiring and connection between the connector CN X5 pins 4 and 13. Modify the wiring and connection so that the deviation counter input successfully turns ON. Check the controller.
	(3) Zero speed clamp signal	(3) Using the I/O signal status display function, check wiring and connection between the connector CN X5 pins 5 and 13. Modify the wiring and connection so that the zero speed clamp input successfully turns ON. Check the controller.
	(4) Internal command speed selection 1 and 2 input signals	(4) Using the I/O signal status display function, check wiring and connection between the connector CN X5 pins 4 and 13, and 6 and 13. Modify the wiring and connection so that the internal command speed selection 1/2 input successfully turn ON. Check the controller.

Positioning Accuracy is poor

Category	Cause	Action
System	The position commands (amount of command pulse) are not correct.	Count the number of feedback pulses either by repeatedly reciprocating for a fixed distance and using the monitoring function of PANATERM®, or by using the monitor mode of feedback pulse of the console. If the count does not return to the same value, adjust the controller. Take action to reduce noise on the command pulse.
	Reading of the positioning completion signal occurs at the edge.	By using the waveform graphic function of PANATERM®, monitor a deviation when positioning completion signal is generated. Read the signal from the controller at a midpoint of the time span, and not at the edge.
	The shape and width of the command pulses do not meet the requirements.	If the command pulses are deformed or narrowed, adjust the pulse generating circuit. Review the action against noise.
	The deviation counter clear input CL (CN X5 pin 4) is superposed with noise.	Not only take action against noise from external DC power supply, but also do not wire any unused signal line.
Adjustment	The position loop gain is small.	Check amount of position deviation either by using the monitoring function of PANATERM® or in the monitor mode of the console. Increase the value of Pr10 so as not to cause oscillation, and check it.
Parameter	The setting of positioning completion range is too high.	Decrease the value of the In-position range Pr60 so that the completion signal will not cause chattering.
	The command pulse frequency exceeds 500 kpps.	Lower the command pulse frequency. Change the dividing/multiplier ratio of the numerator of 1st/2nd command pulse ratio Pr46 to Pr47.
	The incorrect dividing/multiplier ratio is set.	Check whether repeatability is the same.
	The velocity loop gain is in proportional control action under suspension.	• Set the velocity loop integration time constant Pr12 and Pr1A below 999. • Modify wiring and connection so that the second gain action set-up Pr30 is 1, and connection between the gain switching input connector CN X5 pins 5 and 13 is turned OFF. Check the controller.
Wiring	The following signal inputs of the connector CN X5 are chattering. (1) Servo-ON signals (2) Deviation counter clear input signals	 (1) Using the I/O status display function, check wiring and connection between the connector CN X5 pins 2 and 13. Modify the wiring and connection so that Servo-ON signal successfully turns ON. Check the controller. (2) Using the I/O status display function, check wiring and connection between the connector CN X5 pins 4 and 13. Modify the wiring and connection so that the deviation counter clear input successfully turns ON. Check the controller.
Installation	Load inertia is high.	Check overshot in halt condition, by using the waveform graphic function of PANATERM®. Even when it is not corrected after adjusting gains, increase capacity of the motor and driver.

Original position varies

Category	Cause	Action
System	Phase Z is not detected when the original position is calculated.	Check if phase Z is superposed on proximity input (nearest point dog sensor). Initialize correctly according to the controller.
	Speed to creep to the original position is fast.	Decelerate the initialization speed in the vicinity of the original position, or extend the initialization sensor.
Wiring	Output of the original point proximity sensor (nearest point dog sensor) is chattering.	Using an oscilloscope, check input signal of the nearest point dog sensor of the controller. Review wiring around the nearest point dog and take action to reduce and prevent noise.
	Noise is superposed on the encoder wire.	Take various actions: Reduce noise (by installing a noise filter/ inserting ferrite cores), shield I/F cable, use twist pair cable, separate signal line from power line, etc.
	Phase Z signal is not output.	Using an oscilloscope, monitor phase Z signal to be entered into the controller. Check that the connector CN X5 pin 14 is connected to the ground of the controller. For non-isolated open collector interface, connect the ground of the driver. Replace the driver and controller. Ask for repair.
	Wiring of phase Z output is incorrect.	Check that the line driver is connected at both sides. If the controller does not have a differential input, use CZ output (open collector).

The motor has abnormal sound or vibration

Category	Cause	Action
Adjustment	The gains are set high.	Decrease the values of the position loop gain Pr10 and velocity loop gain Pr11 to lower the gains.
	A speed detection filter has changed.	Increase the value of the speed detection filter Pr13 until the sound reaches the allowable level, or reset it to a default setup of 4.
Installation	Resonance between the equipment (machine) and the motor is generated.	Readjust Pr14 (torque filter). Using the frequency characteristic analysis program of the PANATERM®, check whether there is any mechanical resonance. If so, set the notch frequency Pr1D.
	Motor bearing	Drive the motor with no load to see if there is any sound or vibration around the bearing. Replace the motor and check. Ask for repair.
	Electromagnetic sound, gear sound, braking sound, hub sound, rubbing sound from the encoder etc.	Drive the motor with no load and check. Replace the motor and check. Ask for repair.

Protective Functions

Overshooting/Undershooting The motor is overheated (burnout)

Category	Cause	Action
Adjustment	Gains are poorly adjusted.	Check gains using the waveform graphic function of PANATERM®. Correctly adjust gains. Refer to Section on Adjustment.
Installation	Load inertia is high.	Check gains using the waveform graphic function of PANATERM®. Increase capacity of the motor and driver and decrease inertia ratio. Use reduction gears.
	The equipment (machine) has play and slip.	Modify coupling with the equipment (machine).
	Ambient temperature and environment	If the ambient temperature exceeds a specified value, install the cooling fan to reduce the temperature.
	The cooling fan stops. The air intake of the fan is dirty.	Inspect the cooling fans of the equipment and the driver. As the latter needs to be replaced, ask for repair.
	Mismatch between the driver and motor	Check the nameplates of the driver and motor. Referring to the instruction manuals or catalogs, select a correct combination of them.
	The motor bearing is defective.	Power off, turn the shaft of the motor independently, and check if there is any rumbling sound. If so, replace the motor. Ask for repair.
	The electromagnetic brake keeps on running (failure to release the brake).	Check voltage of the brake terminal. Apply power (DC24V) to the power supply and release the brake.
	The motor is defective (due to oil, water, etc.)	Avoid high temperature/humidity, oil, dust, and iron powders.
	With the dynamic brake activated, the motor is rotated by external force.	Check the operating pattern, use condition, and working condition, and avoid this kind of operation.

Rotation speed does not increase to the set speed The speed (movement) is large or small

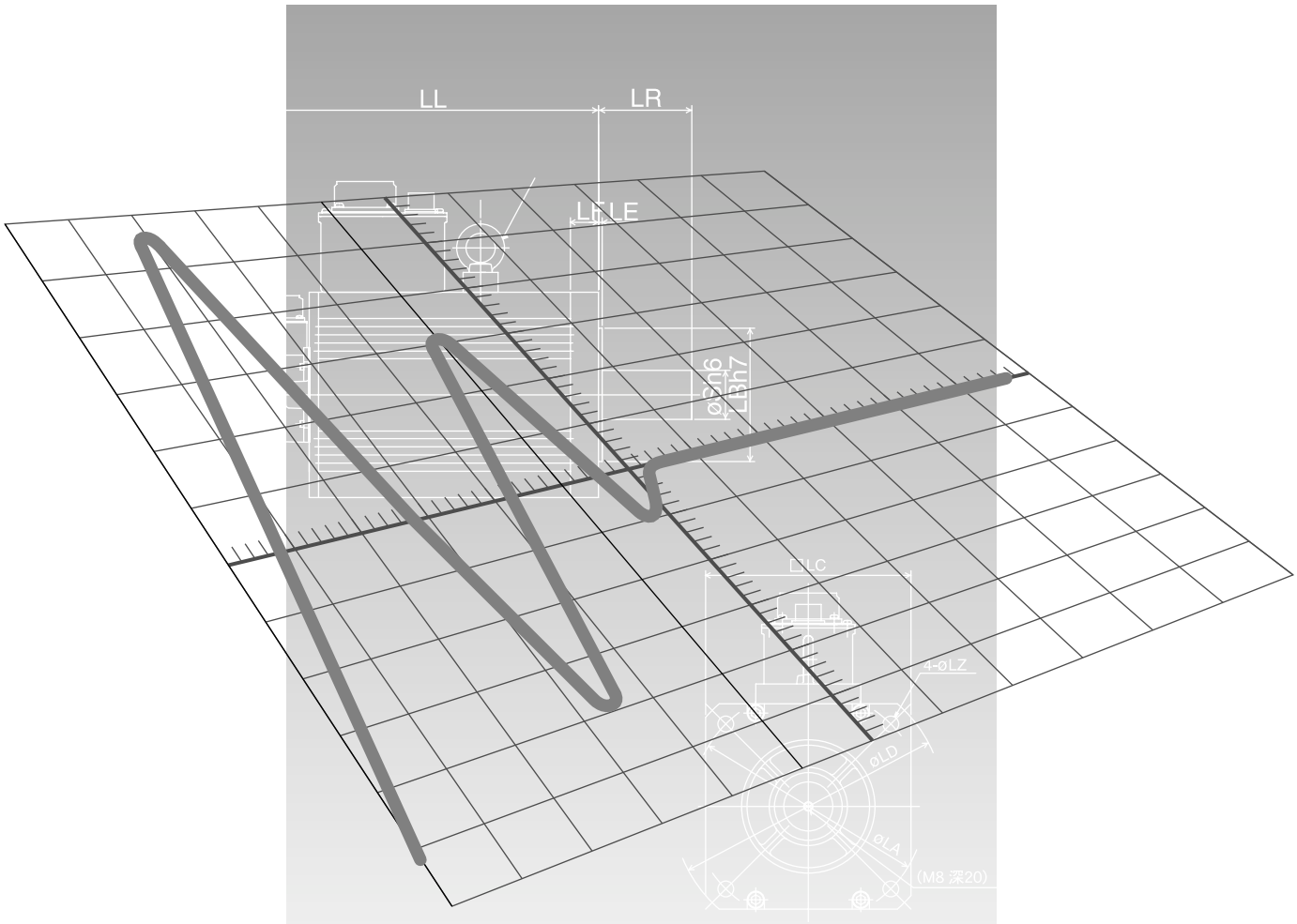
Category	Cause	Action
Adjustment	The position loop gain is low.	Adjust the value of the position loop gain Pr10 to approximately 100.
	The dividing/multiplier are not appropriate.	Correct the values of the numerator of 1st command pulse ratio Pr46, multiplier of numerator of command pulse ratio 4A, and denominator of command pulse ratio 4B. Refer to parameter settings of each mode.

Parameter returns to the last value

Category	Cause	Action
Parameter	A parameter value has not been written into EEPROM prior to power-off of the driver.	Refer to Writing to EEPROM of “Structure of Each Mode” on Page 50 of Preparation edition.

When using PANATERM®, the message “communication port or driver cannot be detected” appears

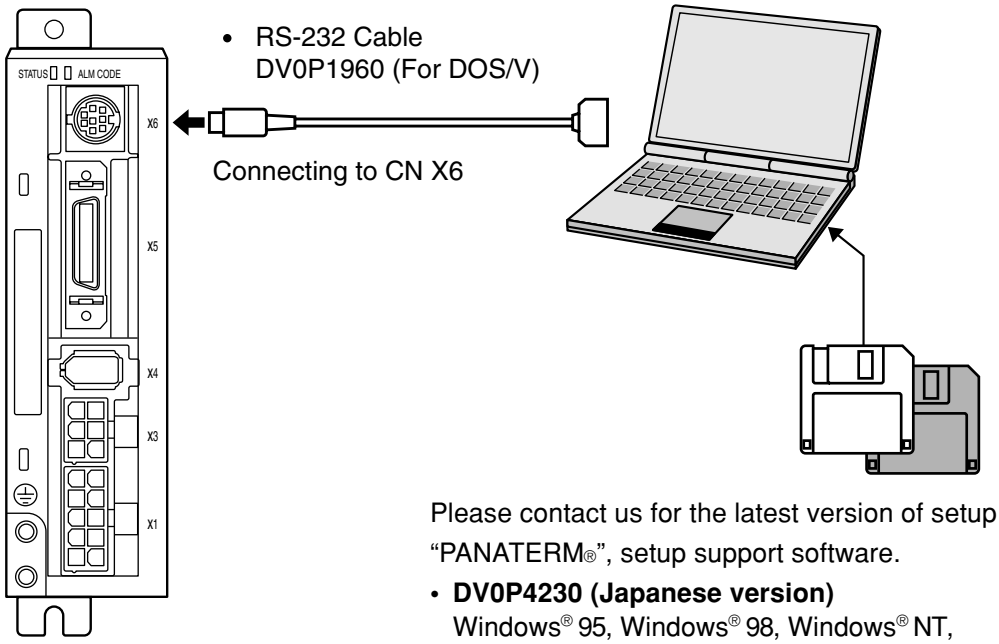
Category	Cause	Action
Wiring	The connector CN X6 is not connected to the personal computer through the communications cable (RS232C).	Connect the communications cable (RS232C) to the connector CN X6. Check that the communications cable is disconnected.



Reference

Outline of "PANATERM®", Setup Support Software

Connection Method



- RS-232 Cable
  DV0P1960 (For DOS/V)

Connecting to CN X6

Please contact us for the latest version of setup disk of "PANATERM®", setup support software.

- **DV0P4230 (Japanese version)**
  Windows® 95, Windows® 98, Windows® NT, Windows® 2000, Windows® Me, Windows® XP (Each Japanese version)
- **DV0P4240 (English version)**
  Windows® 95, Windows® 98, Windows® NT, Windows® 2000, Windows® Me, Windows® XP (Each English version)

Installing PANATERM® on Hard Disk

<Cautions/Remarks>

1. The capacity of hard disk memory should be 15 MB or more. As OS, prepare Windows® 95, Windows® 98, Windows® NT, Windows® 2000,Windows® Me and Windows® XP (each of them should be a Japanese version).
2. You can start "PANATERM®" only after installing it on the hard disk with the setup disk, by following the steps described below.

Steps of Procedure

(1) Power on your personal computer and start a corresponding OS (If there is any running application program, terminate it).
(2) Insert PANATERM® Setup disk 1 into the floppy disk drive.
(3) Start Explorer and select the floppy disk drive.
(For starting of Explorer, see the manual of the corresponding OS.)
(4) Double click on the setup program (Setup.exe) on the floppy disk (Then, PANATERM® setup program will start.).
(5) To start the setup program, press OK.
(6) Operate by following the guidance of the setup program.
(Follow the instruction to change the setup disc 1 to disc 2 during the course.)
(7) Click on Start installation button, and setup will start.
(8) Click OK when the message "Setup completed" appears.
(9) Close all application programs and then restart Windows®. When it restarts, PANATERM® will be added to the program menu.

Starting PANATERM®

<Cautions/Remarks>

1. Once you have installed “PANATERM®” on the hard disk, you do not have to reinstall it every time you boot up.
2. Before you start, connect the driver with the power supply, motor, and encoder. For the startup procedure, refer to the manual of the corresponding OS.

Steps of Procedure

(1) Power on your personal computer and start the corresponding OS.
(2) Turn on the driver.
(3) Click on Start button of the corresponding OS of the personal computer.
(For the startup procedure, refer to the manual of the corresponding OS.)
(4) Select PANATERM® in the program ►.
(5) After opening splash is displayed for 2 seconds, PANATERM® screen will appear.

For any detailed information on operation/functions of “PANATERM®”, refer to the operating instructions of “PANATERM®”.

* Windows®, Windows® 95, Windows® 98, Windows® NT, Windows® 2000, Windows® Me, Windows® XP are the trademarks of Microsoft Corporation in the United States.

Communications

Outline of Communications

With a personal computer or host NC connected with MINAS-E Series through RS232C-compliant serial communications, you can do the following:

(1) Rewriting parameters

(2) Browsing and clearing status and history of alarm data

(3) Monitoring control status including status, I/O, etc.

(4) Saving and Loading parameters

Advantages

- You can write parameters all at once from the host when starting the machine.
- As you can display operating condition of the machine, serviceability will improve.

Note that the following application programs for a personal computer and cables are available for use. For information of PANATERM®, refer to the instruction manual of PANATERM®.

Name of Optional Components	Model Name
PANATERM® Japanese version (WIN95/98/Me/NT4.0/2000/XP)	DV0P4230
PANATERM® English version (WIN95/98/Me/NT4.0/2000/XP)	DV0P4240
Connection cable for personal computer (DOS/V)	DV0P1960

For the latest version, please contact us.

