Doc. no. LEC-OM02407
(Doc no. JXC※-OMT0021-A)

Operation Manual

PRODUCT NAME

AC Servo Motor Driver

MODEL/ Series

LECSB Series

SMC Corporation

LECSB□-□ Series / Driver
1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage.
These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger."
They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC) *1), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems
ISO 4413: Hydraulic fluid power -- General rules relating to systems
IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)
ISO 10218: Manipulating industrial robots -- Safety
etc.

Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
Warning	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Danger	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.
Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.
The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.
This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
The product specified here may become unsafe if handled incorrectly.
The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.
The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and lock circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3) An application which could have negative effects on people, property, or animals requiring special safety analysis.
4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols.

Prohibition	Indicates what must not be done. For example, "No Fire" is indicated by	
Compulsion	Indicates what must be done. For example, grounding is indicated by	

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this installation guide, always keep it accessible to the operator.

LECSB□-□ Series / Driver
1. Safety Instructions

⚠Caution
The product is provided for use in manufacturing industries. The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

Limited warranty and Disclaimer

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*3)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***3) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring or inspection, turn off the power and wait for 15 minutes or more (20 minutes or for drive unit 30kW or more) until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) (L＋ and L－ for drive unit 30kW or more) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the driver, whether the charge lamp is off or not.
- Connect the driver and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the driver and servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, you may get an electric shock.
- During power-on or operation, do not open the front cover. You may get an electric shock.
- Do not operate the driver with the front cover removed. High-voltage terminals and charging area are exposed and you may get an electric shock.
- Except for wiring or periodic inspection, do not remove the front cover even if the power is off. The driver is charged and you may get an electric shock.

2. To prevent fire, note the following

⚠ CAUTION

- Install the driver, servo motor and regenerative resistor on incombustible material. Installing them directly or close to combustibles will lead to a fire.
- Always connect a magnetic contactor between the main circuit power supply and L_1, L_2, and L_3 of the driver, and configure the wiring to be able to shut down the power supply on the side of the driver power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the driver malfunctions.
- When a regenerative resistor is used, use an alarm signal to switch main power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the driver, and servo motor.
- Always connect a no-fuse breaker to the power supply of the driver.

3. To prevent injury, note the follow

⚠ CAUTION

- Only the voltage specified in the Instruction Manual should be applied to each terminal, Otherwise, a burst, damage, etc. may occur.
- Connect the terminals correctly to prevent a burst, damage, etc.
- Ensure that polarity (＋, －) is correct. Otherwise, a burst, damage, etc. may occur.
- Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the driver heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged.
- During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a fault, injury, electric shock, etc.

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their mass.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the servo motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the driver. The driver may drop.
- Install the driver in a load-bearing place in accordance with the Instruction Manual.
- Do not climb or stand on servo equipment. Do not put heavy objects on equipment.
- The driver and servo motor must be installed in the specified direction.
- Leave specified clearances between driver and control enclosure walls or other equipment.
- Do not install or operate the driver and servo motor which has been damaged or has any parts missing.
- Do not block the intake and exhaust areas of the driver and servo motor which has a cooling fan. Doing so may cause faults.
- Do not drop or strike driver or servo motor. Isolate from all impact loads.
- Securely attach the servo motor to the machine. If attach insecurely, the servo motor may come off during operation.
- The servo motor with reduction gear must be installed in the specified direction to prevent oil leakage.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.

⚠ CAUTION

- When you keep or use it, please fulfill the following environmental conditions.

<table>
<tr><th colspan="3" rowspan="2">Item</th><th colspan="3">Environmental conditions</th></tr>
<tr><th colspan="2">Driver</th><th>Servo motor</th></tr>
<tr><td rowspan="4">Ambient temperature</td><td rowspan="2">In operation</td><td>[°C]</td><td colspan="2">0 to 55 (non-freezing)</td><td>0 to 40 (non-freezing)</td></tr>
<tr><td>[°F]</td><td colspan="2">32 to 131 (non-freezing)</td><td>32 to 104 (non-freezing)</td></tr>
<tr><td rowspan="2">In storage</td><td>[°C]</td><td colspan="2">−20 to 65 (non-freezing)</td><td>−15 to 70 (non-freezing)</td></tr>
<tr><td>[°F]</td><td colspan="2">−4 to 149 (non-freezing)</td><td>5 to 158 (non-freezing)</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td colspan="2">In operation</td><td colspan="2">90%RH or less (non-condensing)</td><td>80%RH or less (non-condensing)</td></tr>
<tr><td colspan="2">In storage</td><td colspan="3">90%RH or less (non-condensing)</td></tr>
<tr><td colspan="3">Ambience</td><td colspan="3">Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt</td></tr>
<tr><td colspan="3">Altitude</td><td colspan="3">Max. 1000m (3280 ft) above sea level</td></tr>
<tr><td>(Note) Vibration</td><td colspan="2">[m/s²]</td><td>5.9 or less at 10 to 55Hz (directions of X, Y and Z axes)</td><td>LECS□□-S5
LECS□□-S7
LECS□□-S8
series</td><td>X, Y: 49 m/s²</td></tr>
</table>

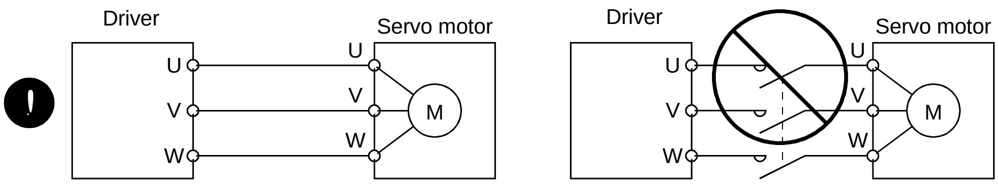
Note. Except the servo motor with reduction gear.

- When the equipment has been stored for an extended period of time, contact your local sales office.

(2) Wiring

⚠ CAUTION

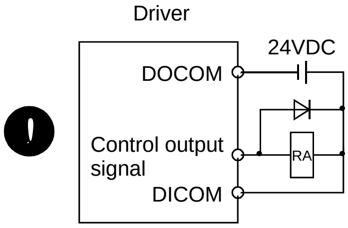
- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.
- Do not install a power capacitor, surge absorber or radio noise filter (FR-BIF-(H) : Mitsubishi Electric Corporation) between the servo motor and driver.
- Connect the wires to the correct phase terminals (U, V, W) of the driver and servo motor. Not doing so may cause unexpected operation.
- Connect the servo motor power terminal (U, V, W) to the servo motor power input terminal (U, V, W) directly. Do not let a magnetic contactor, etc. intervene.



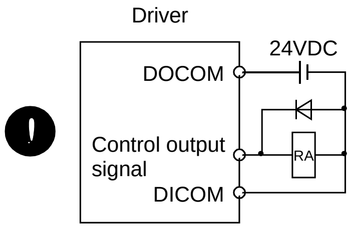
- Do not connect AC power directly to the servo motor. Otherwise, a fault may occur.

⚠ CAUTION

- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



For sink output interface



For source output interface

- When the cable is not tightened enough to the terminal block (connector), the cable or terminal block (connector) may generate heat because of the poor contact. Be sure to tighten the cable with specified torque.

(3) Test run adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- The parameter settings must not be changed excessively. Operation will be insatiable.

(4) Usage

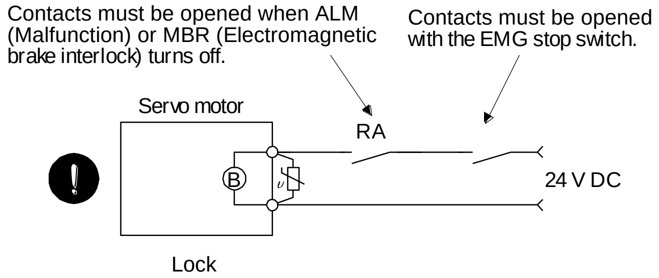
⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- Any person who is involved in disassembly and repair should be fully competent to do the work.
- Before resetting an alarm, make sure that the run signal of the driver is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.
- Do not modify the equipment.
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the driver.
- Burning or breaking a driver may cause a toxic gas. Do not burn or break a converter unit and driver.
- Use the driver with the specified servo motor.
- The lock on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ball screw and the servo motor are coupled via a timing belt), the lock may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may take place at the occur due to a power failure or a product fault, use a servo motor with a lock or an external lock mechanism for the purpose of prevention.
- Do not use the 24VDC interface for the lock. Always use the power supply designed exclusively for the lock. Otherwise, a fault may occur.
- Configure a lock circuit so that it is activated also by an external emergency stop switch.



- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.
- When power is restored after an instantaneous power failure, keep away from the machine because the machine may be restarted suddenly (design the machine so that it is secured against hazard if restarted).

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- With age, the electrolytic capacitor of the driver will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment. Please contact your local sales office.

(7) General instruction

- To illustrate details, the equipment in the diagrams of this Specifications and Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Specifications and Instruction Manual.

● DISPOSAL OF WASTE ●

Please dispose a driver battery (primary battery) and other options according to your local laws and regulations.

⚠ EEP-ROM life

The number of write times to the EEP-ROM, which stores parameter settings, etc., is limited to 100,000. If the total number of the following operations exceeds 100,000, the converter unit, driver and/or converter unit may fail when the EEP-ROM reaches the end of its useful life.

・Write to the EEP-ROM due to parameter setting changes
・Home position setting in the absolute position detection system
・Write to the EEP-ROM due to device changes

Precautions for Choosing the Products

SMC will not be held liable for damage caused by factors found not to be the cause of SMC; machine damage or lost profits caused by faults in the SMC products; damage, secondary damage, accident compensation caused by special factors unpredictable by SMC; damages to products other than SMC products; and to other duties.

COMPLIANCE WITH THE EUROPEAN EC DIRECTIVES

Refer to Appendix 9 for the compliance with EC Directives.

COMPLIANCE WITH UL/C-UL STANDARD

Refer to Appendix 10 for the compliance with UL/C-UL standard.

<<About the manuals>>

This Instruction Manual are required if you use the General-Purpose AC servo LECSB□-□ for the first time. Always purchase them and use the LECSB□-□ safely.

<<Wiring>>

Wires mentioned in this instruction manual are selected based on the ambient temperature of 40℃ (104℉).

CONTENTS

1. FUNCTIONS AND CONFIGURATION

1. FUNCTIONS AND CONFIGURATION

1.1 Summary

It has position control, speed control and torque control modes. Further, it can perform operation with the control modes changed, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
As this new series has the USB or RS-422 serial communication function, a set up software (MR Configurator2TM) installed personal computer or the like can be used to perform parameter setting, test operation, status display monitoring, gain adjustment, etc.
With real-time auto tuning, you can automatically adjust the servo gains according to the machine.
The LECSB□-□ series servo motor with an absolute position encoder which has the resolution of 262144 pulses/rev to ensure. Simply adding a battery to the driver makes up an absolute position detection system. This makes home position return unnecessary at power-on or alarm occurrence by setting a home position once.

(1) Position control mode

An up to 1Mpps high-speed pulse train is used to control the speed and direction of a motor and execute precision positioning of 262144 pulses/rev resolution.
The position smoothing function provides a choice of two different modes appropriate for a machine, so a smoother start/stop can be made in response to a sudden position command.
A torque limit is imposed on the driver by the clamp circuit to protect the power transistor in the main circuit from overcurrent due to sudden acceleration/deceleration or overload. This torque limit value can be changed to any value with an external analog input or the parameter.