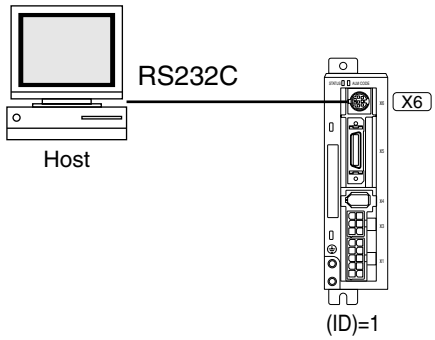
Communications Specification

Connection of Communications Line

MINAS-E Series has RS232C communications port. and is capable of communications between the host as follows:

■ RS232C Communications

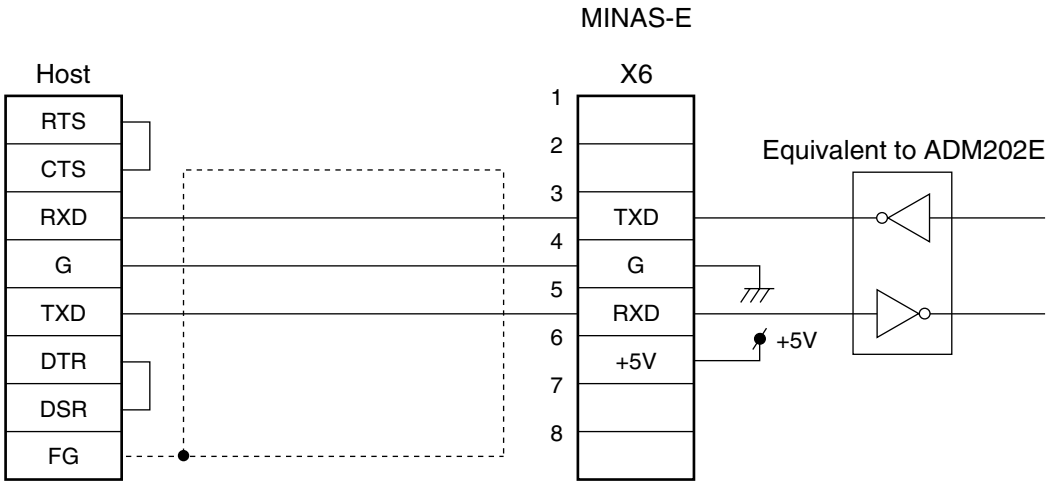
In RS232C communications, a host and the driver are connected 1:1 and communicate with each other according to the RS232C transmission protocol.



- You can change settings of the module ID with Pr00. In particular, you may set the same module ID unless there is management problem on the host side.

Interface of Communication Connector Unit

■ Connection with a Host through RS232C



<Note>

You must leave pins 1, 2, 6, 7 and 8 of X6 unconnected.

Communications

Communications Method

	RS232C
	Full-duplex, asynchronous communication method
Communications baud rate	2400, 4800, 9600bps
Data	8 bit
Parity	No
Start bit	1 bit
Stop bit	1 bit

- Set RS232C communications baud rate with Pr0C. Any change to these parameters will be valid when you power on the control power supply. For detailed information, refer to list of parameters related to the following communications:

List of User Parameters Related to Communications

PrNo.	Parameter Name	Range of Setting	Functional Description
00	Shaft name	1 - 15	Refer to descriptions on parameters on pages 88 and 116.
0C	Setting of baud rate for RS232C communications	0 - 2	Set the communications speed of RS232C communications. 0 : 2400[bps] 1 : 4800[bps] 2 : 9600[bps] A change will be valid when you power on the control power supply.

- Time for data transmission is calculated with the following expression, for instance, in the case of 9600 [bps]:

(1000/9600) x (1 + 8 + 1) = 1.04 [ms/byte]

Start bit — Data — Stop bit

When the baud rates of 2400 bps and 4800 [bps] are used, data transmission time will be 4.17 [ms/byte] and 2.08 [ms/byte], respectively. Note, however, actual communication time will be added time necessary for processing received command, and necessary for switching between a line and transmission/reception control.

■ Handshaking Code

For line control, the following codes are used.

Name	Code	Functions
ENQ	05h	Transmission request
EOT	04h	Ready for receiving
ACK	06h	Acknowledgement
NAK	15h	Negative acknowledgement

ENQ …When the module has a block to transmit, it sends ENQ.

EOT … When the module is ready to receive a block, it sends EOT. The line enters transmission mode when sending ENQ and receiving EOT. It enters reception mode when receiving ENQ and sending EOT.

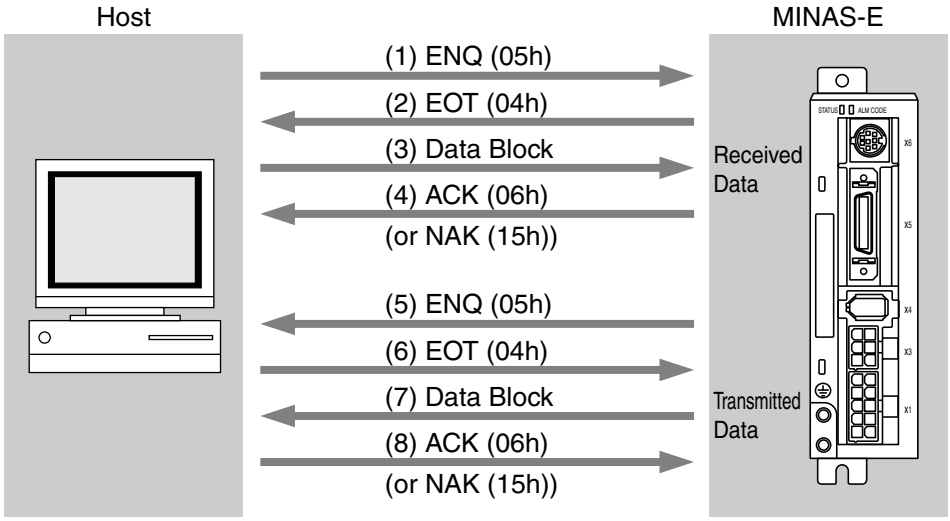
ACK … When a received block is judged normal, ACK is returned.

NAK … When a received block is judged as abnormal, NAK is returned. A judgment is made based on checksum and timeout.

Transmission Sequence

■ Transmission Protocol

● **RS232C**



● **Line Control**

Direction of transmission and conflict are solved.
Reception mode …The module enters reception mode after receiving ENQ and returning EOT.
Transmission mode … The module enters transmission mode after sending ENQ and receiving EOT.
When there occurs a conflict between the transmitting module and receiving module:
When subsequent to transmission of ENQ, a slave receives ENQ while waiting for EOT, priority is given to ENQ sent from a maser, and the slave enters the reception mode.

● **Transmission Control**

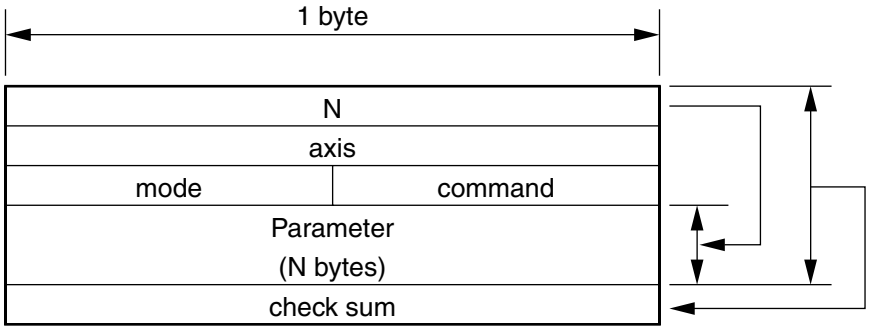
Entering transmission mode, a module transmits a command block continuously and then waits for reception of ACK. When the module receives ACK, transmission is complete. When the number of transferred command bytes is incorrect, ACK may not be returned. When ACK is not returned within T2 period, or when NAK or any code other than ACK is received, transmission retry will be executed. The retry will start with ENQ.

● **Receiving Control**

Entering receiving mode, the module receives transmitted blocks continuously. It obtains the number of command bytes from the first byte, and receives as many command bytes as that number plus 3. When the sum of received data is zero, reception is considered successfully ended and ACK is returned. When abnormal checksum or timeout between characters occurs, NAK is sent.

■ Configuration of Data Block

A data block to be transmitted in physical phase is configured as illustrated below:



N : This is the number of command bytes (0 - 240),
which indicates the number of parameters needed by a command.

axis : This defines a module ID assigned to parameter No.00 axis name of the driver. (1 - 15)

command : This is the control command (0 - 15).

mode : This is the command execution mode (0 - 15),
which differs depending on a command.

check sum : This is 2's complement of the total number of bytes, ranging from the first byte to the byte immediately before the checksum byte.

■ Protocol Parameter

The following parameters can control transfer of a block. A user can set these parameters to any value with INIT command to be described later.

Name	Function	Initial Value	Range of Settings	Unit
T1	Timeout between character transmissions	5 (0.5 second)	1 - 255	0.1 second
T2	Protocol time limit	10 (10 seconds)	1 - 255	1 second
RTY	Retry limit	1 (once)	1 - 8	once
M/S	Master/slave	0 (slave)	0, 1(master)	

T1 .... • This is allowable time between module identification byte and ENQ/EOT, or time from reception of a character code by this device to that of a next character code in a transmission/reception data block. When this specified time is exceeded, timeout error occurs and NAK is returned to the transmitting module.

T2 .... • This is allowable time after this device transmits ENQ till it receives EOT. When this specified time is exceeded, it means that the receiving module is not ready to receive data or fails to receive ENQ code for some reason. In this case, ENQ code will be resent to the receiving module (number of retries).

• This is allowable time after EOT is sent out till a first character is received. When this specified time is exceeded, NAK is returned and the receiving mode ends.

• This is allowable time after checksum byte is sent out till ACK is received. When this specified time is exceeded, ENQ code is resent to the receiving module, as in the case of reception of NAK.

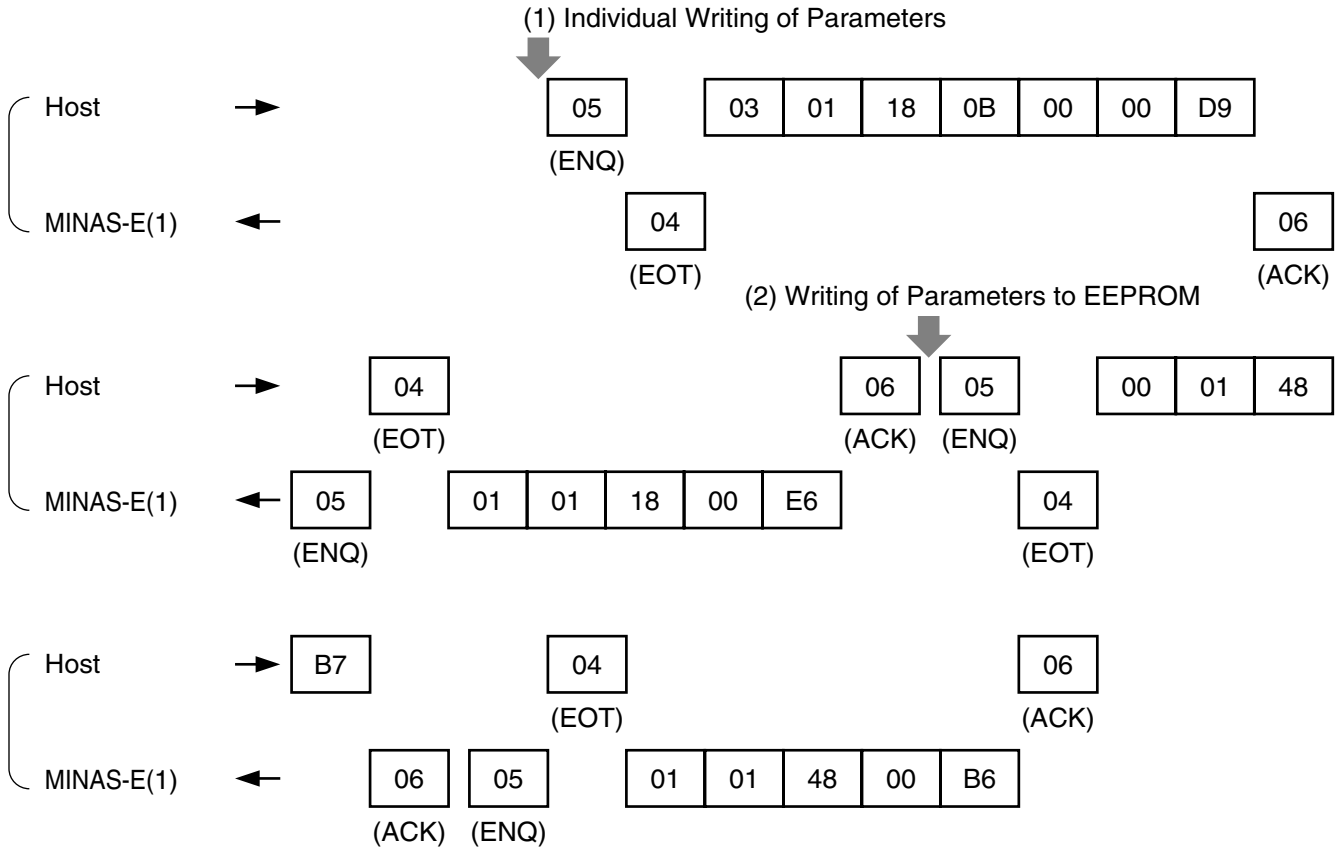
RTY ..... This shows the maximum number of retries. When this specified value is exceeded, transmission error occurs.

M/S ..... This shows switching of a master/slave. When conflict of ENQ transmission occurs, this parameter determines to which priority is given. (0=slave mode, 1=master mode) Transmission of the module defined as a master should take precedence.

Example of Data Communication

■ Example of Changing Parameters

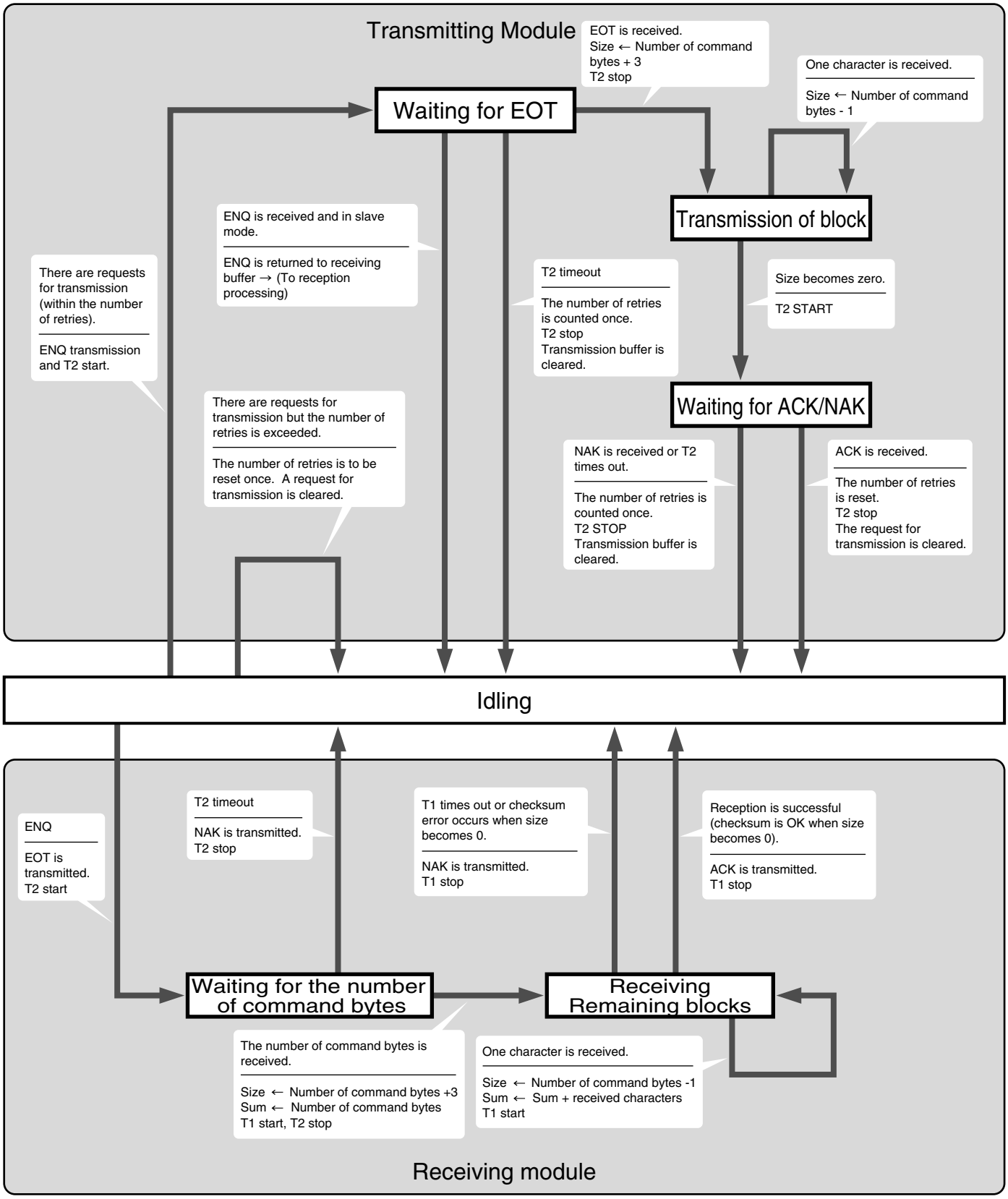
The following illustrates time-series communications data flow when a change is made to a parameter. Communications should be conducted in the sequence of outline, (1) individual writing of parameters and (2) writing to EEPROM if storage is needed. In this example of hardware connection, the device is directly connected with a host through RS232C communications with user ID=1. Data is represented in hexadecimals.



(Note) For details of commands, refer to “List of Communications Commands” on Page 166.

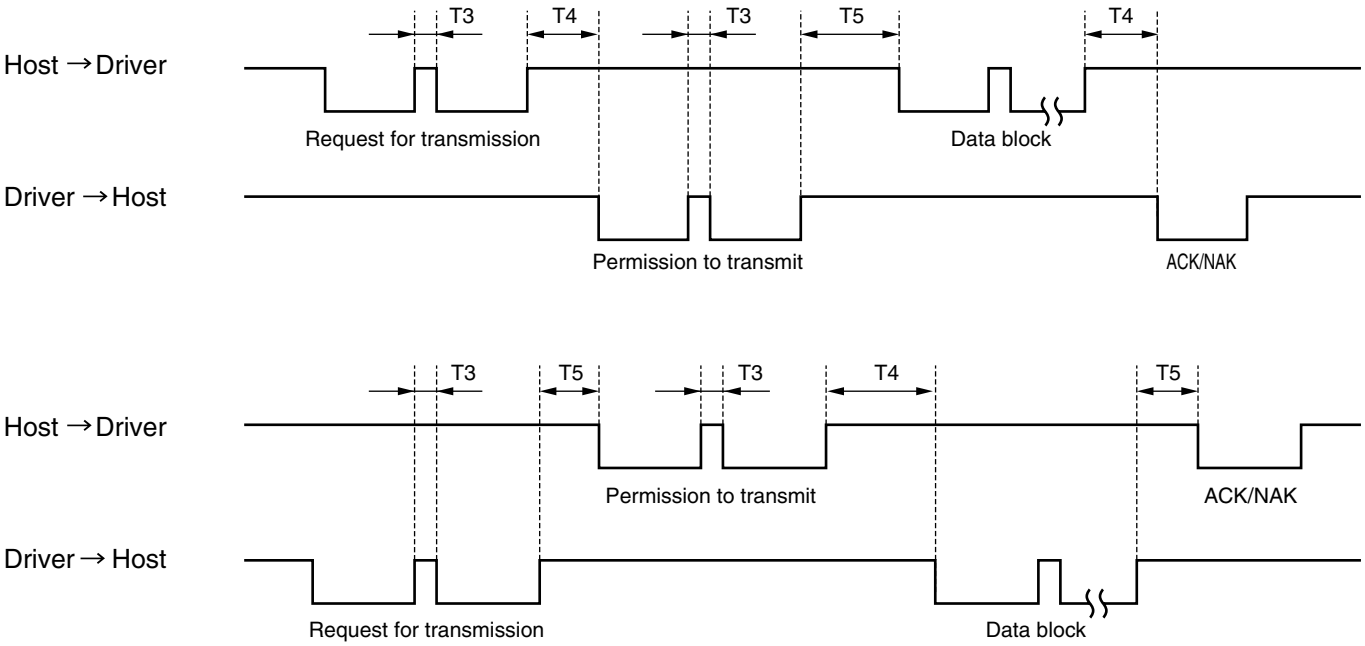
State Transition Diagram

■ RS232C Communications



Communications Timing

■ RS232C Communications



Code	Name	Minimum	Maximum
T3	Continuous inter-character time	Stop bit length	Protocol parameter T1
T4	Driver response time	4ms	Protocol parameter T2
T5	Host response time	2ms	Protocol parameter T2

<Caution>

The time represents a period of time from stop bit rising edge.

Communications

List of Communications Commands

command	mode	Description
0		NOP
	1	Readout of CPU version
	5	Readout of the driver model name
	6	Readout of the motor model name
1		INIT
	1	Setting of protocol parameters
2		POS, STATUS, I/O
	0	Readout of status
	1	Readout of the command pulse counter
	2	Readout of the feedback pulse counter
	4	Readout of current speed
	5	Readout of current torque output
	6	Readout of the current deviation counter
	7	Readout of input signal
	8	Readout of output signal
	9	Readout of current speed/torque/deviation counter
	A	Readout of status/input signal/output signal
8		PARAMETER
	0	Individual readout of parameters
	1	Individual writing of parameters
	4	Writing of parameters to EEPROM
9		ALARM
	0	Readout of current alarm data
	1	Individual readout of alarm history
	2	Batch readout of alarm history
	3	Alarm history clear (also on EEPROM)
	4	Alarm clear
B		PARAMETER
	0	Individual readout of user parameters
	1	Page readout of user parameters
	2	Page writing of user parameters

<Note>

Be sure to use the above commands only. We could not guarantee proper operation of the driver when you transmit a command not listed above.

Details on Communications Commands

command	mode
0	1

● Readout of CPU version information

Received data

0	
axis	
1	0
checksum	

Transmitted data

3	
axis	
1	0
Version (high order)	
(low order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ For version information, Ver.○.○○ is divided into high order data and low order data and sent back. (The decimal point returns low-order 4 bits of the high order data as "0".)

■ A version is expressed by digits of 0 to 9 (Example: Ver.3.13 is composed of high order data 30h and low order data 13h).

■ This indicates the CPU version.

command	mode
0	5

● Readout of the driver model name

Received data

0	
axis	
5	0
checksum	

Transmitted data

0Dh	
axis	
5	0
Driver Model Name (high order)	
⋮	
Driver Model Name (low order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ The driver model name is 12 characters and transmitted by ASCII code.
ex. "MKDET1505＊＊＊"

command	mode
0	6

● Readout of the motor model name

Received data

0	
axis	
6	0
checksum	

Transmitted data

0Dh	
axis	
6	0
Motor Model Name (high order)	
⋮	
Motor Model Name (low order)	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ The motor model name is 12 characters and transmitted by ASCII code.
ex. "MUMA012P1＊＊＊"

command	mode
1	1

● Setting of RS232C protocol parameters

Received data

3	
axis	
1	1
T1	
T2	
M/S	RTY
checksum	

Transmitted data

1	
axis	
1	1
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error		RTY error	T2 error	T1 error	M/S error

■ Setting of the previous protocol parameters remains valid until execution of this command completes. The updated parameter setting will be valid from a next command after execution of this command.
M/S=0 indicates "SLAVE" mode, while M/S=1 indicates "MASTER".

■ The RTY code is 4 bit and M/S is 1 bit.

■ Unit of T1 and T2 are 0.1 second and 1 second, respectively.

command	mode
2	0

● Readout of status

Received data

0	
axis	
0	2
checksum	

Transmitted data

3	
axis	
0	2
Control mode	
Status	
Error code	
checksum	

Status

bit7	6	5	4	3	2	1	0
		CCW Torque being output	CW Torque being output	CCW rotating	CW rotating	Less than DB permission speed	Torque being limited

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ The control modes are defined as follows:

0	High speed response positioning control mode
1	Internal velocity control mode
2	High function positioning control

command	mode
2	1

● Readout of the command pulse counter

Received data

0	
axis	
1	2
checksum	

Transmitted data

5	
axis	
1	2
Counter value L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ A current command position is expressed by absolute coordinates from the start-up time. (Cumulative sum of the number of command pulses)
■ The counter value is 32 bits.
■ For the counter value, "-" indicates CW and "+" indicates CCW.

command	mode
2	2

● Readout of the feedback pulse counter

Received data

0	
axis	
2	2
checksum	

Transmitted data

5	
axis	
2	2
Counter value L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ A current position of the feedback pulse counter is expressed by absolute coordinates from the start-up time.
■ For the counter value, "-" indicates CW and "+" indicates CCW.
■ The feedback pulse counter indicates a cumulative sum of pulses of the position detector, which corresponds to a position of the motor that really moves.

command	mode
2	4

● Readout of current speed

Received data

0	
axis	
4	2
checksum	

Transmitted data

3	
axis	
4	2
Data (current speed) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ This command is used to read current speed (unit [r/min]).
■ An output value is 16 bits.
■ For the counter value, "-" indicates CW and "+" indicates CCW.

command	mode
2	5

● Readout of current torque output

Received data

0	
axis	
5	2
checksum	

Transmitted data

3	
axis	
5	2
Data (torque) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ This command is used to read current torque output (unit: to be converted as rated torque = 2000).
■ An output value is 16 bits.

command	mode
2	6

● Readout of the current deviation counter

Received data

0	
axis	
6	2
checksum	

Transmitted data

5	
axis	
6	2
Data (deviation) L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ This command is used to read a current value of the deviation counter. (unit [pulse])
■ An output value is 32 bits.
■ "+" indicates that the encoder is in CW direction and "-" indicates that the encoder is in CCW direction relative to the position command.

command	mode
2	7

● Readout of input signal

Received data

0	
axis	
7	2
checksum	

Transmitted data

5	
axis	
7	2
Data L	
Data H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

Data

bit7	6	5	4	3	2	1	0
Reserved	Command dividing/ multiplier switching	Zero speed clamp	Control mode switching	CCW overtravel inhibited	CCW overtravel inhibited	Alarm cleared	Servo-ON

bit15	14	13	12	11	10	9	8
Reserved	Reserved	Internal velocity command selection 2	Internal velocity command selection 1	Reserved	Counter cleared	Gain switching	Reserved

bit23	22	21	20	19	18	17	16
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

bit31	31	29	28	27	26	25	24
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

■ For "CW overtravel inhibited", "CCW overtravel inhibited" and speed zero clamp, "1" indicates the open status.
For other input signals, "0" indicates the open status.

command	mode
2	8

●Readout of output signal

Received data

0	
axis	
8	2
checksum	

Transmitted data

7	
axis	
8	2
Data L	
Data H	
Warning data L	
H	
Error code	
checksum	

Warning data

bit7 Overload
bit5 Over-regeneration
bit0 Battery

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

Data

bit7	6	5	4	3	2	1	0
Reserved	Reserved	Torque being limited	Zero speed detected	Electromagnetic brake released	Positioning completed	Servo alarm	Servo ready

bit15	14	13	12	11	10	9	8
Reserved	Reserved	Dynamic brake activated	Reserved	Reserved	Reserved	Speed achieved	Reserved

bit23	22	21	20	19	18	17	16
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

bit31	31	29	28	27	26	25	24
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

■ The following table shows the relation between each signal and operation.

Signal	0	1
Servo ready	not Ready	Servo ready
Servo alarm	Normal condition	Abnormal condition
In positioning completed	Positioning not completed	Positioning being completed
Electromagnetic brake released	Electromagnetic brake running	Electromagnetic brake released
Zero speed detected	Zero speed not detected	Zero speed detected
Torque being limited	Torque not being limited	Torque being limited
Achieved speed	Not achieved speed	Speed being achieved
Dynamic brake activated	Dynamic brake released	Dynamic brake being activated

command	mode
2	9

●Readout of current speed/torque/deviation counter

Received data

0	
axis	
9	2
checksum	

Transmitted data

9	
axis	
9	2
Data L	
(Speed) H	
Data L	
(Torque) H	
Data L	
(Deviation) H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ The speed and torque output values are 16 bits and deviation output value is 32 bits.
■ The unit and sign of output data are same for command Nos. 24, 25, and 26.

command	mode
2	A

● Readout of status/input signal/output signal

Received data

0	
axis	
A	2
checksum	

Transmitted data

0Dh	
axis	
A	2
Control mode	
Status	
Input signal L	
Input signal H	
Output signal L	
Output signal H	
Warning data L	
Warning data H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ Meanings of each bit for control mode, status, input signal, output signal, and warning data are same as those of command No.20 (command=2, mode=0), 27 (mode=7), and 28 (mode=8).

command	mode
8	0

● Individual readout of parameters

Received data

1	
axis	
0	8
Parameter No.	
checksum	

Transmitted data

3	
axis	
0	8
Parameter value L	
H	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error		No. error			

command	mode
8	1

● Individual writing of parameters

Received data

3	
axis	
1	8
Parameter No.	
Parameter value L	
H	
checksum	

Transmitted data

1	
axis	
1	8
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error		No. error			

■ This command just changes a parameter temporarily. If you wish to write to EEPROM, execute writing to EEPROM of parameter (mode=4)

■ Be sure to set 0 to unused parameters. Otherwise, data error will occur.

command	mode
8	4

● Writing of parameters to EEPROM

Received data

0	
axis	
4	8
checksum	

Transmitted data

1	
axis	
4	8
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error				Control LV	

■ This command is used to write a set parameters to EEPROM.

■ Transmission data will be returned after completion of EEPROM writing.
Writing to EEPROM may take approx. 5 seconds max. (if all parameters are changed).

■ When writing of parameters fails, data error will occur.

■ When control power supply LV is detected, control LV of error code will be returned, and parameter writing will be disabled.

command	mode
9	0

● Readout of current alarm data

Received data

0	
axis	
0	9
checksum	

Transmitted data

2	
axis	
0	9
Alarm No.	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ Alarm No. is 0 when no alarm is generated.
(Refer to “Details of Protective Function” on Page 145.)

command	mode
9	1

● Individual readout of alarm history

Received data

1	
axis	
1	9
History No.	
checksum	

Transmitted data

3	
axis	
1	9
History No.	
Alarm No.	
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error		No. error			

■ History No.1 to No.14 indicate the 1st to 14th previous alarm history, respectively.

command	mode
9	2

● Batch readout of alarm history

Received data

0	
axis	
2	9
checksum	

Transmitted data

	0Fh	
	axis	
	2	9
1st previous	Alarm No.	
2nd previous	Alarm No.	
	~	
14th previous	Alarm No.	
	Error code	
	checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ The command is used to read 14 previous alarm events.

command	mode
9	3

● Alarm history clear

Received data

0	
axis	
3	9
checksum	

Transmitted data

1	
axis	
3	9
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error				Control LV	

■ The command clears history of alarm data.
When the command fails to clear, data error occurs.
■ When control power supply LV is detected, control LV of error code will be returned, and parameter writing will be disabled.

command	mode
9	4

● Alarm clear

Received data

0	
axis	
4	9
checksum	

Transmitted data

1	
axis	
4	9
Error code	
checksum	

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error					

■ This command clears the current alarm (only applicable to alarms that can be cleared).

command	mode
B	0

● Individual readout of user parameters

Received data

1	
axis	
0	B
Parameter No.	
checksum	

Transmitted data

9	
axis	
0	B
Parameter value L	
H	
MIN value L	
H	
MAX value L	
H	
Attribute L	
H	
Error code	
checksum	

Attribute

bit7	6	5	4	3	2	1	0
Unused parameter	Display inhibited	For privileged users	To be changed at initialization	System related			

bit15	14	13	12	11	10	9	8
							Read only

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error		Command error		No. error			

command	mode
B	1

● Page readout of user parameters

Received data

1	
axis	
1	B
Page No.	
checksum	

Transmitted data

82h	
axis	
1	B
Page No.	
Parameter value L	
(No.0) H	
MIN value L	
(No.0) H	
MAX value L	
(No.0) H	
Attribute L	
(No.0) H	
≈	
Parameter value L	
(No.0fh) H	
MIN value L	
(No.0fh) H	
MAX value L	
(No.0fh) H	
Attribute L	
(No.0fh) H	
Error code	
checksum	

Attribute

bit7	6	5	4	3	2	1	0
Unused parameter	Display inhibited	For privileged users	To be changed at initialization	System related			

bit15	14	13	12	11	10	9	8
							Read only

Error code

bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error		No. error			

■ A page number is designated from 0 to 7, and 16 parameters are read from each page designation.

command	mode
B	2

● Page writing of user parameters

Received data

21h	
axis	
2	B
Page No.	
Parameter L	
(No.0 value) H	
Parameter value L	
(No.1 value) H	
~	
Parameter value L	
(No.0fh value) H	
checksum	

Transmitted data

2	
axis	
2	B
Page No.	
Error code	
checksum	

Error code

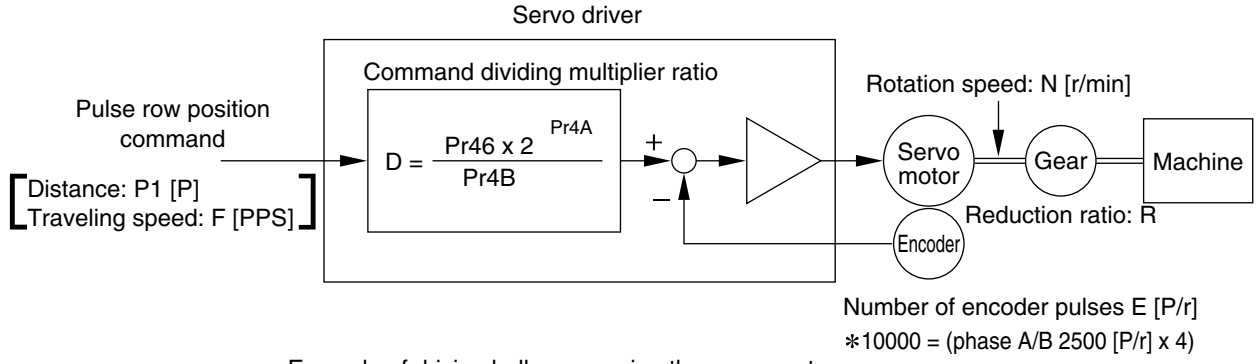
bit7	6	5	4	3	2	1	0
0 : Normal 1 : Error	Data error	Command error		No. error			

■ The command writes 16 parameters at once.

■ Be sure to set 0 to unused parameters. Otherwise, data error will occur.