(2) Speed control mode

An external analog speed command (0 to ±10VDC) or parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.
There are also the acceleration/deceleration time constant setting in response to speed command, the servo lock function at a stop time, and automatic offset adjustment function in response to external analog speed command.

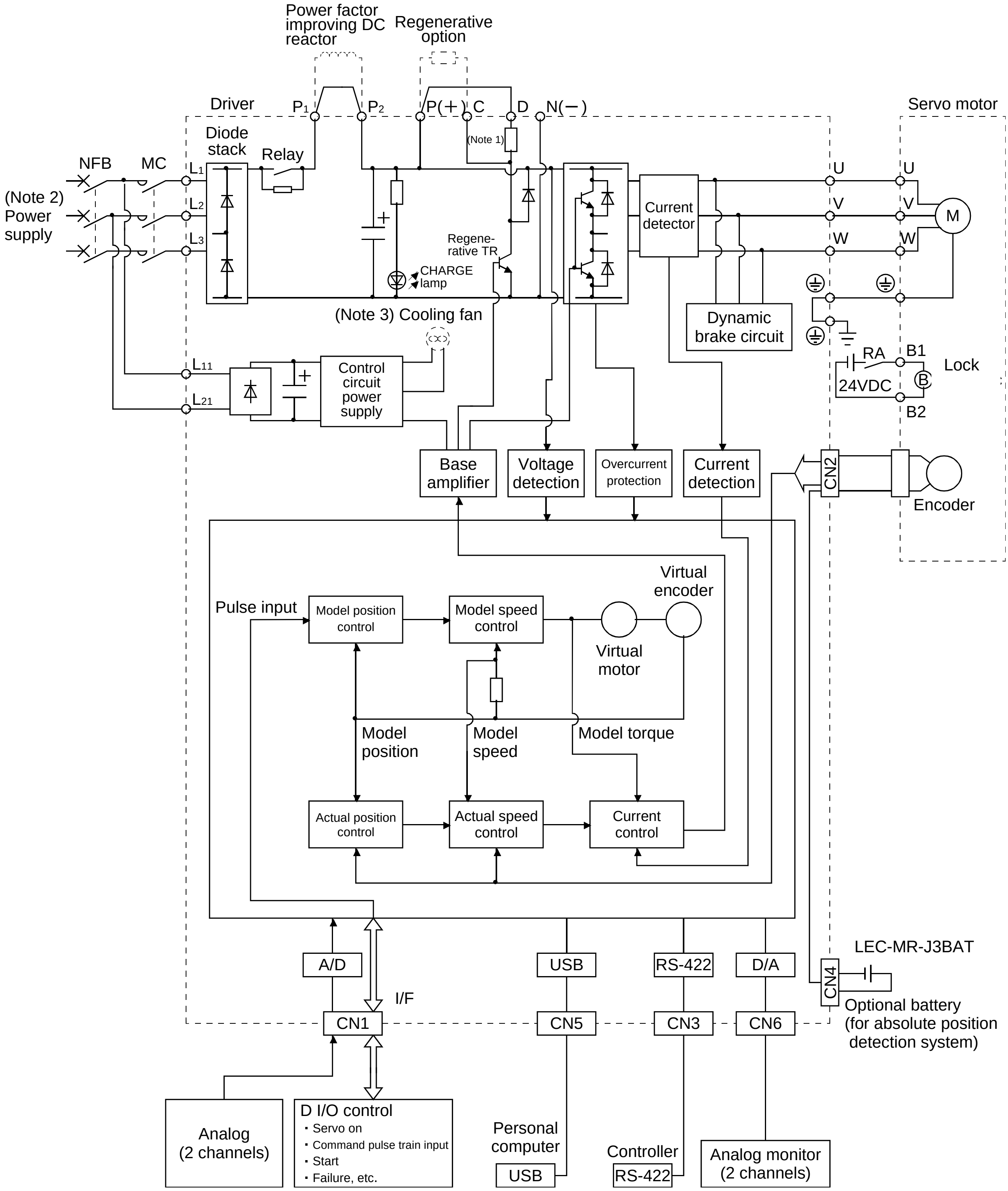
(3) Torque control mode

An external analog torque command (0 to ±8VDC) is used to control the torque output by the servo motor.
To prevent unexpected operation under no load, the speed limit function (external or internal setting) is also available for application to tension control, etc.

1.2 Function block diagram

The function block diagram of this servo is shown below.

(1) LECSB□-□



Note 1. The built-in regenerative resistor is not provided for the LECSB1-S5.

2. For 1-phase 200 to 230VAC, connect the power supply to L1, L2 and leave L3 open.

There is no L_3 for 1-phase 100 to 120VAC power supply. For the specification of power supply, refer to section 1.3.

1.3 Driver standard specifications

(1) 200V class

Item		Driver LECSB□-□	LECSB□-S5	LECSB□-S7	LECSB-□-S8
Output	Rated voltage		3-phase 170VAC		
Output	Rated current [A]		1.1	1.5	2.8
Main circuit power supply	Voltage, frequency		3-phase or 1-phase 200 to 230VAC, 50/60Hz		
Main circuit power supply	Rated current [A]		0.9	1.5	2.6
Main circuit power supply	Permissible voltage fluctuation		3-phase or 1-phase 170 to 253VAC		
Main circuit power supply	Permissible frequency fluctuation		Within ±5%		
Main circuit power supply	Power supply capacity		Refer to section 11.2		
Main circuit power supply	Inrush current		Refer to section 11.5		
Control circuit power supply	Voltage, frequency		1-phase 200 to 230VAC, 50/60Hz		
Control circuit power supply	Rated current [A]		0.2		
Control circuit power supply	Permissible voltage fluctuation		1-phase 170 to 253VAC		
Control circuit power supply	Permissible frequency fluctuation		Within ±5%		
Control circuit power supply	Power consumption [W]		30		
Control circuit power supply	Inrush current		Refer to section 11.5		
Interface power supply	Voltage		24VDC±10%		
Interface power supply	Power supply capacity		(Note 1) 0.3A		
Control System			Sine-wave PWM control, current control system		
Dynamic brake			Built-in		
Protective functions			Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection		
Position control mode	Max. input pulse frequency		1Mpps (for differential receiver), 200kpps (for open collector)		
Position control mode	Command pulse multiplying factor		Electronic gear A:1 to 1048576, B:1 to 1048576, 1/10 < A/B < 2000		
Position control mode	In-position range setting		0 to ±10000 pulse (command pulse unit)		
Position control mode	Error excessive		±3 revolutions		
Position control mode	Torque limit		Set by parameter setting or external analog input (0 to +10VDC/maximum torque)		
Speed control mode	Speed control range		Analog speed command 1: 2000, internal speed command 1: 5000		
Speed control mode	Analog speed command input		0 to ±10VDC / Rated speed		
Speed control mode	Speed fluctuation ratio		±0.01% or less (load fluctuation 0 to 100%) 0% (power fluctuation ±10%) ±0.2% or less (ambient temperature 25±10°C (59 to 95°F))		
Speed control mode	Torque limit		Set by parameter setting or external analog input (0 to +10VDC/maximum torque)		
Torque control mode	Analog torque command input		0 to ±8VDC / Maximum torque (input impedance 10 to 12kΩ)		
Torque control mode	Speed limit		Set by parameter setting or external analog input (0 to ±10VDC/Rated speed)		
Compliance to standards			CE (LVD: IEC/EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)		
Structure			Natural-cooling, open		
Environmental conditions	Ambient temperature	In operation [°C]	(Note 2) 0 to 55 (non-freezing)		
Environmental conditions	Ambient temperature	In operation [°F]	(Note 2) 32 to 131 (non-freezing)		
Environmental conditions	Ambient temperature	In storage [°C]	−20 to 65 (non-freezing)		
Environmental conditions	Ambient temperature	In storage [°F]	−4 to 149 (non-freezing)		
Environmental conditions	Ambient humidity	In operation In storage	90%RH or less (non-condensing)		
Environmental conditions	Ambient		Indoors (no direct sunlight), Free from corrosive gas, flammable gas, oil mist, dust and dirt		
Environmental conditions	Altitude		Max. 1000m above sea level		
Environmental conditions	Vibration		$5.9m/s^2$ or less at 10 to 55Hz (directions of X, Y and Z axes)		
Mass		[kg]	0.8	0.8	1.0
Mass		[lb]	1.76	1.76	2.21

Note 1. 0.3A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
2. When closely mounting the driver of 3.5kW or less, operate them at the ambient temperatures of 0 to 45°C or at 75% or smaller effective load ratio.
3. When a UL/C-UL-compliant servo motor is used in combination, the value is 2.9A.

1.4 Function list

The following table lists the functions of this servo. For details of the functions, refer to the reference field.

Function	Description	(Note) Control mode	Reference
Position control mode	This servo is used as position control servo.	P	Section 3.2.1 Section 3.6.1 Section 4.2
Speed control mode	This servo is used as speed control servo.	S	Section 3.2.2 Section 3.6.2 Section 4.3
Torque control mode	This servo is used as torque control servo.	T	Section 3.2.3 Section 3.6.3 Section 4.4
Position/speed control change mode	Using input device, control can be switched between position control and speed control.	P/S	Section 3.6.4
Speed/torque control change mode	Using input device, control can be switched between speed control and torque control.	S/T	Section 3.6.5
Torque/position control change mode	Using input device, control can be switched between torque control and position control.	T/P	Section 3.6.6
High-resolution encoder	High-resolution encoder of 262144 pulses/rev is used as a servo motor encoder.	P, S, T	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	P	Chapter 14
Gain changing function	You can switch between gains during rotation and gains during stop or use an input device to change gains during operation.	P, S	Section 8.6
Advanced vibration suppression control	This function suppresses vibration at the arm end or residual vibration.	P	Section 8.4
Adaptive filter Ⅱ	Driver detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	P, S, T	Section 8.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	P, S, T	Section 8.5
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting a personal computer installed Set up software(MR Configurator2™) with a driver. Set up software(MR Configurator2™) is necessary for this function.	P	
Machine simulation	Can simulate machine motions on a personal computer screen on the basis of the machine analyzer results. Set up software(MR Configurator2™) is necessary for this function.	P	
Gain search function	Personal computer changes gains automatically and searches for overshoot-free gains in a short time. Set up software(MR Configurator2™) is necessary for this function.	P	
Robust disturbance compensation	This function provides better disturbance response in case of low response level due to high load inertia moment ratio for the roll send axes. Set up software(MR Configurator2™) is necessary for this function.	P, S, T	
Advanced Gain search	Advanced Gain search automatically searches for the optimum parameter for settle time to be short. The gain can be adjusted by setting sequentially in accordance with wizard screens. Set up software(MR Configurator2™) is necessary for this function.	P	
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	P	Parameters No.PB24