Description on Dividing/Multiplier Ratio

Relation between Positional Resolution/Moving Speed and Command Dividing Multiplier Ratio



Example of driving ball screw using the servo motor

As an example of a machine, we describe a ball screw driving system below:

When lead of a ball screw is L [mm], actual distance of a ball screw M [mm] with respect to the distance command PI [P] is expressed with formula (1) below:

M = P1 x (D/E) x (1/R) x L ..... (1)

Therefore, position resolution (distance DM per command pulse) is expressed by the following formula (2):

ΔM = (D/E) x (1/R) x L ..... (2)

Through transformation of formula (2), a command dividing multiplier ratio D is determined by the formula (3):

D = (ΔM x E x R)/L ..... (3)

In addition, actual traveling speed V [mm/s] of a ball screw with respect to traveling speed command F [PPS] is expressed by formula (4), and the corresponding motor rotation speed N is determined by formula (5):

V = F x (D/E) x (1/R) x L ..... (4)

N = F x (D/E) x 60 ..... (5)

Through transformation of formula (5), a command dividing multiplier ratio D is determined by the formula (6):

D = (N x E)/(F x 60) ..... (6)

<Remarks>

1. Set the positional resolution (ΔM) at approx. 1/5 to 1/10 of the positioning accuracy ($\Delta\varepsilon$), in view of mechanical errors.
2. Set a value from 1 to 10000 to Pr46 and Pr4B.
3. You can set any value depending on numerator and denominator settings. However, if you specify an extreme dividing/multiplier ratio, we cannot guarantee proper operation of the motor. We recommend that you set the dividing/multiplier ratio in the range of 1/50 to 20 times.
4.

2^n	Decimal
2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072

Example		Command dividing multiplier ratio $D = \frac{\Delta M \times E \times R}{L}$ ... Formula (3)		$D = \frac{Pr46 \times 2^{Pr4A}}{Pr4B}$
1	Lead of ball screw L = 10mm Reduction ratio R=1 Position resolution ΔM = 0.005mm For the encoder of 2500 P/r (E=10000P/r)	$D = \frac{0.005 \times 10000 \times 1}{10}$ $= 5$	Determine parameters Pr46, Pr4A and Pr4B so that D=5. Consider the following: $D = \frac{10000 \times 2^0}{2000}$	Pr46 = 10000 Pr4A = 0 Pr4B = 2000
2	Lead of ball screw L = 20mm Reduction ratio R=1 Position resolution ΔM = 0.005mm For the encoder of 2500 P/r (E=10000P/r)	$D = \frac{0.0005 \times 10000 \times 1}{20}$ $= 0.25$	D<1 is not appropriate to determination of the accuracy.	D = 1 is a condition of minimum resolution.

Example	Motor rotation speed (r/min) $N = F \times \frac{D}{E} \times 60$ ... Formula (5)		
Lead of ball screw L= 20mm Reduction ratio R=1 Position resolution ΔM = 0.005mm Line driver pulse input 500 kpps For the encoder of 2500 P/r	$D = \frac{0.005 \times 10000 \times 1}{20}$ ... Formula (3) $= 25$ $N = 500000 \times \frac{2.5}{10000} \times 60$ ... Formula (5) $= 7500$ Thus, motor specification is not met.		
To make motor rotation speed 3000 r/min under the same condition as above, with lead of ball screw of L = 20 mm and the line driver pulse input of 500 kpps.	Command dividing multiplier ratio $D = \frac{N \times E}{F \times 60}$ ... Formula (6)		$D = \frac{Pr46 \times 2^{Pr4A}}{Pr4B}$
	$D = \frac{3000 \times 10000}{500000 \times 60} = 1$	Determine parameters Pr46, Pr4A and Pr4B so that D=1. Consider the following: $D = \frac{10000 \times 2^0}{10000}$	Pr46 = 10000 Pr4A = 0 Pr4B = 10000
	Then, distance per command pulse (mm) is as follows: (position resolution) $\Delta M = \frac{D}{E} \times \frac{1}{R} \times L = \frac{1}{10000} \times \frac{1}{1} \times 20 = 0.002mm$		

Conformance to EC Directives/UL Standards

EC Directives

The EC Directives apply to all such electronic products as those having specific functions and directly sold to general consumers in EU countries. These products are required to meet the EU unified standards and to be furnished with CE Marking.
However, our AC servo meet the EC Directives for Low Voltage Equipment so that the machine or equipment comprising our AC servo can meet relevant EC Directives.

EMC Directives

Our servo systems can meet EMC Directives and related standards. However, to meet these requirements, the systems must be limited with respect to configuration and other aspects, e g. the distance between the servo driver and motor is restricted, and some special wiring conditions must be met. This means that in some cases machines and equipment comprising our servo systems may not satisfy the requirements for wiring and grounding conditions specified by the EMC Directives. Therefore, conformance to the EMC Directives (especially the requirements for emission noise and noise terminal voltage) should be examined based on the final products that include our servo drivers and servo motors.

Applicable Standards

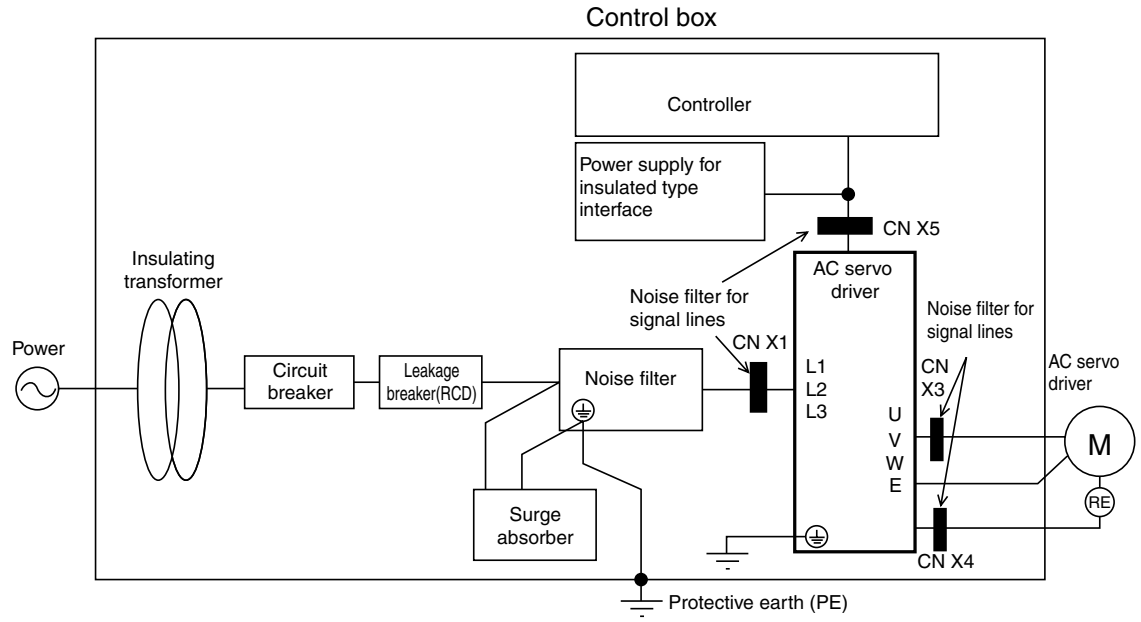
Subject	Applicable standard		
Motor	IEC60034-1		Standards referenced by Low-Voltage Directives
Motor and driver	EN50178		
	EN55011	Radio Disturbance Characteristics of Industrial, Scientific and Medical (ISM) Radio Frequency Equipment	Standards referenced by EMC Directives
	EN61000-6-2	General standards for immunity in industrial environment	
	├ IEC61000-4-2	Electrostatic Discharge Immunity Test	
	├ IEC61000-4-3	Radio Frequency Electromagnetic Field Immunity Test	
	├ IEC61000-4-4	Electric High-Speed Transition Phenomenon - Burst Immunity Test	
	├ IEC61000-4-5	Lightning Surge Immunity Test	
	├ IEC61000-4-6	High Frequency Conduction Immunity Test	
	└ IEC61000-4-11	Instantaneous Outage - Immunity Test	

IEC: International Electrotechnical Commission
EN: Europaischen Normen
EMC: Electromagnetic Compatibility

Peripheral Equipment

Environment

The servo driver should be used under Contamination Level 2 or 1 specified by IEC60664-1 (housing the driver in an IP54 control box).



Power

Single-phase 100V: Single-phase 100V $^{+\ 10\%}_{-\ 15\ \%}$ to 115V $^{+\ 10\%}_{-\ 15\ \%}$ 50/60Hz

Single-phase 200V: Single-phase 200V $^{+\ 10\%}_{-\ 15\ \%}$ to 240V $^{+\ 10\%}_{-\ 15\ \%}$ 50/60Hz

Three-phase 200V: Three-phase 200V $^{+\ 10\%}_{-\ 15\ \%}$ to 240V $^{+\ 10\%}_{-\ 15\ \%}$ 50/60Hz

(1) Use under the environment of Over-voltage Category II specified by IEC60664-1
In order to realize the environment of overvoltage category II, install in the power supply input unit an insulating transformer that is compliant with ICE or EN standard (EN 60742).

(2) The power for interface should be marked CE or appropriate EN Standard type (EN60950), 12VDC to 24VDC, insulated.

Circuit Breaker

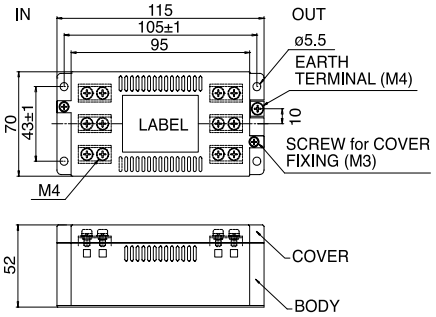
Install a circuit breaker between the power supply and noise filter. The circuit breaker should be IEC Standard and UL listed (UL) marked.

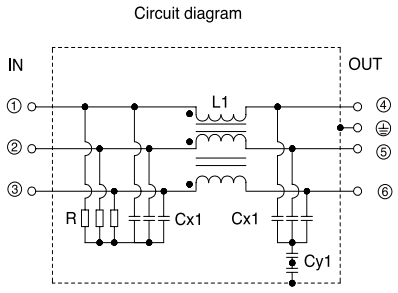
Conformance to EC Directives/UL Standards

Noise Filter

When, one set of noise filters is installed in the power unit with two or more drivers, be sure to consult with the noise filter manufacturer.

Option Part No.	Manufacturer's part No.	Manufacturer
DV0P4160	3SUP-HU10-ER-6	Okaya Electric Industries Co., Ltd.





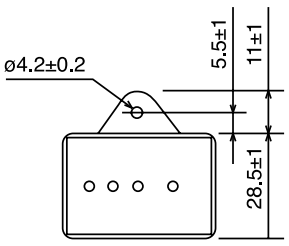
Surge Absorber

Install the surge absorber on the primary line of the noise filter.

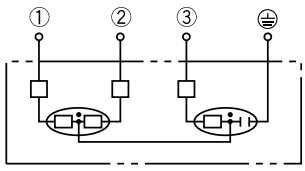
<Note>

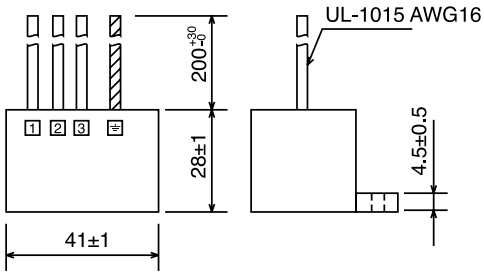
When conducting voltage-resistant test on the machine/equipment, remove the surge absorber. Otherwise the absorber may be damaged.

Option Part No.	Manufacturer's part No.	Manufacturer
DV0P1450	R•A•V-781BXZ-4	Okaya Electric Industries Co., Ltd.



Circuit diagram

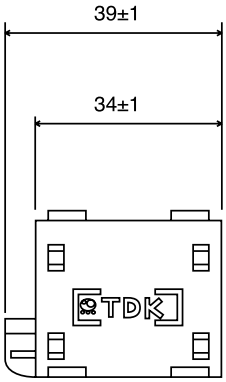




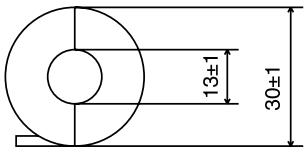
Noise Filter for Signal cables

Provide all the cables (power supply cable, motor cable, encoder cable, interface cable) with the noise filter for signal cable.

Option Part No.	Manufacturer's part No.	Manufacturer
DV0P1460	ZCAT3035-1330	TDK Co., Ltd.



Weight: 62.8 g



Grounding

(1) Don't fail to connect the servo driver protective earth terminal (⏚) and the protective earth plate of the control panel together.

(2) When connecting to the protective earth terminal (⏚), avoid co-clamping. Two protective earth terminals are provided.

Leakage Breaker

Connect Type-B leakage breaker (RCD) to the primary power supply of the servo driver.

Driver and Peripheral Devices Applied Thereto (EC Directives)

For the detail refer to "System Configuration and Wiring", Page 26.

Install the noise filters in reference to DV0P4160 (page 182).

Conformance to UL Standards

The noise filters conform to UL508C (File No. E164620) to satisfy the following conditions.

(1) The servo driver should be used under Contamination Level 2 or 1 specified by IEC60664-1 (housing the driver in an IP54 control box).

(2) Install a circuit breaker or fuse between the power supply and noise filter. The circuit breaker or fuse should be a UL listed mark (Ⓤ) type.
The current rating of the circuit breaker or fuse should be per the table in page 26.

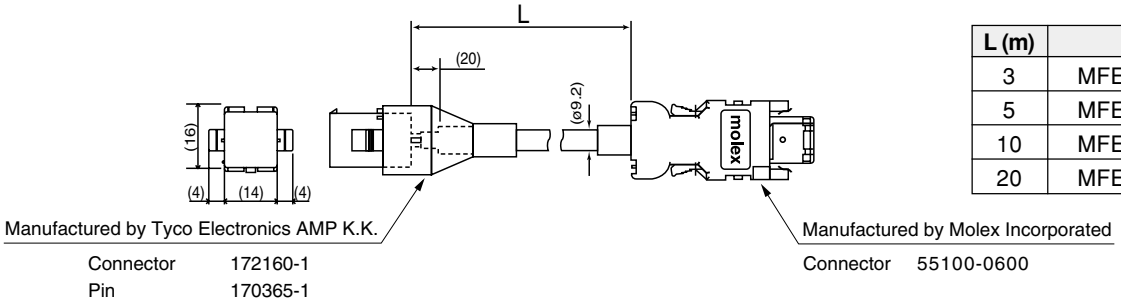
Optional Parts

MINAS-E Series Table of Junction Cable by Model

Figure No.	Motor Type	Junction Cable	Part No.
2-1	MUMA50W - 400W	For an encoder (2500 P/r 5 wires) Incremental	MFECAO * * OEAM
3-1		For a motor	MFMCAO * * OAEB
4-1		For a brake	MFMCBO * * OGET

Junction Cable for Encoder

Figure 2-1 **MFECA0 * * 0EAM**

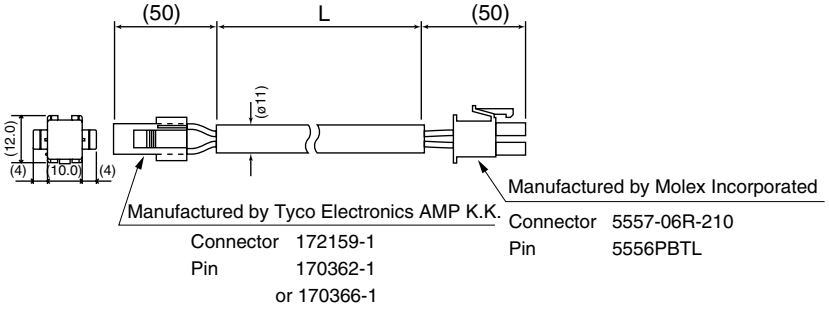


L (m)	Part No.
3	MFECA0030EAM
5	MFECA0050EAM
10	MFECA0100EAM
20	MFECA0200EAM

Junction Cable for Motors (Robotop® 600V DP)

Figure 3-1 **MFMCA0 * * 0AEB**

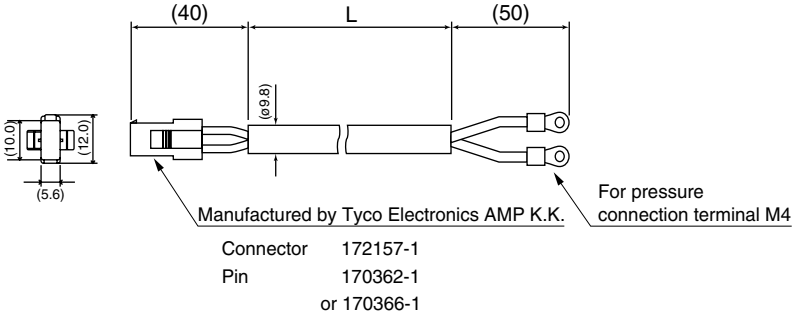
Robotop® is a trade mark of Daiden Co., Ltd.



L (m)	Part No.
3	MFMCA0030AEB
5	MFMCA0050AEB
10	MFMCA0100AEB
20	MFMCA0200AEB

Junction Cable for Brakes (Robotop® 600V DP)

Figure 4-1 **MFMCB0 * * 0GET**



L (m)	Part No.
3	MFMCB0030GET
5	MFMCB0050GET
10	MFMCB0100GET
20	MFMCB0200GET

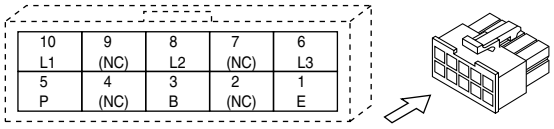
Connector Kits for Power Supply of the Driver

(1) Part No. DV0P2870

(2) Components

Name	Manufacturer's part No.	Number	Manufacturer	Remarks
Connector (10P)	5557-10R-210	1	Molex Incorporated	For connector CN X1 (pin 10)
Connector Pin	5556PBTL	6		

(3) Pin arrangement of connector for CN x 1



(4) Recommended manual pressure bonding tool (Customers are requested to provide it by themselves.)

Manufacturer's part No.	Wire rod
57026-5000	UL1007
57027-5000	UL1015

<Cautions>

1. **The above table shows arrangement of pins viewed from the pin inserting direction of the connector. Also check pin Nos. carved on the main body of the connector so as to avoid incorrect wiring.**
2. **For wiring and connection, refer to "System Configuration and Wiring", Wiring of Main Circuits (Page 27).**
3. **You should leave a pin labeled with (NC) unconnected.**

Optional Parts

Connector Kits for Connection of Motor and Encoder

● Used for: MUMA 50W to 400W [Incremental 2500 pulse 5-wire]

(1) Part No. DV0P3670

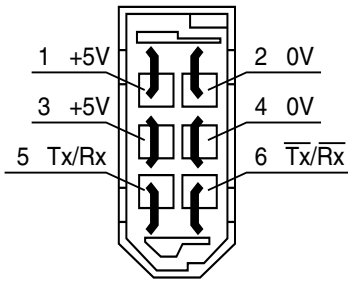
(2) Components

Name	Manufacturer's part No.	Number	Manufacturer	Remarks
Connector	55100-0600	1	Molex Incorporated	For connector CN X4 (pin 6)
Connector (6P)	172160-1	1	Manufactured by Tyco Electronics AMP K.K.	For junction of encoder cable (pin 6)
Connector pin	170365-1	6		
Connector (4P)	172159-1	1	Manufactured by Tyco Electronics AMP K.K.	For junction of motor power line (pin 4)
Connector pin	170366-1	4		
Connector (6P)	5557-06R-210	1	Molex Incorporated	For connector CN X3 (pin 6)
Connector pin	5556PBTL	4		

<Note>

You may use parts of other manufacturer equivalent to the above parts for such components as connector, connector cover, etc.

(3) Pin arrangement of connector CN X4 plug



(Case FG)

(4) Recommended manual pressure bonding tool (A customer is requested to provide it by himself.)

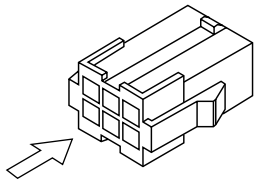
Name	Manufacturer's part No.	Manufacturer	Wire rod
For junction of encoder cable	755330-1	Tyco Electronics AMP K.K.	–
For junction of motor power line	755331-1		
For connector CN X3	57026-5000	Molex Incorporated	UL1007
	57027-5000		UL1015

<Cautions>

1. **The above figure shows the pin arrangement viewed from the soldering side of the connector. Also check pin Nos. carved on the main body of the connector so as to avoid incorrect wiring.**
2. **Be sure to connect shield of the shielded wire to be used to the case (FG).**
3. **For wiring and connection, refer to "System Configuration and Wiring", Connector CNX4 (Page 29).**

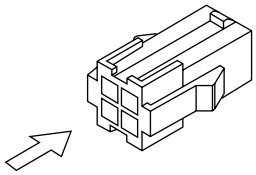
(5) Pin arrangement of connector for junction of encoder cable

1 (NC)	2 TX/RX	3 $\overline{TX}/\overline{RX}$
4 +5V	5 0V	6 FG



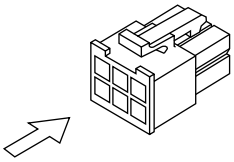
(6) Pin arrangement of connector for junction of motor power line

1 U	2 V
3 W	4 E



(7) Pin arrangement of connector for connector CN X3

6 W	5 (NC)	4 V
3 E	2 (NC)	1 U



<Cautions>

1. **The above table shows arrangement of pins viewed from the pin inserting direction of the connector. Also check pin Nos. carved on the main body of the connector so as to avoid incorrect wiring.**
2. **For wiring and connection, refer to "System Configuration and Wiring", Wiring of Main Circuits (Page 27).**

Optional Parts

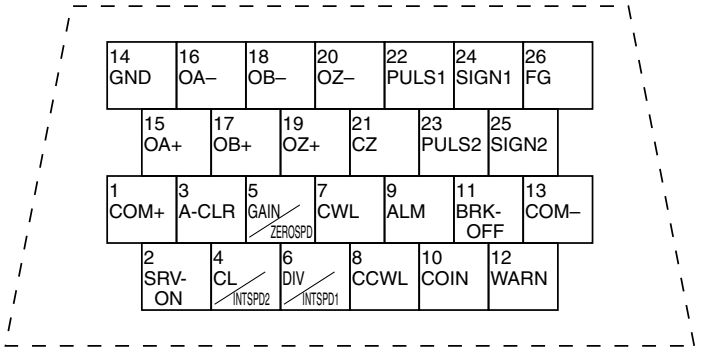
Connector Kit for Connection with Host Controller

(1) Part No. DV0P0770

(2) Components

Name	Manufacturer's part No.	Number	Manufacturer	Remarks
Connector	10126-3000PE	1	Sumitomo 3M Ltd	For CN X5
Connector Cover	10326-52A0-008	1		(Pin 26)

(3) Pin arrangement of connector X5 (pin 26) (viewed from the soldering side of the connector)



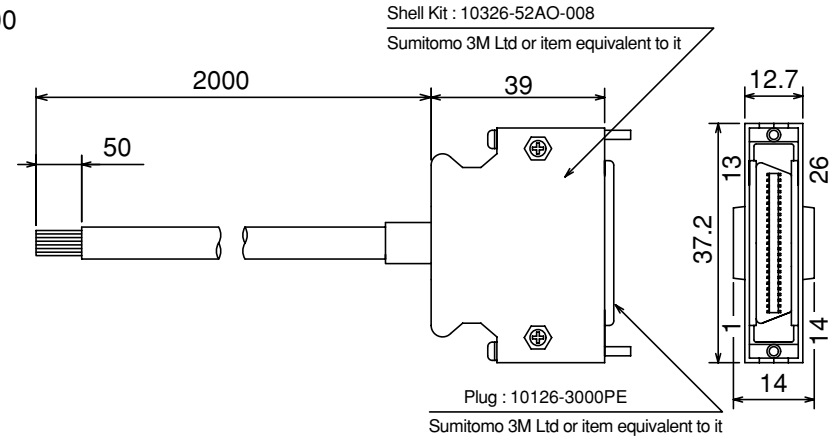
<Cautions>

1. **When wiring, also check pin Nos. carved on the main body of the connector.**
2. **For codes representative of signal names in the above table or functions of signals, refer to Wiring to Connector CN X5 (Page 30, 67 and 105).**

Interface Cable for Connection with Host Controller

(1) Part No. DV0P0800

(2) Outline dimension



(3) Table of Wiring

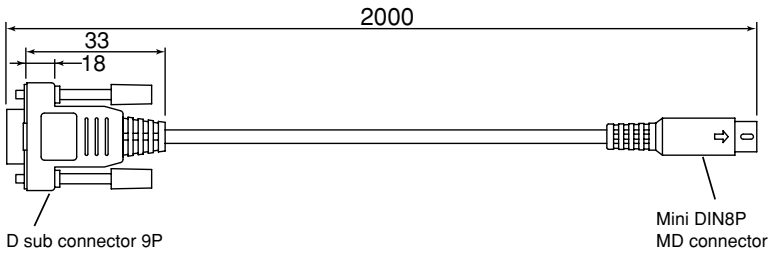
Pin No.	Signal Name	Color of Core Wire	Pin No.	Signal Name	Color of Core Wire	Pin No.	Signal Name	Color of Core Wire
1	COM+	Orange (red 1)	10	COIN	Pink (black 1)	19	OZ+	Pink (red 2)
2	SRV-ON	Orange (black 1)	11	BRK-OFF	Orange (red 2)	20	OZ–	Pink (black 2)
3	A-CLR	Gray (red 1)	12	WARN	Orange (black 2)	21	CZ	Orange (red 3)
4	CL/INTSPD2	Gray (black 1)	13	COM–	Gray (red 2)	22	PLUS1	Gray (red 3)
5	GAIN/ZEROSPD	White (red 1)	14	GND	Gray (black 2)	23	PLUS2	Gray (black 3)
6	DIV/INTSPD1	White (black 1)	15	OA+	White (red 2)	24	SIGN1	White (red 3)
7	CWL	Yellow (red 1)	16	OA–	White (black 2)	25	SIGN2	White (black 3)
8	CCWL	Yellow (black 1)	17	OB+	Yellow (red 2)	26	FG	Orange (black 3)
9	ALM	Pink (red 1)	18	OB–	Yellow (black 2)			

<Remarks>

- For example, the color of the wire, Orange (Red 1) means that the lead wire is colored in orange with one red dot mark.
- The shield of this cable is not connected with the terminal of the connector.
  Please use the connector kit for connection with Host Controller when you connect the shield with FG or GND on the driver side.

Communications Cable (Connection with Personal Computer)

(1) Part No. DV0P 1960 (for DOS/V compatible machines)



For pin arrangement of CN X6, see Page 159.

"PANATERM®", software for communications control

(1) Part No. DV0P4230 (Japanese version) DV0P4240 (English version)

(2) This is supplied in the form of a 3.5 inch floppy disk.

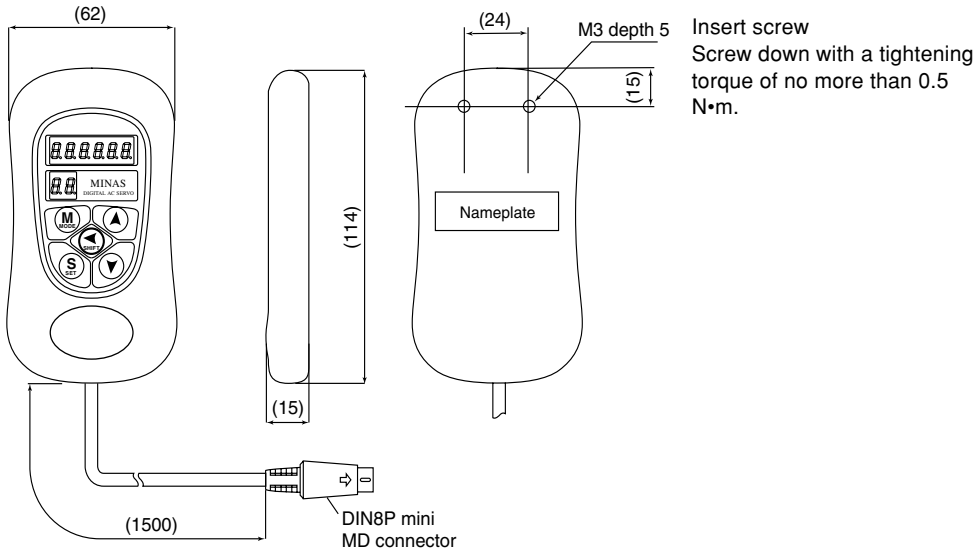
<Cautions>

For details on the operating environment or others, refer to the operating instructions of "PANATERM®".

For information on latest version, please contact us.

Console

Part No. DV0P3690



Optional Parts

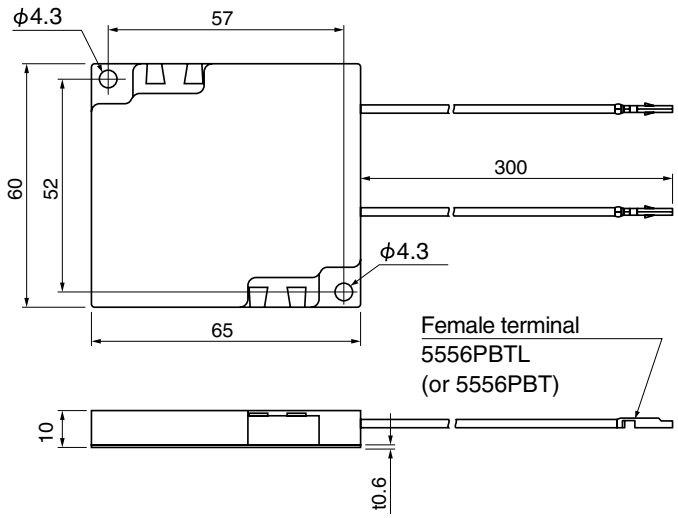
External Regenerative Resistor

Part No.	Manufacturer's model name	Specification			Remarks (Specifications for the driver voltage)
		Ohmic Value	Rated Power	Operating Temperature for Built-in Temperature Fuse	
DV0P2890	45M03	50 Ω	10W	130±2˚C	For single-phase 100V
DV0P2891	45M03	100 Ω	10W	130±2˚C	For single-phase/ three-phase 200V

Manufactured by: IWAKI MUSEN KENKYUSHO CO., LTD.

<Note>

For safety reasons, the external regenerative resistor has a built-in temperature fuse. The built-in temperature fuse may be disconnected depending on heat dissipation conditions, range of use temperatures, supply voltage, and load variations.



<Cautions>

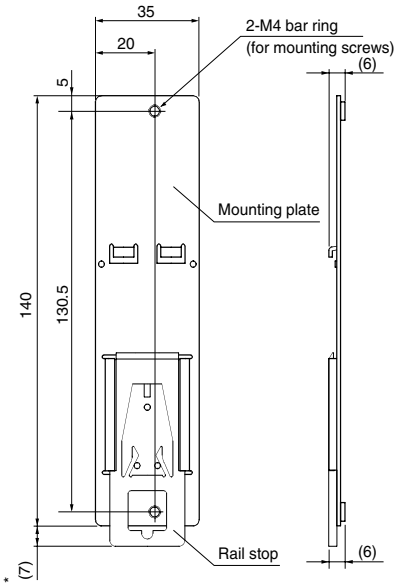
The regenerative resistor may be hot.

Take preventive actions against a fire and burn.
Do not mount the regenerative resistor in the vicinity of an inflammable object or in a place where an operator may easily touch it by hand.

DIN Rail Mounting Unit

(1) Part No. DV0P3811

(2) Outline Dimension



<Remarks>

- Two mounting screws (M4 x length 8, pan head machine screws) are supplied.
- * When extended, the rail stopper is 10mm long.

<Note>

For installation and removal, refer to "Installation" of Before Use edition on Pages 18 to 19.

Reactor

Driver Outline Frame Code	Voltage Specification for Power Source of Driver	Rated Output	Reactor Part No.	Figure
MKDE	Single-phase 100V	50 - 100W	DV0P227	1
	Single-phase 200V	50 - 100W	DV0P220	2
	Three-phase 200V	50 - 200W		
MLDE	Single-phase 100V	200W	DV0P228	1
	Single-phase 200V	200 - 400W	DV0P220	2
	Three-phase 200V	400W		

Figure 1

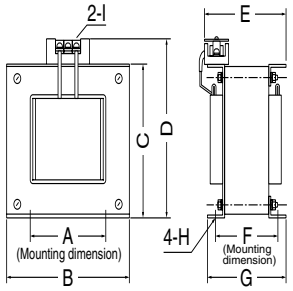


Figure 2

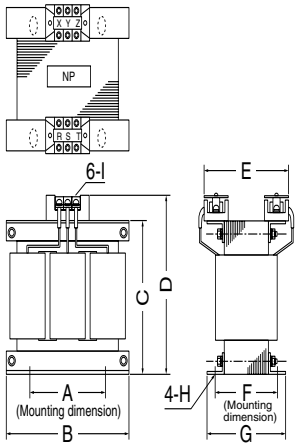


Figure	Part No.	A	B	C	D	E	F	G	H	I	Inductance (mH)	Rated Current (A)
1	DV0P227	55	80	68	90	90	41	55	ø 7	M4	4.02	5
	DV0P228										2	8
2	DV0P220	65	125	83	118	145	70	85	Width 7 x Length 12	M4	6.81	3

- The former Agency of Natural Resources and Energy of Ministry of International Trade and Industry (present Ministry of Economy, Trade and Industry) established higher harmonics suppression guidelines in September 1994.
  (1) Drivers rated 4kW or lower are subject to “Higher Harmonics Suppression Guidelines for Home Electric and General Purpose Appliances”.
  (2) Drivers rated over 4kW are subject to “Higher Harmonics Suppression Guidelines for High Voltage and Special Customers”.
- The Ministry of Economy, Trade and Industry strongly demands manufacturers to enforce measures to curb harmonics.
  In order to comply with the established regulatory level, connect a power-factor improvement reactor (L) to drivers of 4 kW or lower. For drivers of over 4kW, determine the level of harmonics according to the guideline and take a suppression measure, as appropriate.

<Reference>

[Harmonics Suppression Technical Guideline], JEAG 9702-1995, Japan Electric Association

[Harmonic Current Calculation Procedure for General-purpose Inverter at Special Customers], JEM-TR201-1996, Japan Electrical Manufacturers’ Association

Recommended Parts

Surge Absorber for Motor Brake

Motor	Surge Absorber for Motor Brake
MUMA50W - 400W	• C-5A2 or Z15D151 Ishizuka Electronics Corporation

• The recommended parts are specified items to measure the brake release time.