Function	Description	(Note) Control mode	Reference
Electronic gear	Input pulses can be multiplied by 1/50 to 50.	P	Parameters No.PA06, PA07
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	P, S	Chapter 7
Position smoothing	Speed can be increased smoothly in response to input pulse.	P	Parameter No.PB03
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	S, T	Parameter No.PC03
Return converter	Used when the regenerative option cannot provide enough regenerative power.	P, S, T	Section 12.4
Alarm history clear	Alarm history is cleared.	P, S, T	Parameter No.PC18
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal.	S	Parameter No.PC22
Command pulse selection	Command pulse train form can be selected from among three different types.	P	Section 5.1.12
Input signal selection (Device settings)	Forward rotation start, reverse rotation start, servo-on (SON) and other input device can be assigned to certain pins of the CN1 connectors.	P, S, T	Parameters No.PD03 to PD08, PD10 to PD12
Output signal selection (Device settings)	Trouble (ALM), dynamic brake interlock (MBR) and other output device can be assigned to certain pins of the CN1 connectors.	P, S, T	Parameters No.PD13 to PD16, PD18
Torque limit	Servo motor torque can be limited to any value.	P, S	Section 3.6.1 (5) Section 5.1.11
Speed limit	Servo motor speed can be limited to any value.	T	Section 3.6.3 (3) Parameter No.PC05 to PC11
Status display	Servo status is shown on the 5-digit, 7-segment LED display	P, S, T	Section 6.3
External I/O signal display	ON/OFF statuses of external I/O signals are shown on the display.	P, S, T	Section 6.7
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	P, S, T	Section 6.8
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop at the analog speed command (VC) or analog speed limit (VLA) of 0V.	S, T	Section 6.4
Test operation mode	JOG operation, positioning operation, motor-less operation, DO forced output and program operation. However, Set up software(MR Configurator2™) is necessary for positioning operation and program operation.	P, S, T	Section 6.9
Analog monitor output	Servo status is output in terms of voltage in real time.	P, S, T	Parameter No.PC14
Set up software (MR Configurator2™)	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	P, S, T	Section 12.8
Alarm code output	If an alarm has occurred, the corresponding alarm number is output in 3-bit code.	P, S, T	Section 9.1

Note. P: Position control mode, S: Speed control mode, T: Torque control mode
P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

1.4.1 Applicable control mode for each actuator.
The following control mode can be selected for applicable actuators.
Please refer 「3. SIGNALS AND WIRING」 and「5. PARAMETERS」 about wiring and parameter setting.

Table. Applicable control mode.

(○ : Applicable, × : Inapplicable)

Driver type	Actuator type	Control mode Note 1) 2) (Selected by parameter number PA1.)		
		Position control	Speed control	Torque control
LECSB (Absolute)	LEY	○	○Note 2)	○Note2)
	LEF	○	×	×
	LEJ	○	×	×
Command method		[Pulse train]	[ON/OFF Signal]	[ON/OFF Signal]
Operation method		Positioning operation	Setting speed operation	Setting torque operation

Note 1. The control change mode cannot be used.
Note 2. Make the moving range limitation by external sensor etc to avoid actuator hitting to the work piece or stroke end.
When using the thrush control, the following parameter should be set.
If not, it will cause malfunction.
LECSB : The value of the parameter value [PC13] “Analog torque maximum output command” should be 30 (Maximum thrush of the product) or less. (LEY63 : 50% or less).

When the control equivalent to the pushing operation of the controller LECP series is performed, select the LECSS / LECSS-T driver and combine it with the Motion or Simple Motion (manufactured by Mitsubishi Electric Corporation) which has a pushing operation function.

1.5 Model code definition

(1) Model

LECS B 1 — S1

Driver Type

A	Pulse input type (Incremental encoder)
B	Pulse input type (Absolute encoder)

Power supply

1	AC100～120V 50,60Hz
2	AC200～230V 50,60Hz

Motor type

	Type	Capacity	Encoder
S1	AC Servo motor(S1,S2)	50,100W	Incremental
S3	AC Servo motor(S3)	200W	
S4	AC Servo motor(S4)	400W	
S5	AC Servo motor(S5,S6)	50,100W	Absolute
S7	AC Servo motor(S7)	100W	
S8	AC Servo motor(S8)	200W	

(2) Option Model

a) Motor cable / Lock cable / Encoder cable

LE — C S M — S 5 A

Motor Type

S	AC Servo motor

Cable Content

M	Motor cable
B	Lock cable
E	Encoder cable

Connector Direction

A	Axis side
B	Opposite axis side

Cable Length (L) [m]

2	2m
5	5m
A	10m

Cable Type

S	Standard cable
R	Robot cable

b) I/O Connector

LE-CSNB

Driver Type

B	LECSB

*LE-CSNB is 10150-3000PE(Connector)/10350-52F0-008（Shell kit）of Sumitomo 3M Limited or equivalent goods.
Applicable wire size: AWG24~30

c) Regenerative options

LEC-MR-RB-032

Regenerative option Type

032	Permissible regenerative power 30W
12	Permissible regenerative power 100W

*MR-RB□ of Mitsubishi Electric Corporation.

d) Setup software (MR Configurator2TM)

LEC-MRC2□

Languag

NIL	Japanese version
E	English version
C	Chinese version

* SW1DNC-MRC2-□ of Mitsubishi Electric Corporation.
Refer to the website of Mitsubishi Electric Corporation for the information of the operating environment and upgrading.
Prepare USB cable should be ordered separately.

e) USB cable(3m)

LEC-MR-J3USB

* MR-J3USBCBL3M of Mitsubishi Electric Corporation.

f) Battery

LEC-MR-J3BAT

* MR-J3BAT of Mitsubishi Electric Corporation.
Battery for replacement.
Absolute position data is maintained by installing the battery to the driver.

g） I/O Cable

LEC-CSNB-1

Cable length(L)[m]

1	1.5

Driver Type

B	LECSB

*LEC-CSNB-1(Connector/ Shell kit) is 10150-3000PE (Connector)/ 10350-52F0-008(Shell kit) of Sumitomo 3M Limited or equivalent goods.

Applicable wire size: AWG24

Wiring

LEC-CSNB-1: Pin no. 1 to 50

	Connector pin no.	Pair no. of wire	Insulation color	Dot mark	Dot color
A side	1	1	Orange	▬	Red
	2			▬	Black
	3	2	Light gray	▬	Red
	4			▬	Black
	5	3	White	▬	Red
	6			▬	Black
	7	4	Yellow	▬	Red
	8			▬	Black
	9	5	Pink	▬	Red
	10			▬	Black
	11	6	Orange	▬ ▬	Red
	12			▬ ▬	Black
	13	7	Light gray	▬ ▬	Red
	14			▬ ▬	Black
	15	8	White	▬ ▬	Red
	16			▬ ▬	Black
	17	9	Yellow	▬ ▬	Red
	18			▬ ▬	Black

	Connector pin no.	Pair no. of wire	Insulation color	Dot mark	Dot color
A side	19	10	Pink	▬ ▬	Red
	20			▬ ▬	Black
	21	11	Orange	▬ ▬ ▬	Red
	22			▬ ▬ ▬	Black
	23	12	Light gray	▬ ▬ ▬	Red
	24			▬ ▬ ▬	Black
	25	13	White	▬ ▬ ▬	Red
	26			▬ ▬ ▬	Black
	27	14	Yellow	▬ ▬ ▬	Red
	28			▬ ▬ ▬	Black
	29	15	Pink	▬ ▬ ▬	Red
	30			▬ ▬ ▬	Black
	31	16	Orange	▬ ▬ ▬ ▬	Red
	32			▬ ▬ ▬ ▬	Black
	33	17	Light gray	▬ ▬ ▬ ▬	Red
	34			▬ ▬ ▬ ▬	Black

	Connector pin no.	Pair no. of wire	Insulation color	Dot mark	Dot color
A side	35	18	White	▬ ▬ ▬ ▬	Red
	36			▬ ▬ ▬ ▬	Black
	37	19	Yellow	▬ ▬ ▬ ▬	Red
	38			▬ ▬ ▬ ▬	Black
	39	20	Pink	▬ ▬ ▬ ▬	Red
	40			▬ ▬ ▬ ▬	Black
	41	21	Orange	▬ ▬ ▬ ▬ ▬	Red
	42			▬ ▬ ▬ ▬ ▬	Black
	43	22	Light gray	▬ ▬ ▬ ▬ ▬	Red
	44			▬ ▬ ▬ ▬ ▬	Black
	45	23	White	▬ ▬ ▬ ▬ ▬	Red
	46			▬ ▬ ▬ ▬ ▬	Black
	47	24	Yellow	▬ ▬ ▬ ▬ ▬	Red
	48			▬ ▬ ▬ ▬ ▬	Black
	49	25	Pink	▬ ▬ ▬ ▬ ▬	Red
	50			▬ ▬ ▬ ▬ ▬	Black

1.6 Combination with servo motor

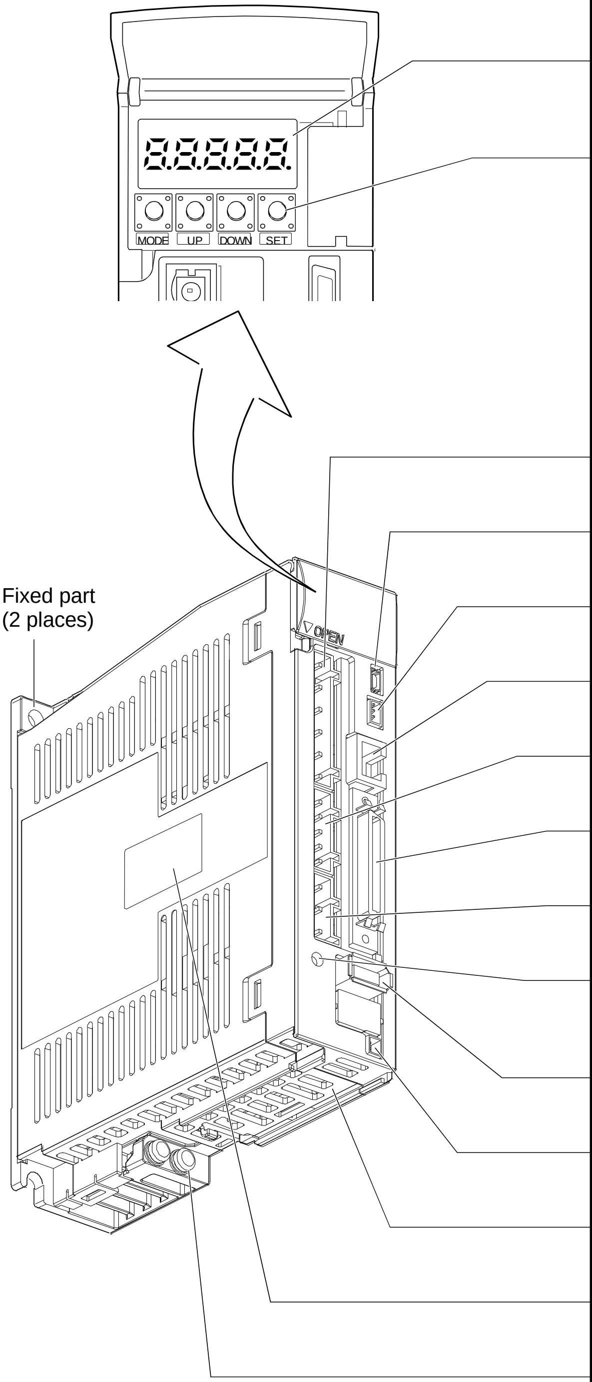
The following table lists combinations of driver and servo motors. The same combinations apply to the models with a lock and the models with a reduction gear.

Driver	Servo motors
	LE-□-□
LECSB□-S5	S5,S6
LECSB□-S7	S7
LECSB□-S8	S8

1.7 Structure

1.7.1 Parts identification

(1) LECSB□-□



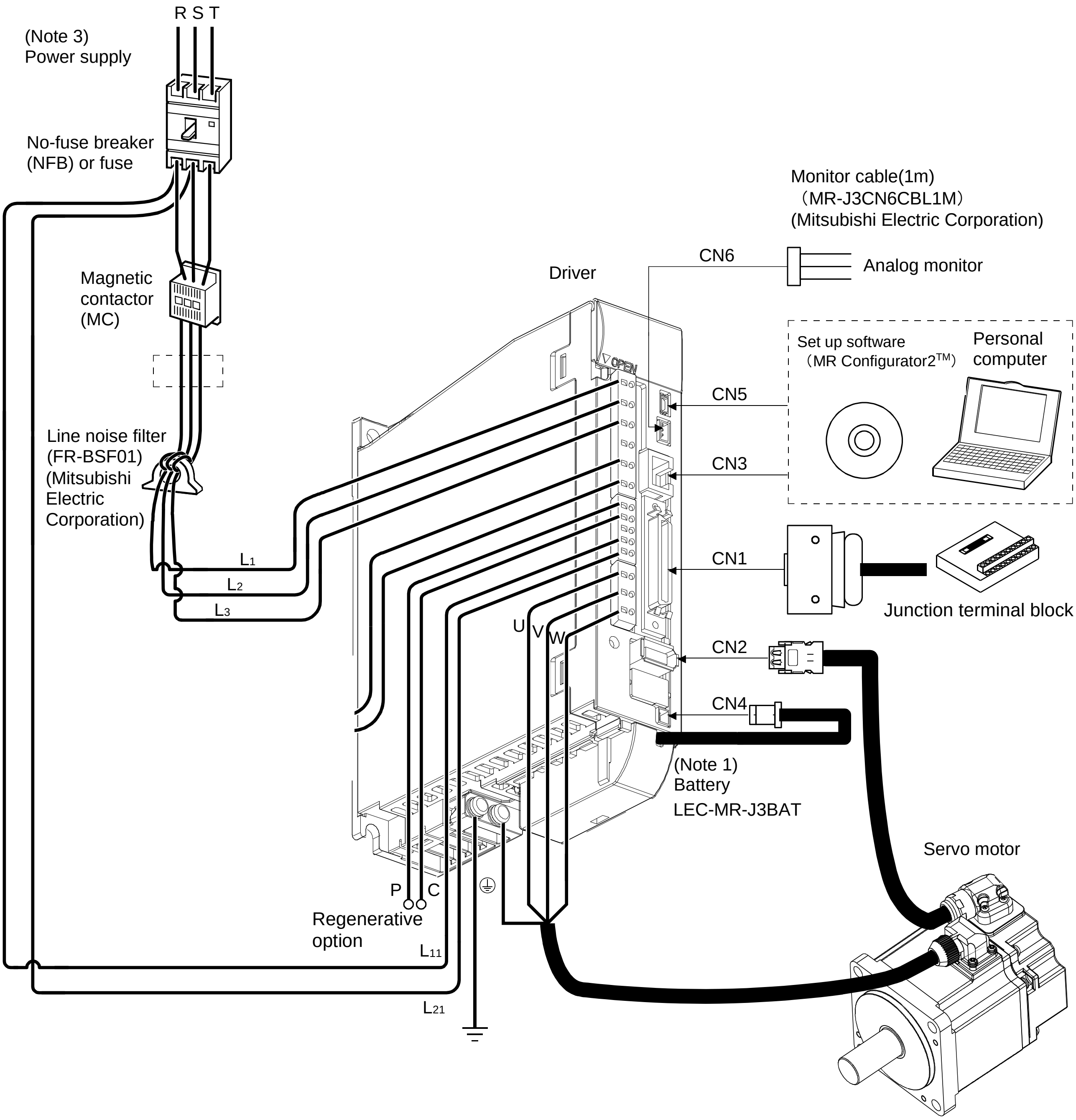
Name/Application	Detailed explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE UP DOWN SET SET: Used to set data. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode.	Chapter 6
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect the personal computer.	Section 12.8 Chapter 13
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Battery holder Contains the battery for absolute position data backup.	Section 14.3
Rating plate	Section 1.5
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3

1.8 Configuration including auxiliary equipment

POINT
・Equipment other than the driver and servo motor are optional or recommended products.

(1) LECSB□-□

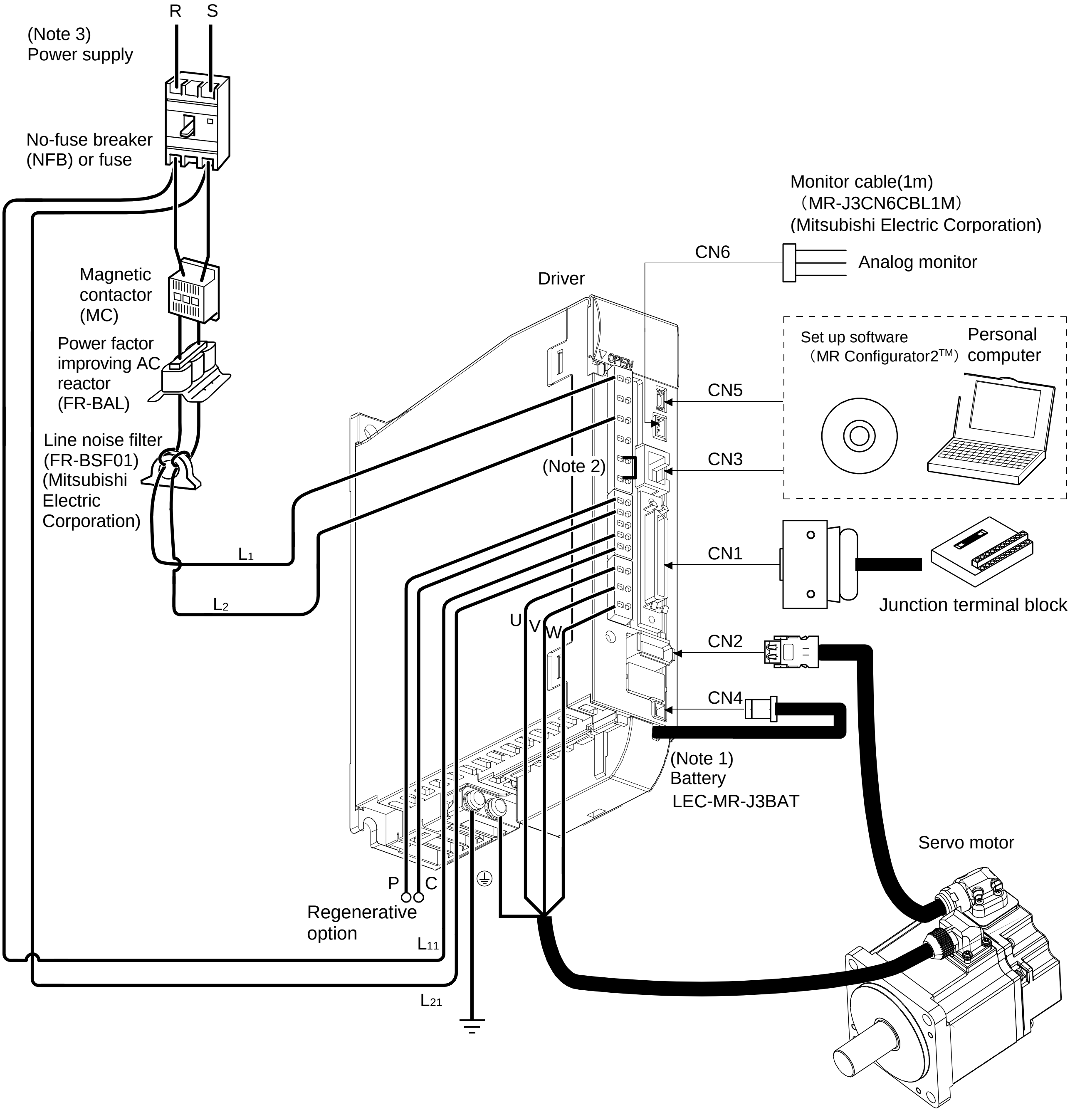
(a) For 3-phase or 1-phase 200 to 230VAC



Note 1. The battery is used for the absolute position detection system in the position control mode.

3.For 1-phase 200 to 230VAC, connect the power supply to L_1 ・ L_2 and leave L_3 open. Refer to section 1.3 for the power supply specification.

(b) For 1-phase 100 to 120VAC



Note 1. The battery is used for the absolute position detection system in the position control mode.
2. The power factor improving DC reactor cannot be used.
3. Refer to section 1.3 for the power supply specification.

2. INSTALLATION

2. INSTALLATION

WARNING	・To prevent electric shock, ground each equipment securely.

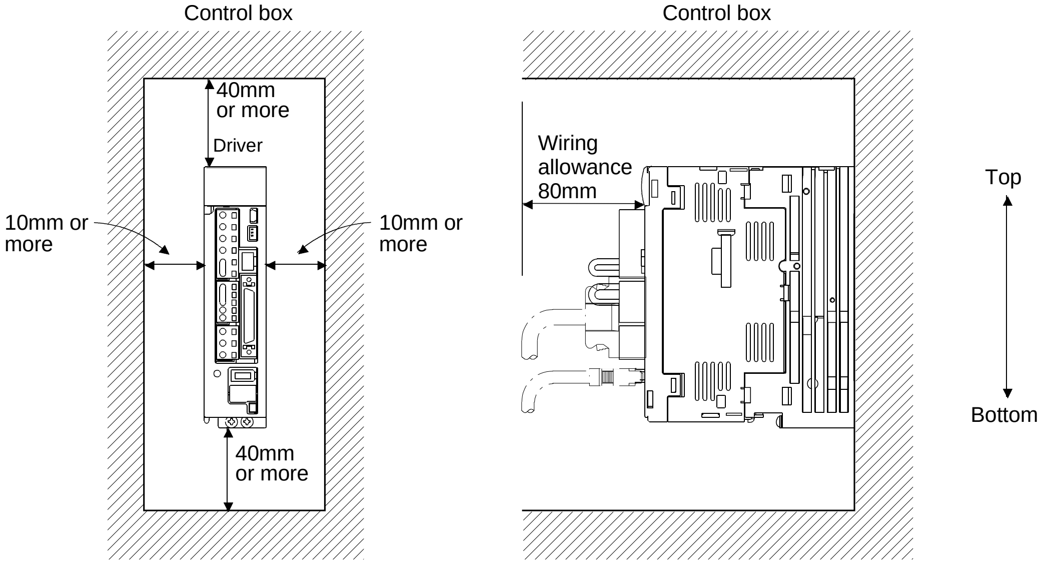
CAUTION	
	・Stacking in excess of the limited number of product packages is not allowed. ・Install the equipment to incombustibles. Installing them directly or close to combustibles will led to a fire. ・Install the equipment in a load-bearing place in accordance with this Instruction Manual. ・Do not get on or put heavy load on the equipment to prevent injury. ・Use the equipment within the specified environmental condition range. (For details of the environmental condition, refer to section 1.3.) ・Provide an adequate protection to prevent screws, metallic detritus and other conductive matter or oil and other combustible matter from entering the driver. ・Do not block the intake and exhaust areas of the driver and servo motor which has a cooling fan. Doing so may cause faults. ・Do not subject the driver to drop impact or shock loads as they are precision equipment. ・Do not install or operate a faulty driver. ・When the product has been stored for an extended period of time, contact your local sales office. ・When handling the driver, be careful about the edged parts such as the corners of the each unit. ・The driver must be installed in the metal cabinet (control box).

2.1 Installation direction and clearances

⚠ CAUTION	・The equipment must be installed in the specified direction. Otherwise, a fault may occur. ・Leave specified clearances between the driver and control box inside walls or other equipment.