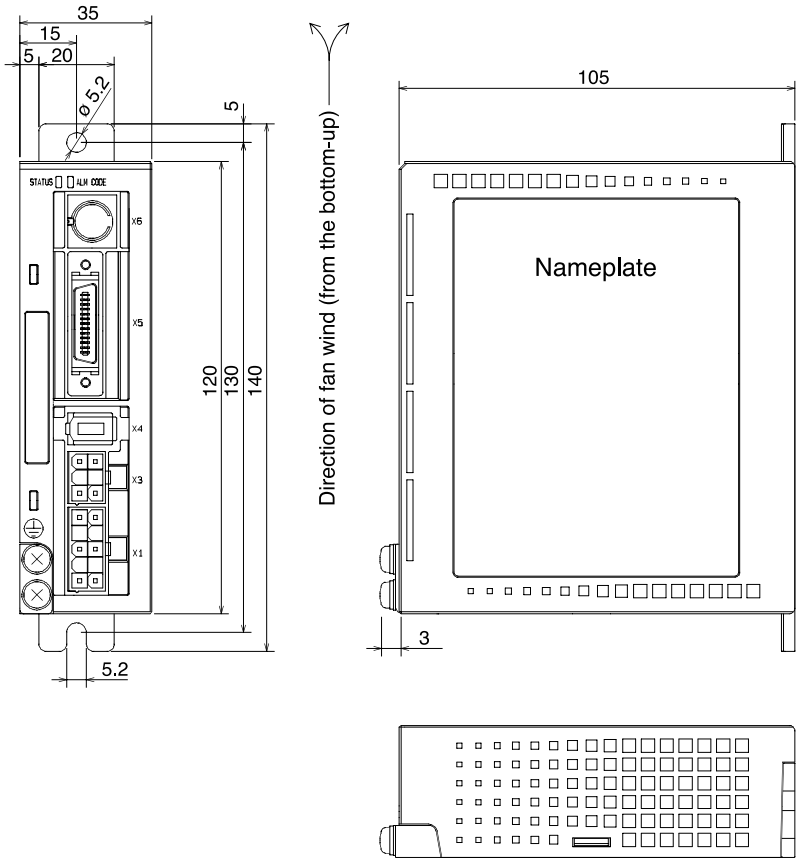
List of Manufacturers of Peripheral Equipment

As of February 2003

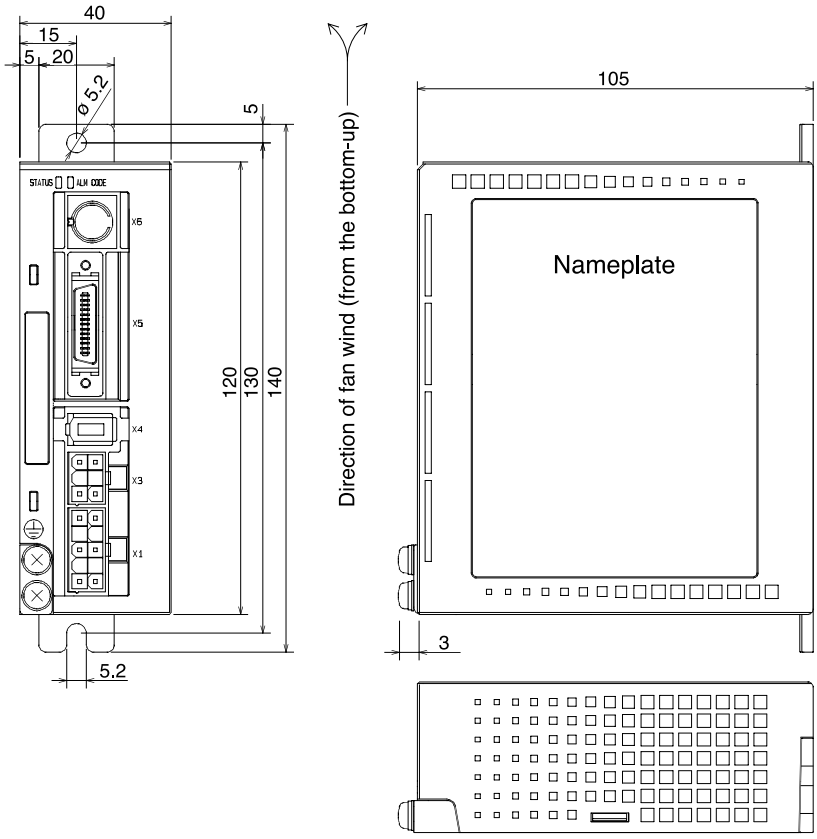
Manufacturer/Agent	Phone Number	Equipment
Matsushita Electric Works, Ltd. Automation Controls Company	+81-6-6908-1131 http://www.mew.co.jp	No-fuse breaker Electromagnetic switch Surge absorber
IWAKI MUSEN NKENKYUSHO CO., LTD.	+81-44-833-4311 http://www.iwakimusen.co.jp/	Regenerative resistor
Ishizuka Electronics Corporation	+81-3-3621-2703 http://www.semitec.co.jp/	Surge absorber for holding brake
Renesas Technology Corpration.	+81-6-6233-9511 http://www.renesas.com/jpn/	
TDK Corporation	+81-3-5201-7229 http://www.tdk.co.jp/	Noise filter for signal line
Okaya Electric Industries, Co., Ltd.	+81-3-3424-8120 http://www.okayatec.co.jp/	Surge absorber Noise filter
Sumitomo 3M Ltd	+81-3-5716-7290 http://www.mmmco.jp	Connector
Tyco Electronics AMP K.K.	+81-44-844-8111 http://www.tycoelectronics.com/japan/amp	
Japan Molex Incorporated	+81-462-65-2313 http://www.molex.co.jp	
Daiden Co., Ltd.	+81-3-5805-5880 http://www.dyden.co.jp	Cable

Dimensional Outline Drawing

Driver (Frame K) Estimated Mass 0.35 kg



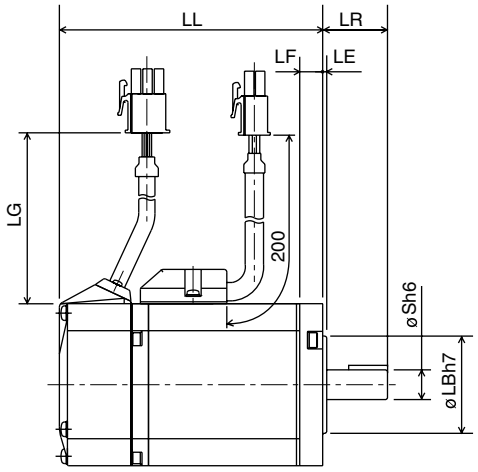
Driver (Frame L) Estimated Mass 0.4 kg



Dimensional Outline Drawing

Motor

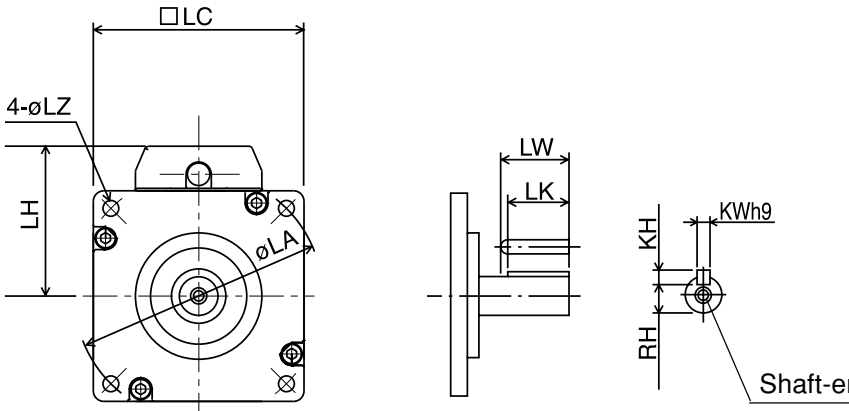
MUMA Series 50W to 400W



Output	LG
50W, 100W	230mm
200W, 400W	220mm

(Unit: mm)

		Model	Output (W)	LL	S	LB	LE	LF	LR
MUMA	Without a brake	MUMA5A☐P1☐	50	75.5	8	22	2	7	24
		MUMA01☐P1☐	100	92.5					
		MUMA02☐P1☐	200	96	11	50	3		30
		MUMA04☐P1☐	400	124	14				
	With a brake	MUMA5A☐P1☐	50	107	8	22	2	7	24
		MUMA01☐P1☐	100	124					
		MUMA02☐P1☐	200	129	11	50	3		30
		MUMA04☐P1☐	400	157	14				



Specification of Keyed Version

(Dimension)

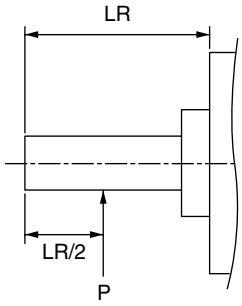
Output	Screw	Depth
50W, 100W	M3	6
200W	M4	8
400W	M5	10

(Unit: mm)

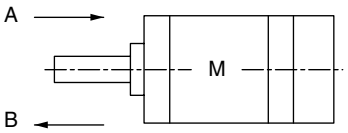
		LA	LC	LZ	LW	LK	KW	KH	RH	LH	Mass (kg)	Rotor Moment of Inertia ($x10^{-4}kg \cdot m^2$)
MUMA	Without a brake	48	42	3.4	14	12.5	3	3	6.2	34	0.40	0.021
											0.50	0.032
		70	60	4.5	20	18	4	4	8.5	43	0.96	0.10
					25	22.5	5	5	11		1.5	0.17
	With a brake	48	42	3.4	14	12.5	3	3	6.2	34	0.60	0.026
											0.70	0.036
		70	60	4.5	20	18	4	4	8.5	43	1.4	0.13
					25	22.5	5	5	11		1.9	0.20

Allowable Load of Output Shaft

Radial Load Direction (P)



Thrust Load Directions (A, B)

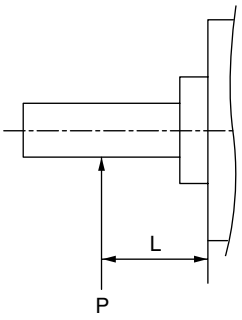


Unit: N (1kgf = 9.8N)

Motor Series	Motor Output	When Assembled			In Operation	
		Radial Load	Thrust Load		Radial Load	Thrust Load
			Direction A	Direction B		Directions A, B
MUMA	50W, 100W	147	88.2	117.6	68.6	58.8
	200W, 400W	392	147	196	245	98

<Remarks>

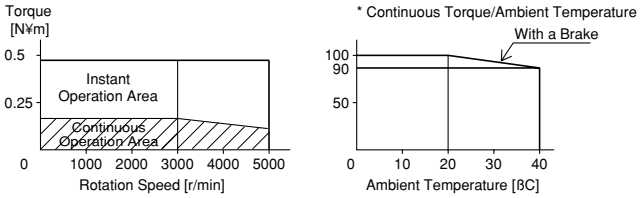
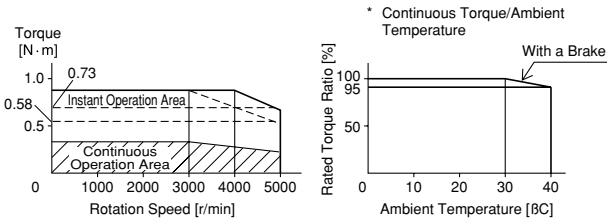
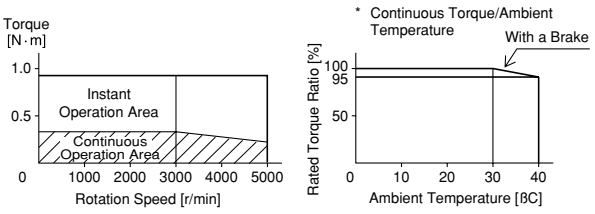
If a position of load point varies, calculate allowable radial load P (N) from distance L (mm) of a load point from mounting flange face, based on the relational expression, so that the result of calculation will be as follows:



Motor Series	Motor Output	Relational Expression of Load - Load Point
MUMA	50W, 100W	$P = \frac{1406}{L + 7.5}$
	200W	$P = \frac{2940}{L - 3}$
	400W	$P = \frac{5831}{L + 8.8}$

Motor Characteristics (S-T Characteristics) [Reference]

- Note that motor characteristics may vary depending on whether or not there is a brake.
- The continuous torque — ambient temperature characteristic shows a value when our standard flange made of aluminum (having about doubled angle of that of the motor flange) is mounted.
- They are characteristics without an oil seal.

<table>
<tr><th rowspan="2">Motor Capacity</th><th colspan="2">Supply Voltage of Driver</th></tr>
<tr><th>AC100V</th><th>AC200V</th></tr>
<tr><td>50W</td><td colspan="2">●MUMA5AZP1□
Supply Voltage of Driver: At AC100V/200V
 
</td></tr>
<tr><td>100W</td><td>●MUMA011P1 □
Supply Voltage of Driver: AC100V
(A dotted line indicates the case in which the supply voltage drops by 10%.)
 
</td><td>●MUMA012P1 □
Supply Voltage of Driver: AC200V
 
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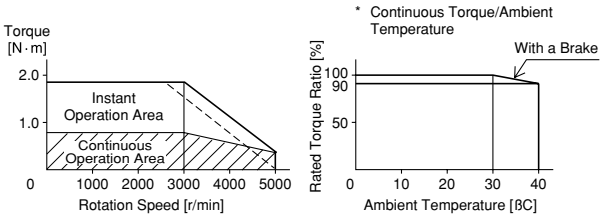
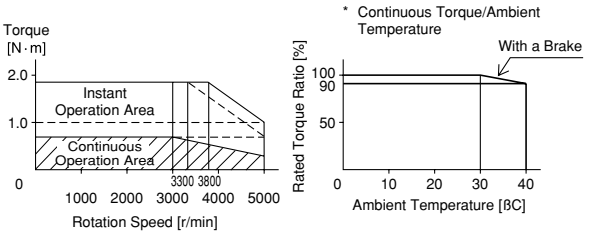
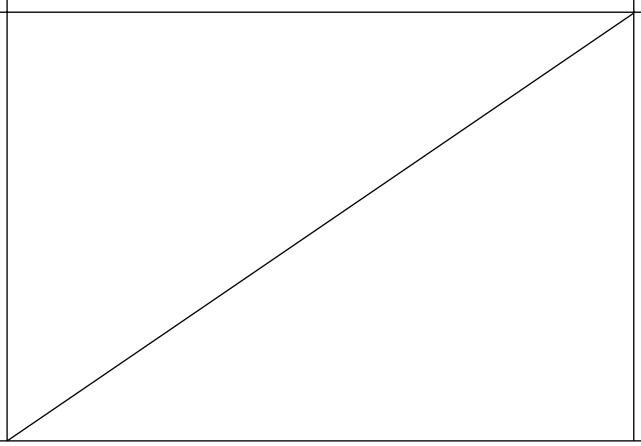
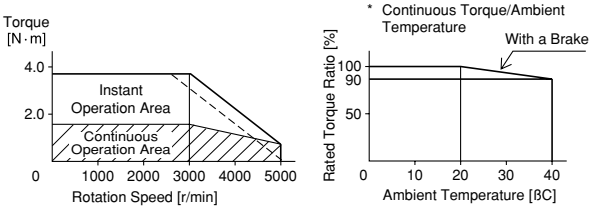
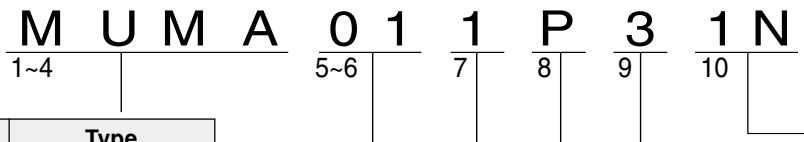
<tr><td>200W</td><td>●MUMA021P1 □
Supply Voltage of Driver: AC200V
(A dotted line indicates the case in which the supply voltage drops by 10%.)
 
</td><td>●MUMA022P1 □
Supply Voltage of Driver: AC200V
(A dotted line indicates the case in which the supply voltage drops by 10%.)
 
</td></tr>
<tr><td>400W</td><td>  </td><td>●MUMA042P1 □
Supply Voltage of Driver: AC200V
(A dotted line indicates the case in which the supply voltage drops by 10%.)
 
</td></tr>
</table>

* In the case of no oil seal and no brake, the rated torque ratio is 100% at ambient temperature of 40ßC.

Servo Motor with Gear

Checking Model of Servo Motor with Gear

How to check the model



Symbol	Type
MUMA	Ultra low Inertia

Reduction Ratio

Symbol	Reduction Ratio
1N	1/5
2N	1/9
4N	1/25

Structure of the motor

Specifications of Position/Speed Detector

Motor Rated Output — Rated Output

Symbol	Rated Output
01	100W
02	200W
04	400W

Voltage Specification
1 : 100V
2 : 200V

Specification of Rotary Encoder

Symbol	Specification			
	Method	Number of Pulses	Resolution	Lead Wire
P	Incremental	2500P/r	10000	5-wire

Structure of the motor

Symbol	Holding Brake	
	No	Yes
3	●	
4		●

Check the Combination of Driver and Motor with Gear

This driver was designed for use with the motor designated by us.
Check a name of the series, rated output, voltage specification, and encoder specification of the motor you plan to use.