(1) LECSB□-□

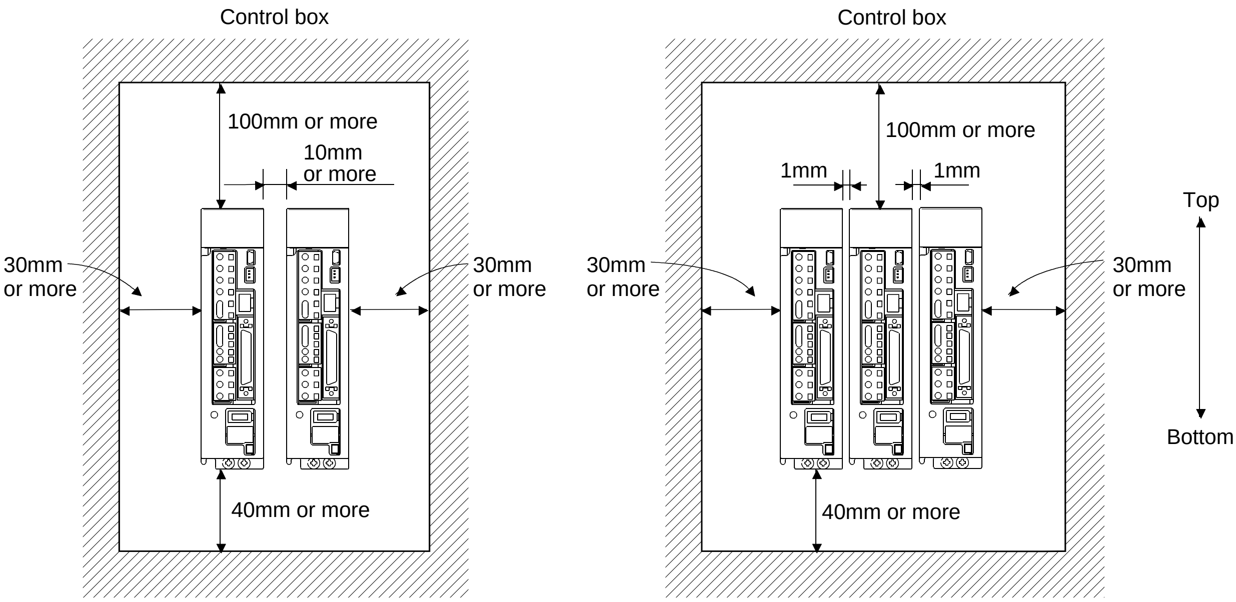
(a) Installation of one driver



(b) Installation of two or more drivers

POINT
・Close mounting is available for the driver of under 3.5kW for 200V class and 400W for 100V class.

Leave a large clearance between the top of the driver and the internal surface of the control box, and install a cooling fan to prevent the internal temperature of the control box from exceeding the environmental conditions.
When installing the drivers closely, leave a clearance of 1mm between the adjacent drivers in consideration of mounting tolerances.
In this case, make circumference temperature into 0 to 45℃, or use it at 75**%** or a smaller effective load ratio.



Leaving clearance　　Mounting closely

(2) Others
When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the driver is not affected.
Install the driver on a perpendicular wall in the correct vertical direction.

2.2 Keep out foreign materials
(1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the driver.

(2) Prevent oil, water, metallic dust, etc. from entering the driver through openings in the control box or a cooling fan installed on the ceiling.

(3) When installing the control box in a place where there are much toxic gas, dirt and dust, conduct an air purge (force clean air into the control box from outside to make the internal pressure higher than the external pressure) to prevent such materials from entering the control box.

2.3 Cable stress

(1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.

(2) For use in any application where the servo motor moves, fix the cables (encoder, power supply, brake) with having some slack from the connector connection part of the servo motor to avoid putting stress on the connector connection part. Use the optional encoder cable within the flexing life range. Use the power supply and brake wiring cables within the flexing life of the cables.

(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.

(4) For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to section 11.4 for the flexing life.

(5) The minimum bending radius : Min. 45mm.

2.4 Inspection items

⚠WARNING	・Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or longer until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the driver whether the charge lamp is off or not. ・Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock.

POINT

・Do not test the driver with a megger (measure insulation resistance), or it may become faulty.

・Do not disassemble and/or repair the equipment on customer side.

It is recommended to make the following checks periodically.

(1) Check for loose terminal block screws. Retighten any loose screws.

(2) Check the cables and the wires for scratches and cracks. Perform periodic inspection according to operating conditions.

2.5 Parts having service lives

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions.

Part name		Life guideline
Driver	Smoothing capacitor	10 years
	Relay	Number of power-on and number of emergency stop times : 100,000 times
	Cooling fan	10,000 to 30,000hours (2 to 3 years)
	Absolute position battery	Refer to section 14.2

(1) Smoothing capacitor

Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment (40℃ (104℉) surrounding air temperature or less).

(2) Relays

Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life when the cumulative number of power-on and emergency stop times is 100,000, which depends on the power supply capacity.

(3) Driver cooling fan

The cooling fan bearings reach the end of their life in 10,000 to 30,000 hours. Normally, therefore, the cooling fan must be changed in a few years of continuous operation as a guideline.
It must also be changed if unusual noise or vibration is found during inspection.

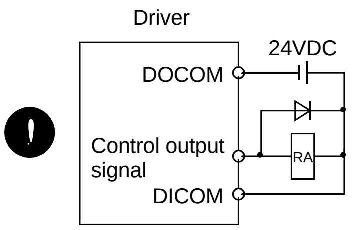
3. SIGNALS AND WIRING

3. SIGNALS AND WIRING

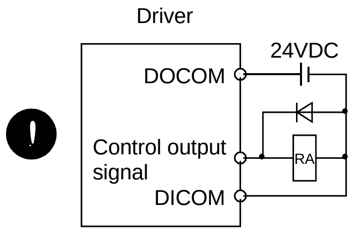
⚠WARNING	・Any person who is involved in wiring should be fully competent to do the work. ・Before wiring, turn off the power and wait for 15 minutes or longer until the charge lamp turns off. Then, confirm that the voltage between P(+) and N(−) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the driver whether the charge lamp is off or not. ・Ground the driver and the servo motor securely. ・Do not attempt to wire the driver and servo motor until they have been installed. Otherwise, you may get an electric shock. ・The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, you may get an electric shock.

⚠CAUTION

・Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpected resulting in injury.
・Connect cables to correct terminals to prevent a burst, fault, etc.
・Ensure that polarity (+, −) is correct. Otherwise, a burst, damage, etc. may occur.
・The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



For sink output interface



For source output interface

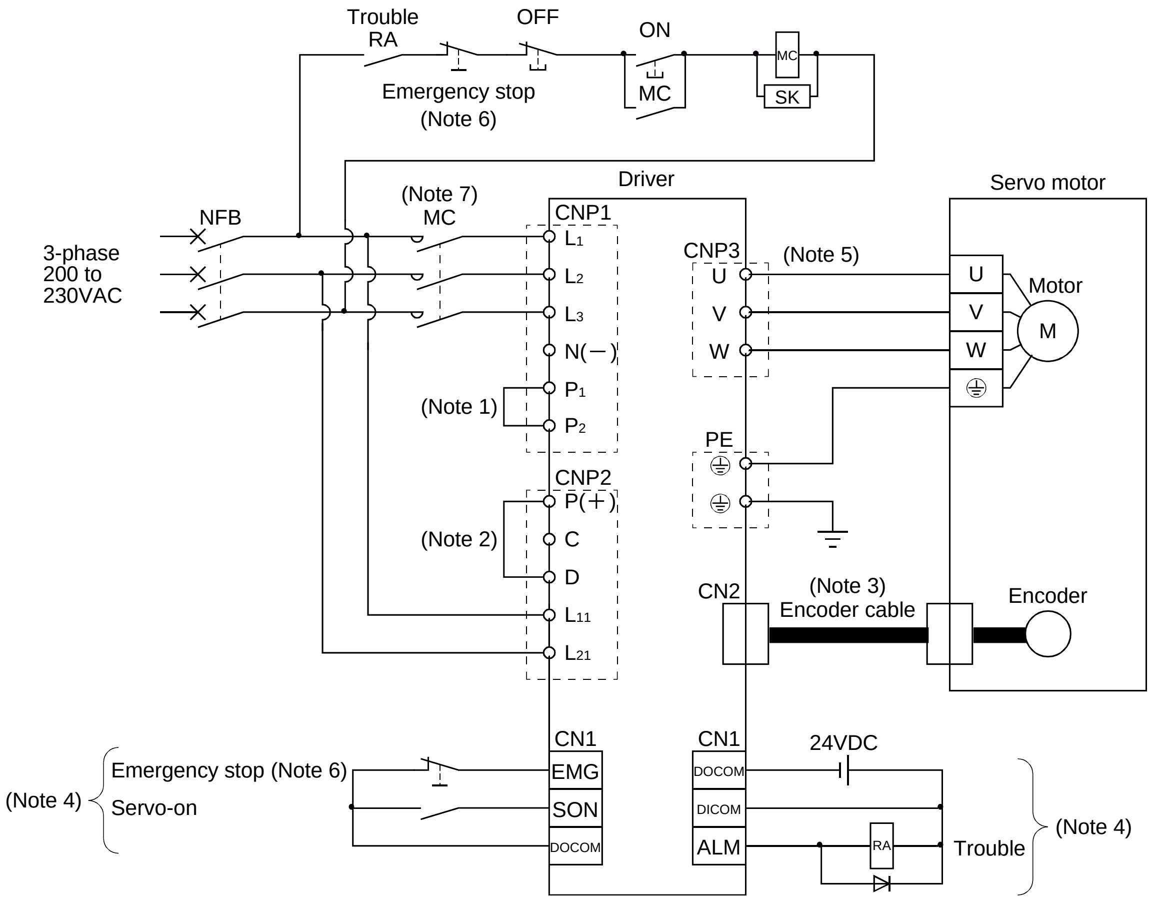
・Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the driver.
・Do not install a power capacitor, surge killer or radio noise filter (FR-BIF-(H) : Mitsubishi Electric Corporation) with the power line of the servo motor.
・When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative resistor, causing a fire.
・Do not modify the equipment.
・During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

3.1 Input power supply circuit

⚠CAUTION	・Always connect a magnetic contactor between the main circuit power and L_1, L_2, and L_3 of the driver, and configure the wiring to be able to shut down the power supply on the side of the driver's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the driver malfunctions. ・Use the trouble (ALM) to switch power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire. ・Check the model and input the correct voltage for the power supply of the driver. When a voltage, which exceeds the maximum input voltage of the driver specifications, is input, the driver malfunctions.