Incremental Specification 2500 P/r

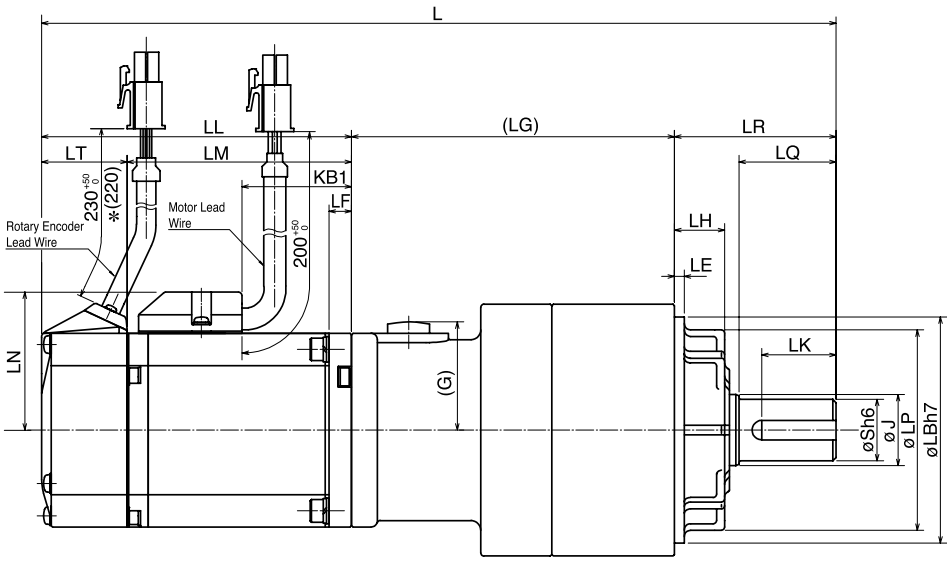
<Note>
You must not use any combination other than those listed below.

	Applicable Motors with Gear				Applicable Drivers	
Power Supply	**Motor Rated Output**	**Reduction Ratio 1/5**	**Reduction Ratio 1/9**	**Reduction Ratio 1/25**	**Driver Model**	**Driver Frame**
Single Phase 100V	100W	MUMA011P * 1N	MUMA011P * 2N	MUMA011P * 4N	MKDET1110P	Frame K
	200W	MUMA021P * 1N	MUMA021P * 2N	MUMA021P * 4N	MLDET2110P	Frame L
Single Phase 200V	100W	MUMA012P * 1N	MUMA012P * 2N	MUMA012P * 4N	MKDET1505P	Frame K
	200W	MUMA022P * 1N	MUMA022P * 2N	MUMA022P * 4N	MLDET2210P	Frame L
	400W	MUMA042P * 1N	MUMA042P * 2N	MUMA042P * 4N	MLDET2510P	
Three-Phase 200V	100W	MUMA012P * 1N	MUMA012P * 2N	MUMA012P * 4N	MKDET1505P	Frame K
	200W	MUMA022P * 1N	MUMA022P * 2N	MUMA022P * 4N	MKDET1310P	
	400W	MUMA042P * 1N	MUMA042P * 2N	MUMA042P * 4N	MLDET2310P	Frame L
					MLDET2510P	

<Remarks>
・ The mark "*" under the model name of the applicable motors refer to the structure of motor.

Dimensional Outline Drawing of Motor with Gear

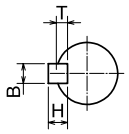
Servo Motor with Gear



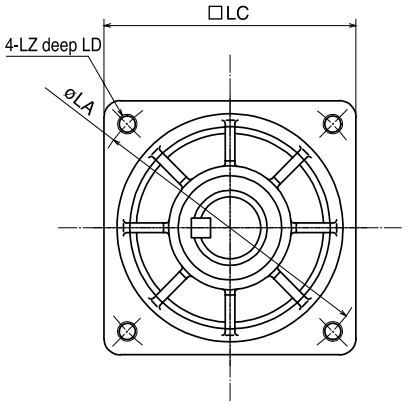
* 220 refers to 200W or higher.

(unit: mm)

		Model	Motor Output	Reduction Ratio	L	LL	LM	LT	KB1	LF	LR	LQ	LB	S	LP	LH	J	(LG)	LE	(G)
MUMA	Without a brake	MUMA01□P31N	100W	1/5	192	92.5	64	28.5	38.8	7	32	20	50	12	45	10	14	67.5	3	25
		MUMA01□P32N		1/9																
		MUMA01□P34N		1/25	234,5						50	30	70	19	62	17	22	92		
		MUMA02□P31N	200W	1/5	200.5	96	69.5	26.5	34		50	30	70	19	62	17	22	72.5		34
		MUMA02□P32N		1/9	235.5													89.5		
		MUMA02□P34N		1/25	246													100		
		MUMA042P31N	400W	1/5	263	123.5	97		61.5									89.5		
		MUMA042P32N		1/9																
		MUMA042P34N		1/25	288.5						61	40	90	24	75	18	28	104	5	
	With a brake	MUMA01□P41N	100W	1/5	223.5	124	95.5	28.5	38.8	7	32	20	50	12	45	10	14	67.5	3	25
		MUMA01□P42N		1/9																
		MUMA01□P44N		1/25	266						50	30	70	19	62	17	22	92		
		MUMA02□P41N	200W	1/5	233.5	129	102.5	26.5	34		50	30	70	19	62	17	22	72.5		34
		MUMA02□P42N		1/9	268.5													89.5		
		MUMA02□P44N		1/25	279													100		
		MUMA042P41N	400W	1/5	296	156.5	130		61.5									89.5		
		MUMA042P42N		1/9																
		MUMA042P44N		1/25	321.5						61	40	90	24	75	18	28	104	5	



Detailed View of Shaft End



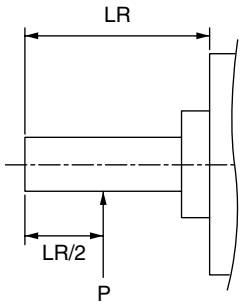
(unit: mm)

		LC	LA	LZ	LD	Key Dimensions (B × H × LK)	T	LN	Mass (kg)	Moment of Inertia ($\times 10^{-4}$kg·m^2)
MUMA	Without a brake	52	60	M5	12	4 × 4 × 16	2.5	34	1.05	0.072
										0.0663
		78	90	M6	20	6 × 6 × 22	3.5		2.20	0.0645
		52	60	M5	12	4 × 4 × 16	2.5	43	1.68	0.218
		78	90	M6	20	6 × 6 × 22	3.5		2.66	0.368
										0.388
									3.2	0.533
									3.2	0.438
		98	115	M8		8 × 7 × 30	4		4.7	0.470
	With a brake	52	60	M5	12	4 × 4 × 16	2.5	34	1.25	0.076
										0.0703
		78	90	M6	20	6 × 6 × 22	3.5		2.40	0.0685
		52	60	M5	12	4 × 4 × 16	2.5	43	2.08	0.248
		78	90	M6	20	6 × 6 × 22	3.5		3.06	0.398
										0.418
									3.6	0.563
										0.468
		98	115	M8		8 × 7 × 30	4		5.1	0.500

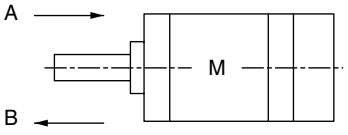
A value of moment of inertia is a motor shaft converted value (of the motor + speed reducer).

Allowable Load of Output Shaft of Servo Motor with Gear

Radial Load (P) Direction



Thrust Loading (A, B) Direction



Unit: N

Motor Output	Gear Ratio	Shaft Allowable Load	
		Radial Load	Thrust Load A, B directions
100W	1/5	490	245
	1/9	588	294
	1/25	1670	833
200W	1/5	490	245
	1/9	1180	588
	1/25	1670	833
400W	1/5	980	490
	1/9	1180	588
	1/25	2060	1030

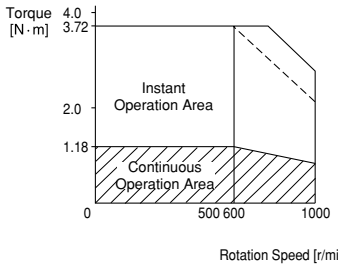
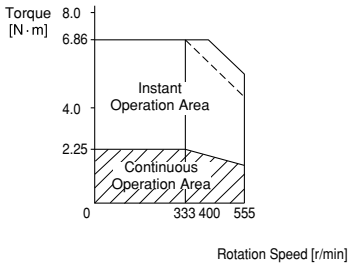
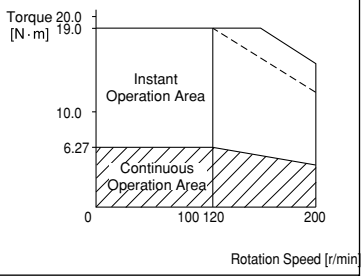
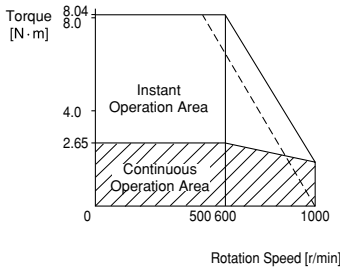
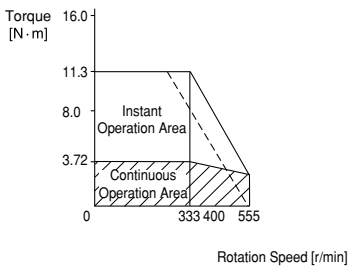
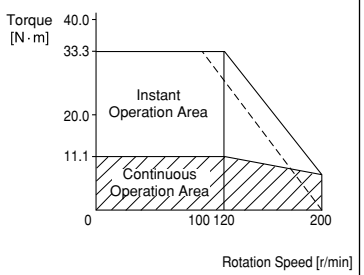
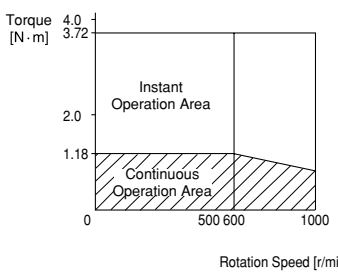
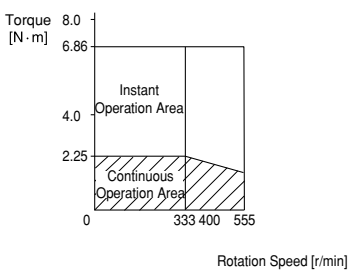
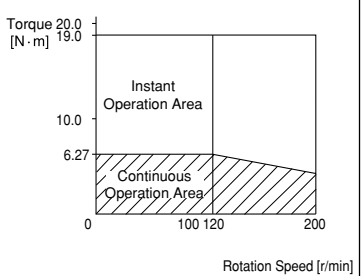
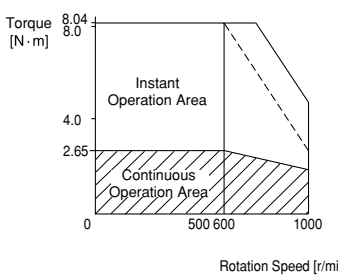
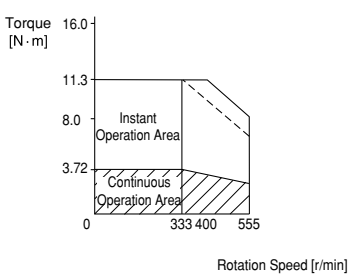
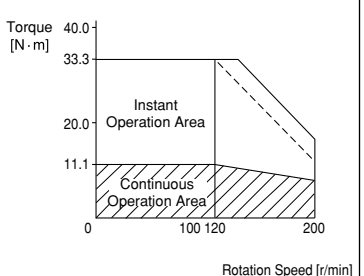
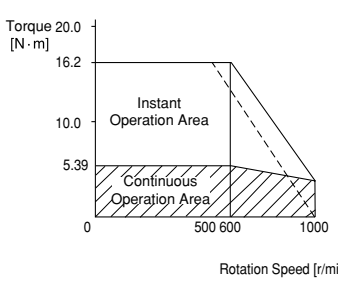
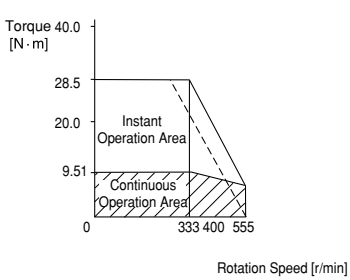
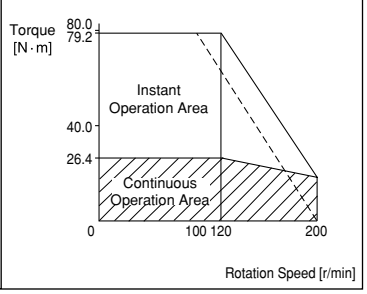
Requests Concerning Installation

(1) Do not tap on the shaft when mounting the pulley, sprocket, etc. to the output shaft of the gear head. If you do tap on it, you may hear abnormal sound.

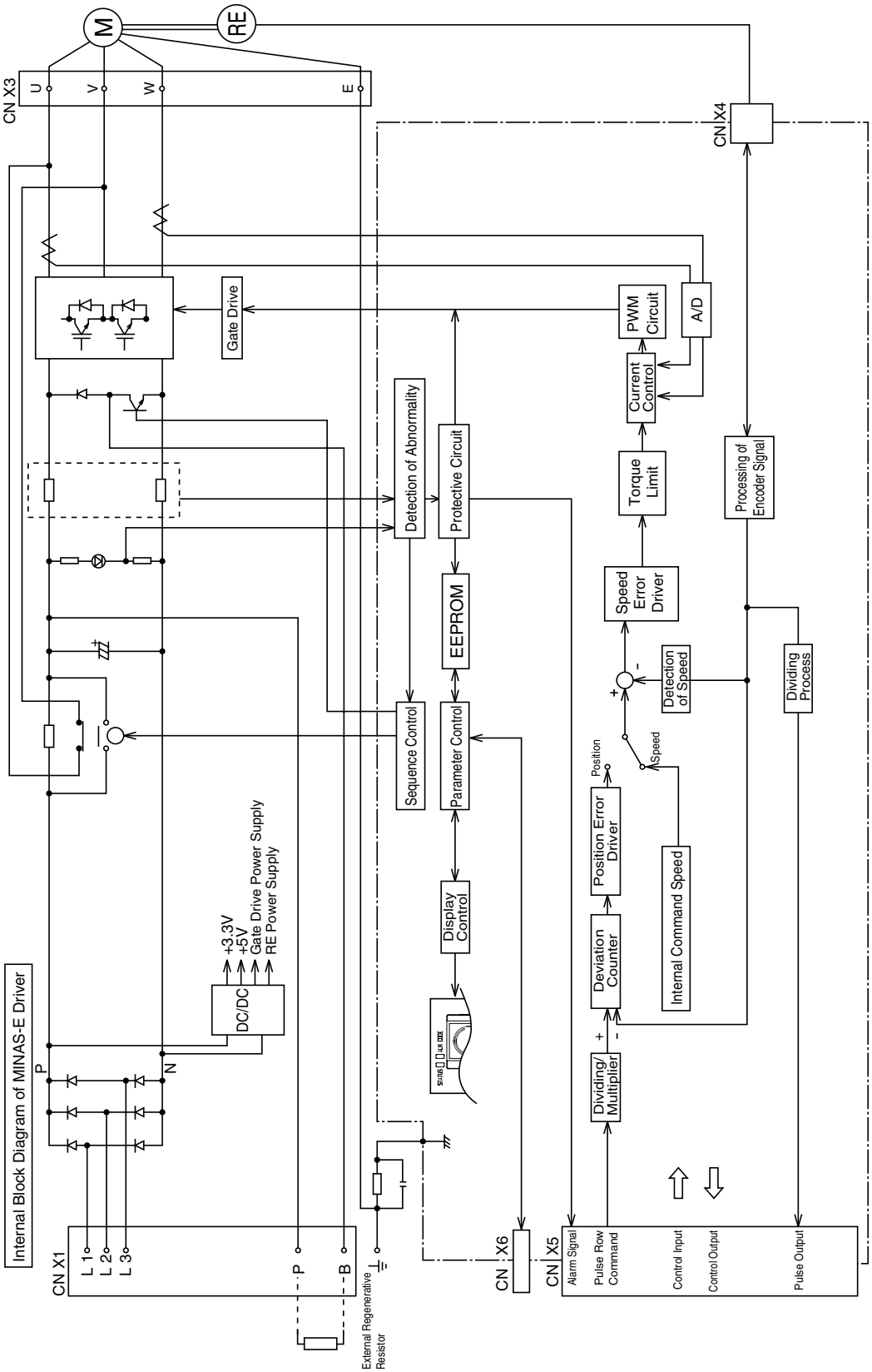
(2) Give load to the pulley, sprocket, etc., so that force can act on the root of the output shaft, whenever possible.

(3) If you plan to use a rigid coupling, ask us for information on the mounting precision and strength.