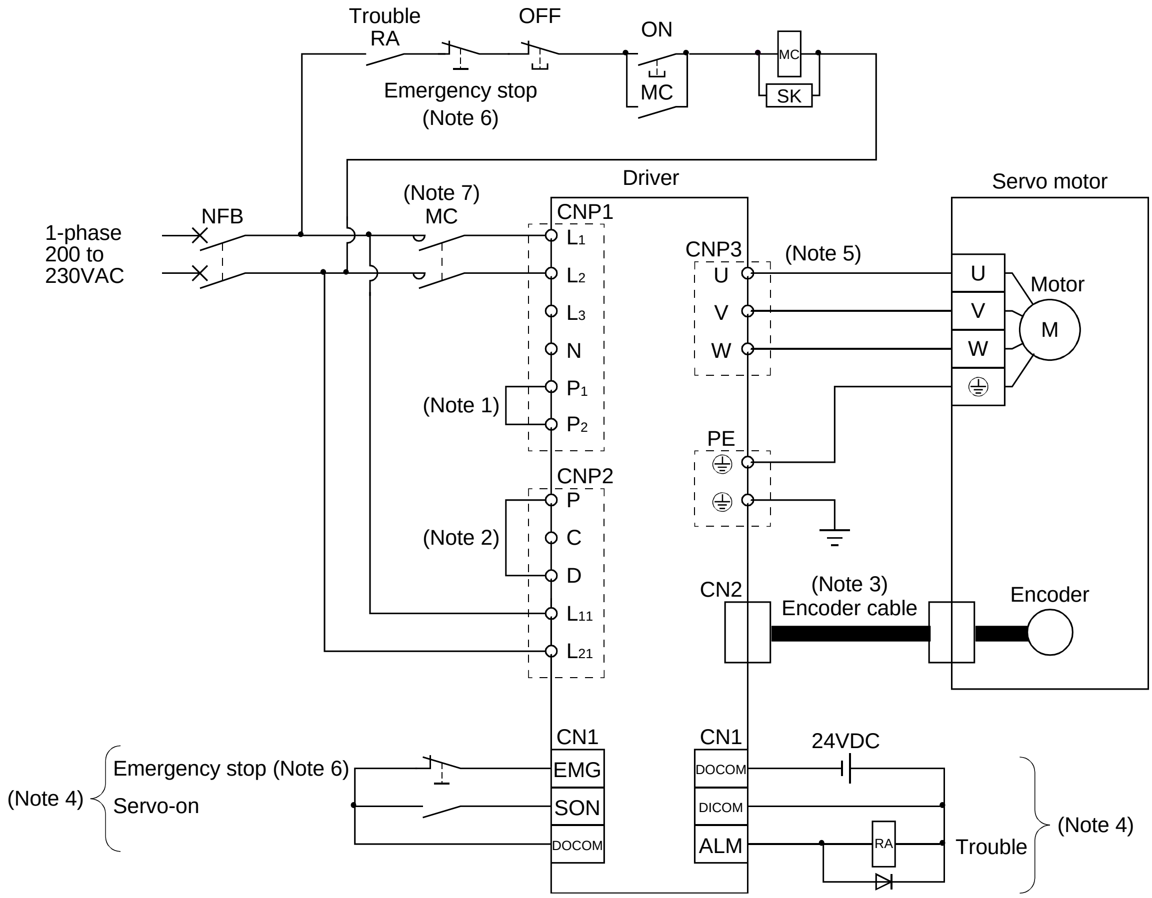
Wire the power supply and main circuit as shown below so that the servo-on (SON) turns off as soon as alarm occurrence is detected and power is shut off.
A no-fuse breaker (NFB) must be used with the input cables of the power supply.

(1) For 3-phase 200 to 230VAC power supply to LECSB□-□



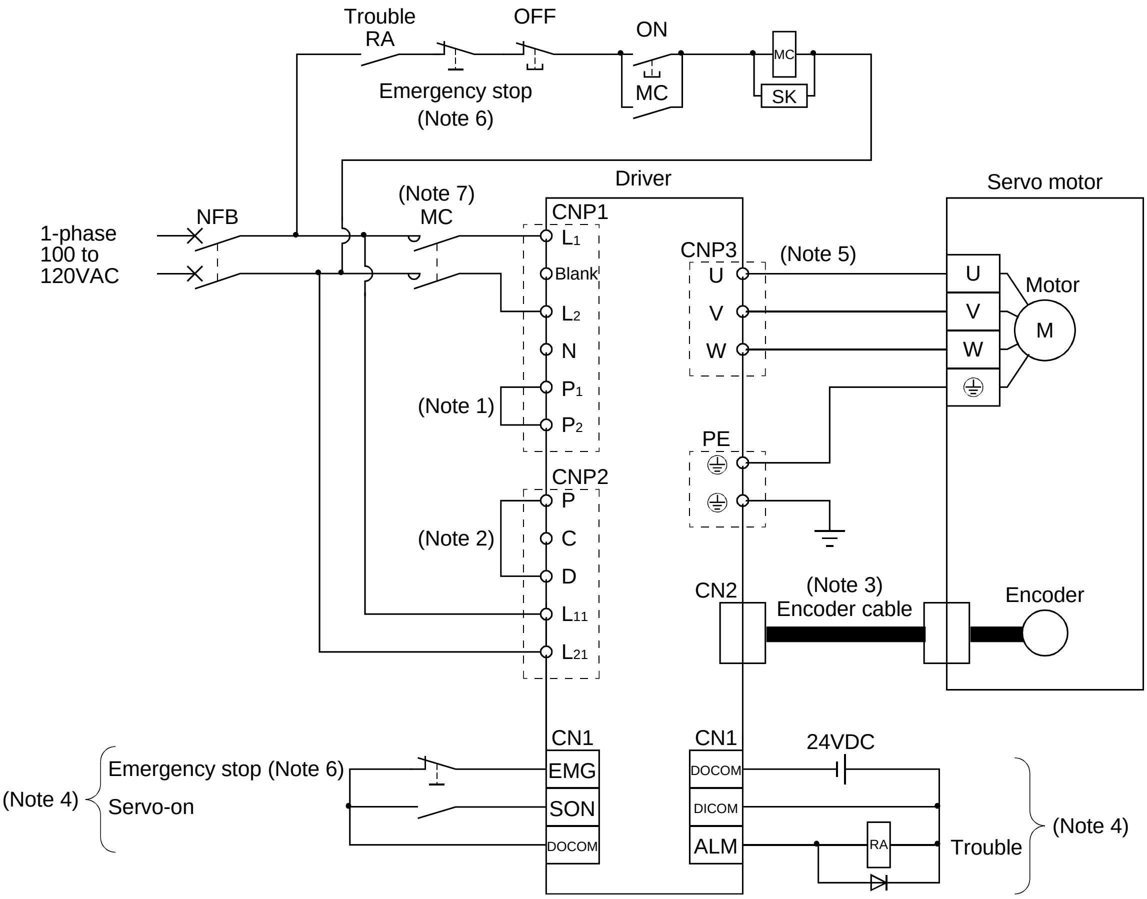
Note 1. Always connect P_1 and P_2. (Factory-wired.)
2. Always connect P(+) and D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface.
For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.
6. Configure the circuit to shut down the main circuit power supply simultaneously with the turn off of emergency stop (EMG) using the external sequence.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

(2) For 1-phase 200 to 230VAC power supply to LECSB□-□



Note 1. Always connect P_1 and P_2. (Factory-wired.)
2. Always connect P and D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.
6. Configure the circuit to shut down the main circuit power supply simultaneously with the turn off of emergency stop (EMG) using the external sequence.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

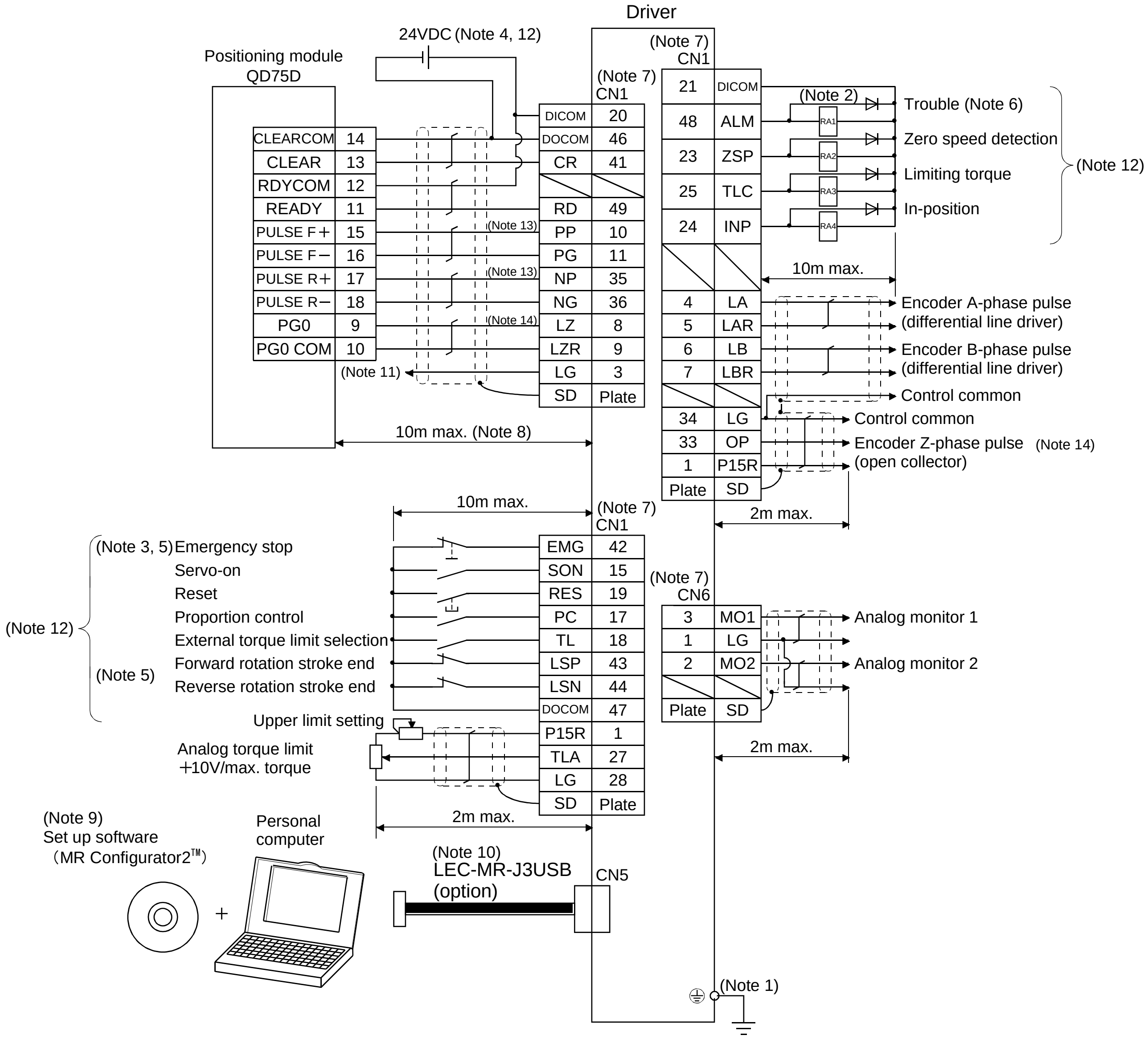
(3) For 1-phase 100 to 120VAC power supply to LECSB□-□



Note 1. Always connect P_1 and P_2. (Factory-wired.) The power factor improving DC reactor cannot be used.
2. Always connect P and D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.
6. Configure the circuit to shut down the main circuit power supply simultaneously with the turn off of emergency stop (EMG) using the external sequence.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

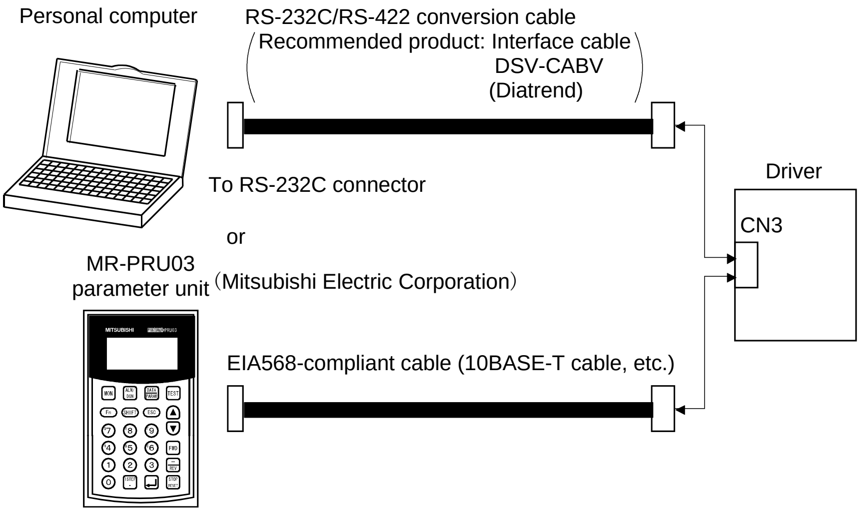
3.2 I/O signal connection example

3.2.1 Position control mode



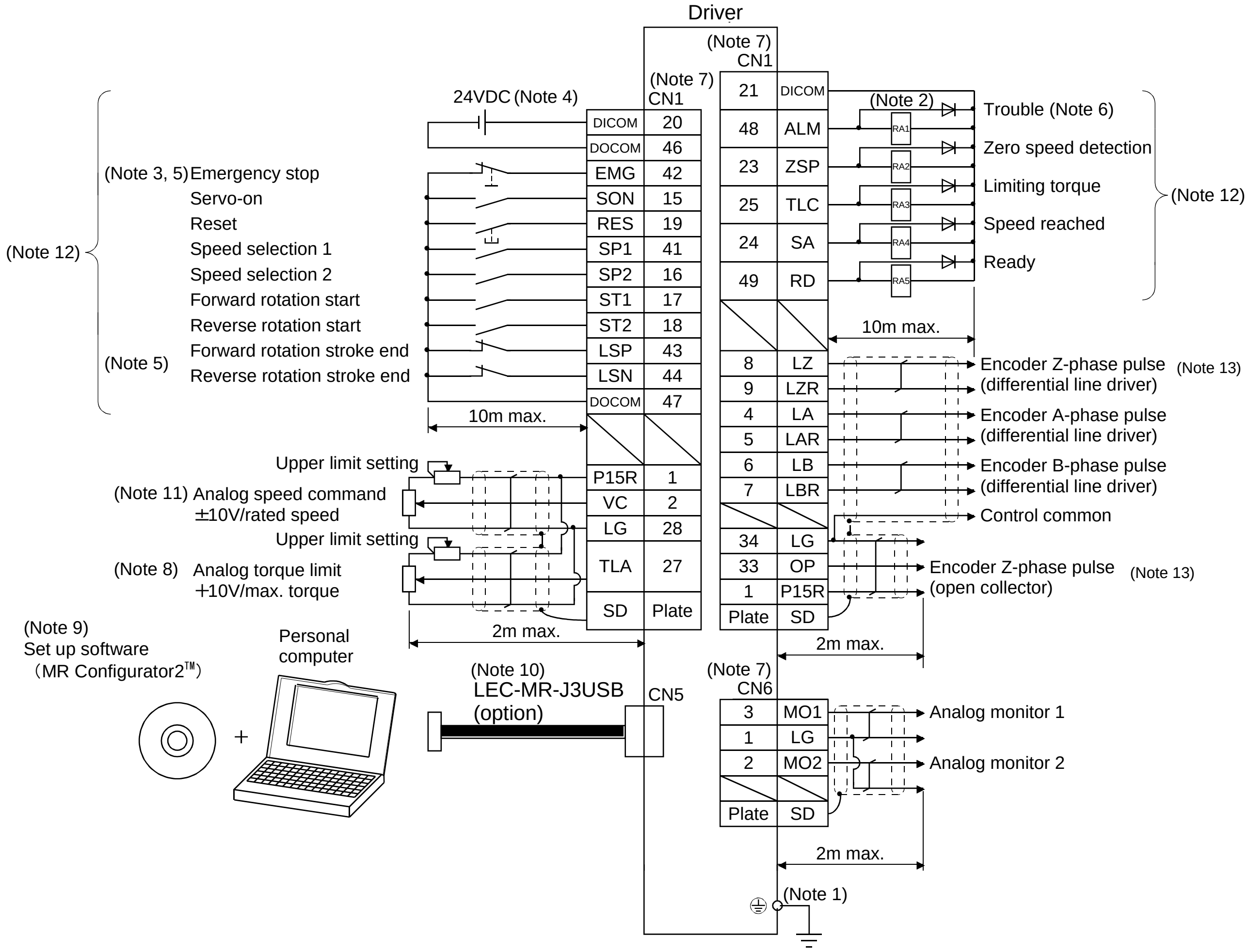
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the driver to the protective earth (PE) of the control box.

2. Connect the diode in the correct direction. If it is connected reversely, the driver will be faulty and will not output signals, disabling the emergency stop (EMG) and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. When starting operation, always turn on emergency stop (EMG) and Forward/Reverse rotation stroke end (LSP/LSN). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the PC or PLC…etc should be stopped by the sequence program.
7. The pins with the same signal name are connected in the driver.
8. This length applies to the command pulse train input in the differential line driver system. It is 2m or less in the open collector system.
9. Use LEC-MRC2E.
10. Personal computers or parameter units can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.

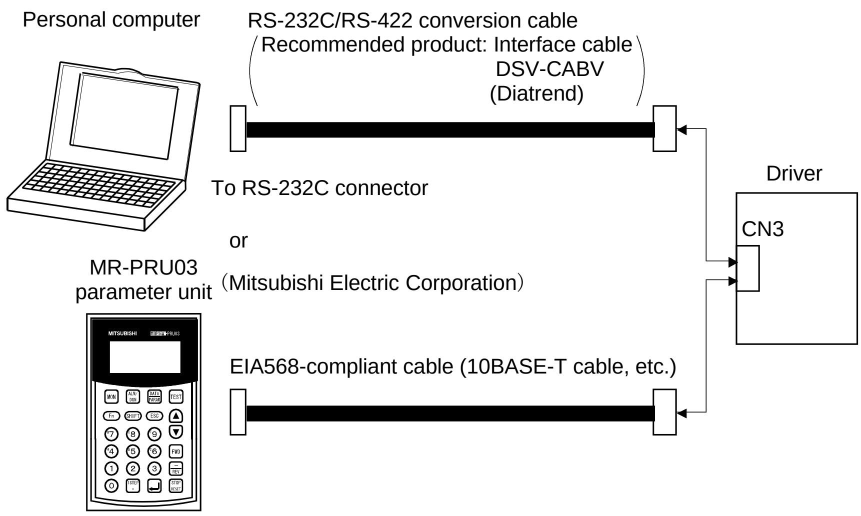


11. This connection is not required for the QD75D. Depending on the used positioning module, however, it is recommended to connect the LG and control common terminals of the driver to enhance noise immunity.
12. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
13. If the command pulse train input is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.
14. Encoder Z-phase pulse will correspond to the differential line driver system and the open collector system. If the encoder Z-phase pulse is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.

3.2.2 Speed control mode

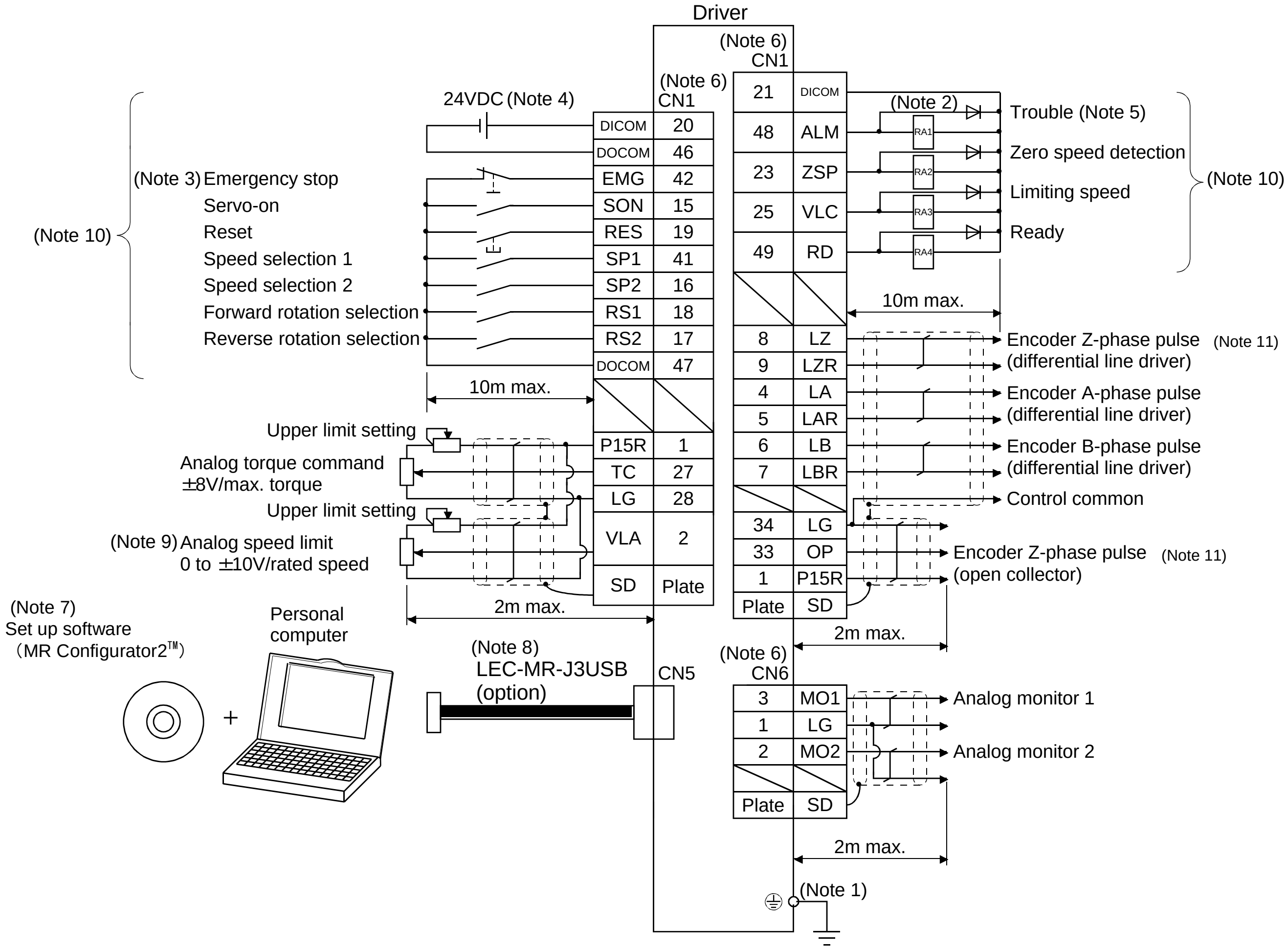


Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the driver to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will be faulty and will not output signals, disabling the emergency stop (EMG) and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. When starting operation, always turn on emergency stop (EMG) and forward/reverse rotation stroke end (LSP/LSN). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition.
7. The pins with the same signal name are connected in the driver.
8. By setting parameters No.PD03 to PD08, PD09 to PD12 to make external torque limit selection (TL) available, TLA can be used.
9. Use LEC-MRC2E.
10. Personal computers or parameter units can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



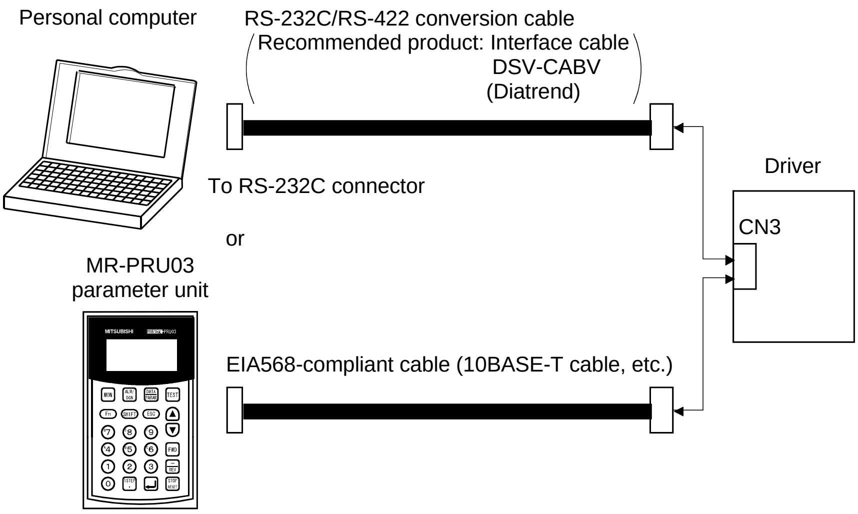
11. Use an external power supply when inputting a negative voltage.
12. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
13. Encoder Z-phase pulse will correspond to the differential line driver system and the open collector system.
If the encoder Z-phase pulse is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.