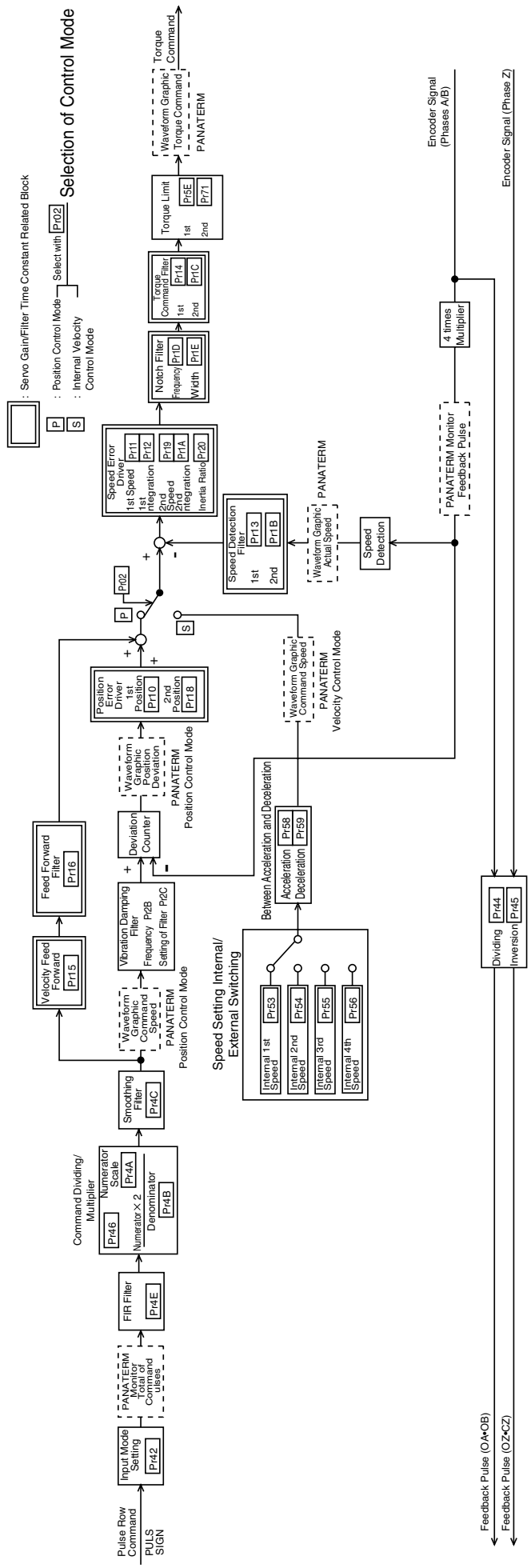
(4) The motor has a built-in detector. If you inadvertently give excessive shock to the motor unit when coupling it with a device, the detector may be broken. Thus, assemble it carefully.

Driver Supply Voltage	Motor Output \ Reduction Ratio	1/5	1/9	1/25
100V	100W	MUMA011P□1N 	MUMA011P□2N 	MUMA011P□4N 
	200W	MUMA021P□1N 	MUMA021P□2N 	MUMA021P□4N 
200V	100W	MUMA012P□1N 	MUMA012P□2N 	MUMA012P□4N 
	200W	MUMA022P□1N 	MUMA022P□2N 	MUMA022P□4N 
	400W	MUMA042P□1N 	MUMA042P□2N 	MUMA042P□4N 

Driver Internal Block Diagram



●Control Block Diagram



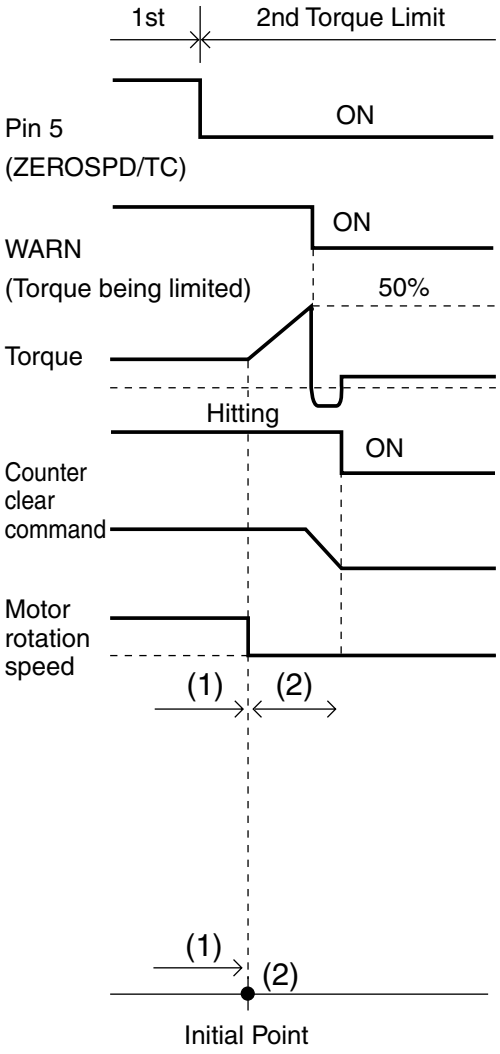
Specifications

Driver	Power Supply	Single-phase 100V		Single-phase AC100V $^{+10\%}_{-15\%}$ - 115V $^{+10\%}_{-15\%}$ 50/60Hz
		Single-phase 200V		Single-phase AC200V $^{+10\%}_{-15\%}$ - 240V $^{+10\%}_{-15\%}$ 50/60Hz
		Three-phase 200V		Three-phase AC200V $^{+10\%}_{-15\%}$ - 240V $^{+10\%}_{-15\%}$ 50/60Hz
		Allowable frequency variations		Within –5%
	Control method			IGBT transistor PWM control (Sine wave driving)
	Detector	Specification of applicable rotary encoder		Incremental encoder 5-wire 2500 P/r
	Built-in functions	Regeneration		Externally installed regenerative resistor
		Dynamic brake		At power-off, Servo-OFF, activation of protective function, and activation of limit switches
		Auto gain tuning		Normal, real time
		Electronic gear (Dividing/multiplier of a command pulse)		A value resulting from the calculation of $\frac{1 - 10000}{1 - 10000} \times 2^{0 - 17}$
		Dividing of feedback pulse		Two-phase pulse of 5 to 2500 P/r output at any number of pulse
	Protective Function	Capable of storing 14 alarms including a current alarm code No. Note, however, that alarm marked with * cannot be stored.		Undervoltage*, overvoltage, overcurrent, overload, regenerative overload, encoder error, position over-deviation, over-speed, command pulse dividing error, position deviation overflow, EEPROM data error* (abnormal parameter, abnormal check code), overtravel input error*, etc.
	Monitor	Panel Display		Status LED (STATUS), alarm code LED (ALM CODE)
	Setting	Communications		RS232C
	Position Control	Maximum Input Pulse Frequency		Line driver 500 kpps, open collector 200 kpps
		Form		Line driver, open collector
		Type		90ß phase difference two-phase pulse, CW/CCW pulse, pulse row + sign
	Velocity Control	Internal command speed		Four-speed setup (Capable of setting CW/CCW, up to 20000r/min. However, use it within the use range of the motor.)
		Acceleration time setting		0 to 10 s/1000r/min, possible to individually set acceleration/ deceleration.
	Rotary Encoder	Rotary encoder feedback signal	Phases A•B	Line driver output
			Phases Z	Line driver output, Open collector output
	Control Input			Refer to Section "System Configuration and Wiring".
	Structure			Base mount type, open (IPOO)
	Mass			Refer to Section "Dimensional Outline Drawing of Driver".
	Ambient Conditions			Refer to Section "Installation".
Motor	Rated Rotation Speed			3000r/min
	Maximum Rotation Speed		100V	50W - 200W: 5000r/min
			200V	50W - 400W: 5000r/min
	Holding Brake			Refer to Section "Holding Brake Built in the Servo Motor" for DC24V.
	Rotary Encoder			Incremental encoder 5-wire 2500 P/r
	Structure (dust-proof/drip-proof protection)			Equivalent to IP65 (excluding connector unit, shaft-through part)
	Mass			Refer to Section "Dimensional Outline Drawing".
	Ambient Conditions			Refer to Section "Installation".

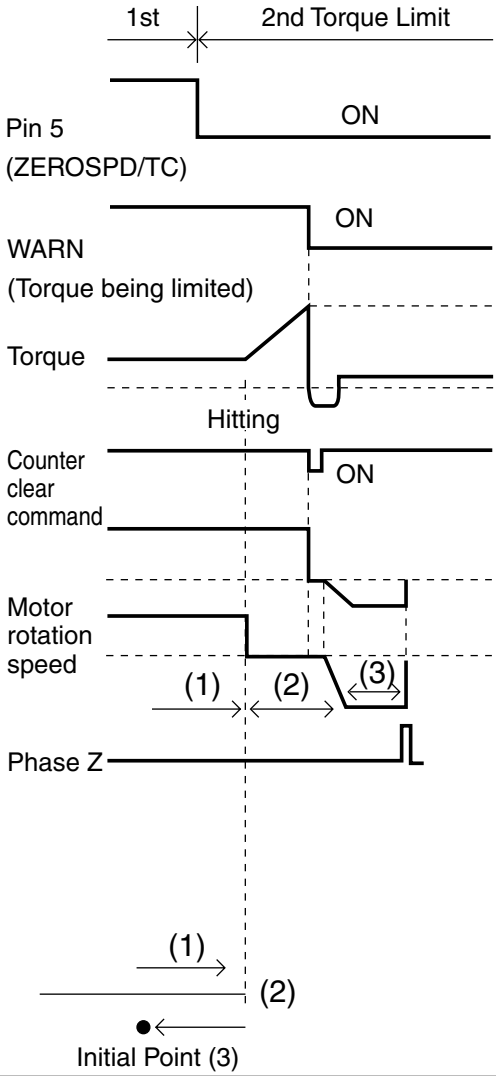
Hit-and-stop Initialization

When you find it difficult to install a sensor as the surroundings are not good, Hit-and-stop Initialization can be used.

(1) When you set a point where the motor hits, as the origin:



(2) When you stop the motor using phase Z with the hit point as a starting point, and make it an origin

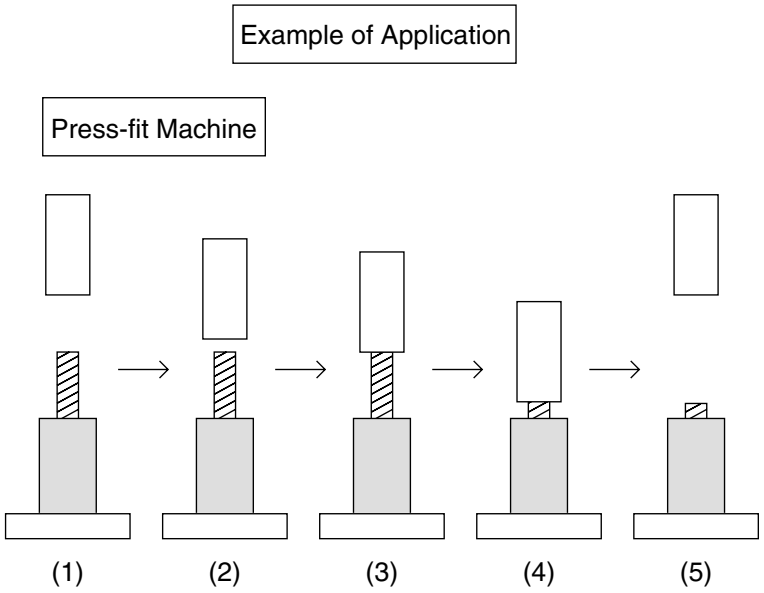


Parameter No.	Name	Example of Settings
70	1st over-speed level set-up	6000
71	2nd torque limit set-up	50 (Set it 100% or less)
72	2nd position over-deviation set-up	1875 (Same as No.1)
73	2nd over-speed level set-up	6000
06	ZEROSPD/TC input selection	2 (Speed zero clamp disabled. Torque limit switching input enabled.)
09	Warning output selection	0 (Torque being limited)

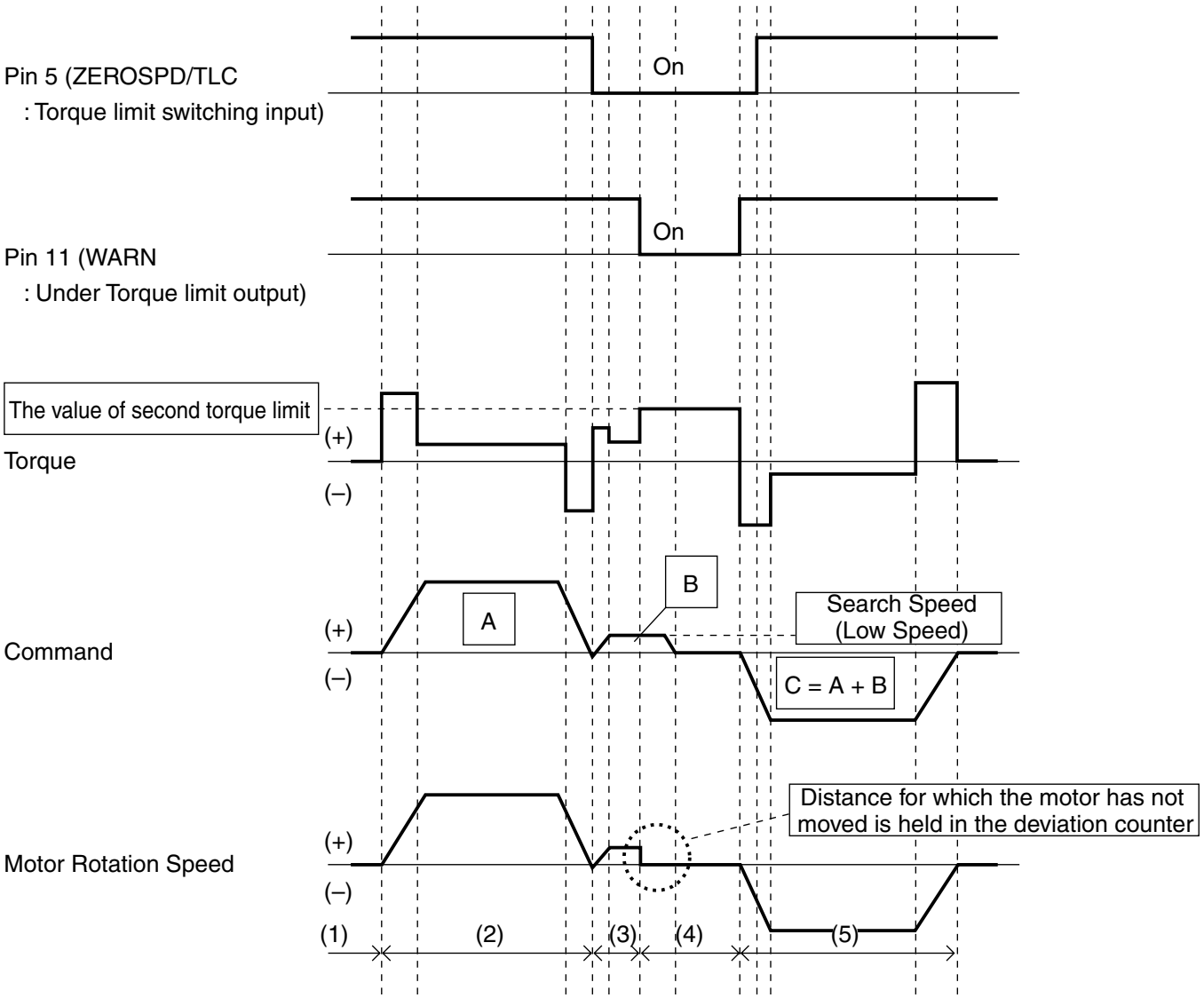
<Note>
Set pin 5 "H (OFF)" after hit-and-stop initialization completes.

Hit-and-stop Initialization and Load Pressing Control

Load Pressing Control



PrNo.	Name	Example of Settings
06	ZEROSPD/TC input selection	2
09	Warning output selection	0
5E	Torque limit set-up	200
70	1st over-speed level set-up	3000
71	2nd torque limit set-up	50
72	2nd over-position deviation set-up	10000
73	2nd over-speed level set-up	3000



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Reference

Motor Company, Matsushita Electric Industrial Co., Ltd. Marketing Group

Tokyo: Kyobashi MID Bldg, 2-13-10 Kyobashi, Chuo-ku, Tokyo 104-0031
TEL (03) 3538-2961
FAX (03) 3538-2964

Osaka: 1-1, Morofuku 7-chome, Daito, Osaka 574-0044
TEL (072) 870-3065
FAX (072) 870-3151

MEMO

After-Sale Service (Repair)

Repair

- Ask the seller where the product was purchased for details of repair work.
  When the product is installed in a machine or device, consult first the manufacture of the machine or device.

Cautions for Proper Use

- This product is intended to be used with a general industrial product, but not designed or manufactured to be used in a machine or system that may cause personal death when it is failed.
- Install a safety equipments or apparatus in your application, when a serious accident or loss of property is expected due to the failure of this product.
- Consult us if the application of this product is under such special conditions and environments as nuclear energy control, aerospace, transportation, medical equipment, various safety equipments or equipments which require a lesser air contamination.
- We have been making the best effort to ensure the highest quality of the products, however, application of exceptionally larger external noise disturbance and static electricity, or failure in input power, wiring and components may result in unexpected action. It is highly recommended that you make a fail-safe design and secure the safety in the operative range.
- If the motor shaft is not electrically grounded, it may cause an electrolytic corrosion to the bearing, depending on the condition of the machine and its mounting environment, and may result in the bearing noise. Checking and verification by customer is required.
- Failure of this product depending on its content, may generate smoke of about one cigarette. Take this into consideration when the application of the machine is clean room related.
- Please be careful when using in an environment with high concentrations of sulphur or sulphuric gases, as sulphuration can lead to disconnection from the chip resistor or a poor contact connection.
- Take care to avoid inputting a supply voltage which significantly exceeds the rated range to the power supply of this product. Failure to heed this caution may result in damage to the internal parts, causing smoking and/or a fire and other trouble.

Electronic data of this manual

Electronic data of this manual can be downloaded at the following web site.

- Web Site of Motor Company, Matsushita Electric Industrial Co., Ltd.

<http://panasonic.co.jp/motor/>

Memorandum (Fill in the blanks for convenience in case of inquiry or repair)

Date of purchase	Date:	Model No.	(Driver) _____ (Motor) _____
Place of purchase			
	TEL:		

Motor Company
Matsushita Electric Industrial Co., Ltd.
7-1-1, Morofuku, Daito, Osaka 574-0044, Japan
TEL: +81 -72-871 -1212

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