3.2.3 Torque control mode



Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the (terminal marked ⏚) driver to the protective earth (PE) of the control box.

2. Connect the diode in the correct direction. If it is connected reversely, the driver will be faulty and will not output signals, disabling the emergency stop (EMG) and other protective circuits.
3. The emergency stop switch(normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. Trouble (ALM) turns on in normal alarm-free condition.
6. The pins with the same signal name are connected in the driver.
7. Use LEC-MRC2E.
8. Personal computers or parameter units can also be connected via the CN3 connector, enabling RS-422 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



9. Use an external power supply when inputting a negative voltage.
10. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
11. Encoder Z-phase pulse will correspond to the differential line driver system and the open collector system.
    If the encoder Z-phase pulse is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.

3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT

- For the layout of connector and terminal block, refer to outline drawings in chapter 10.

<table>
<tr><th>Abbreviation</th><th>Connection target (application)</th><th>Description</th></tr>
<tr><td>L_1
L_2
L_3</td><td>Main circuit power supply</td><td>Supply the following power to L_1, L_2, L_3. For the 1-phase 200 to 230VAC power supply, connect the power supply to L_1, L_2, and keep L_3 open.
<table>
<tr><th>Power supply \ Driver</th><th>LECSB2-S5
LECSB2-S7
LECSB2-S8</th><th>LECSB1-S5
LECSB1-S7
LECSB1-S8</th></tr>
<tr><td>3-phase 200 to 230VAC, 50/60Hz</td><td>$L_1 \cdot L_2 \cdot L_3$</td><td></td></tr>
<tr><td>1-phase 200 to 230VAC, 50/60Hz</td><td>$L_1 \cdot L_2$</td><td></td></tr>
<tr><td>1-phase 100 to 120VAC, 50/60Hz</td><td></td><td>$L_1 \cdot L_2$</td></tr>
</table></td></tr>
<tr><td>P_1
P_2</td><td>Power factor improving DC reactor</td><td>When not using the power factor improving DC reactor, connect P_1 and P_2. (Factory-wired.)
When using the power factor improving DC reactor, disconnect P_1 and P_2, and connect the power factor improving DC reactor to P_1 and P_2.
Refer to section 12.13.</td></tr>
<tr><td>P
C
D</td><td>Regenerative option</td><td>When using driver built-in regenerative resistor, connect P(+) and D. (Factory-wired)
When using regenerative option, disconnect P(+) and D, and connect regenerative option to P and C.
Refer to section 12.2 to 12.5.</td></tr>
<tr><td>L_{11}
L_{21}</td><td>Control circuit power supply</td><td>Supply the following power to $L_{11} \cdot L_{21}$.
<table>
<tr><th>Power supply \ Driver</th><th>LECSB2-S5
LECSB2-S7
LECSB2-S8</th><th>LECSB1-S5
LECSB1-S7
LECSB1-S8</th></tr>
<tr><td>1-phase 200 to 230VAC, 50/60Hz</td><td>$L_{11} \cdot L_{21}$</td><td></td></tr>
<tr><td>1-phase 100 to 120VAC, 50/60Hz</td><td></td><td>$L_{11} \cdot L_{21}$</td></tr>
</table></td></tr>
</table>

Abbreviation	Connection target (application)	Description
U V W	Servo motor power	Connect to the servo motor power supply terminals (U, V, W). During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.
N	Return converter Brake unit	Do not connect to driver. For details, refer to section 12.3 to 12.5.
⏚	Protective earth (PE)	Connect to the earth terminal of the servo motor and to the protective earth (PE) of the control box to perform grounding.

3.3.2 Power-on sequence

(1) Power-on procedure

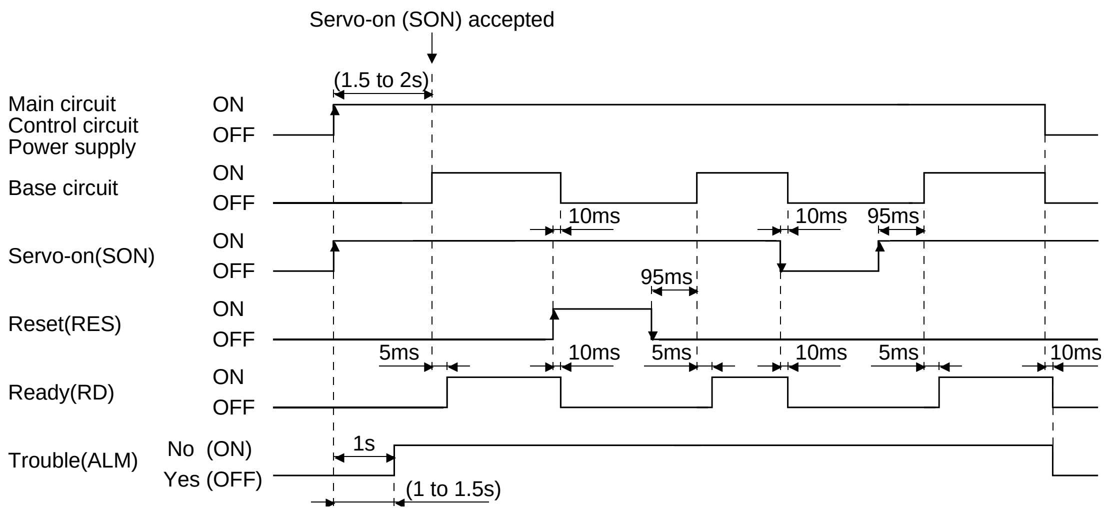
1) Always wire the power supply as shown in above section 3.1 using the magnetic contactor with the main circuit power supply (3-phase: L_1, L_2, L_3, 1-phase: L_1, L_2). Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply L_{11}, L_{21} simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the driver will operate properly.

3) The driver can accept the servo-on (SON) about 1 to 2s after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the main circuit power supply, the base circuit will switch on in about 1 to 2s, and the ready (RD) will switch on in further about 5ms, making the driver ready to operate. (Refer to paragraph (2) of this section.)

4) When the reset (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart

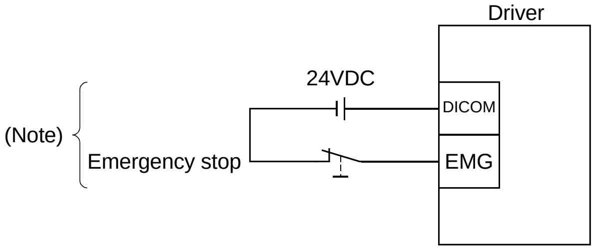


Power-on timing chart

(3) Emergency stop

CAUTION	· Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.

Make up a circuit that shuts off main circuit power as soon as EMG is turned off at an emergency stop. When EMG is turned off, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (AL.E6).
During ordinary operation, do not use the external emergency stop (EMG) to alternate stop and run.
The driver life may be shortened.
Also, if the forward rotation start (ST1) and reverse rotation start (ST2) are on or a pulse train is input during an emergency stop, the servo motor will rotate as soon as the warning is reset. During an emergency stop, always shut off the run command.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

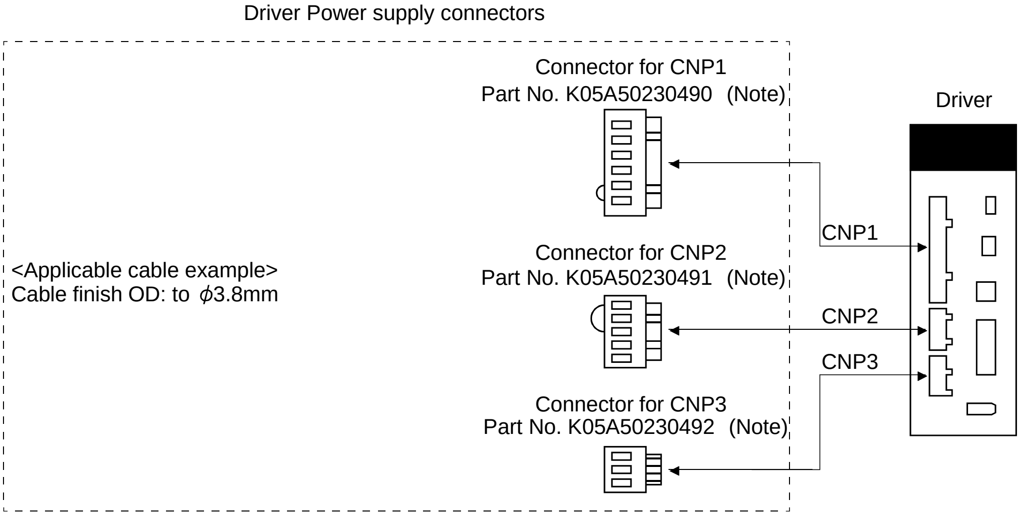
3.3.3 CNP1, CNP2, CNP3 wiring method

POINT
・Refer to section 12.11 for the wire sizes used for wiring.

Use the supplied driver power supply connectors for wiring of CNP1, CNP2 and CNP3.

(1) LECSB□-□

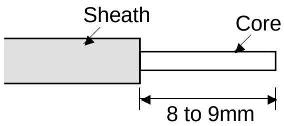
(a) Driver power supply connectors



Note. MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD
Please purchase from distributor or distributor of Mitsubishi Electric Corporation.

(b) Termination of the cables

Solid wire: After the sheath has been stripped, the cable can be used as it is.



Twisted wire: Use the cable after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a ferrule may be used to put the wires together.

Cable size		Ferrule type (Note 1)		Crimping tool (Note 2)
[mm^2]	AWG	For 1 cable	For 2 cable	
1.25/1.5	16	AI 1,5-10 BK	AI-TWIN2×1,5-10 BK	Variocrimp 4 206-204
2/2.5	14	AI 2,5-10 BU		

Note 1. Manufacturer: Phoenix Contact
2. Manufacturer: WAGO

(2) Insertion of cable into connectors

Insertion of cable into connectors are as follows.

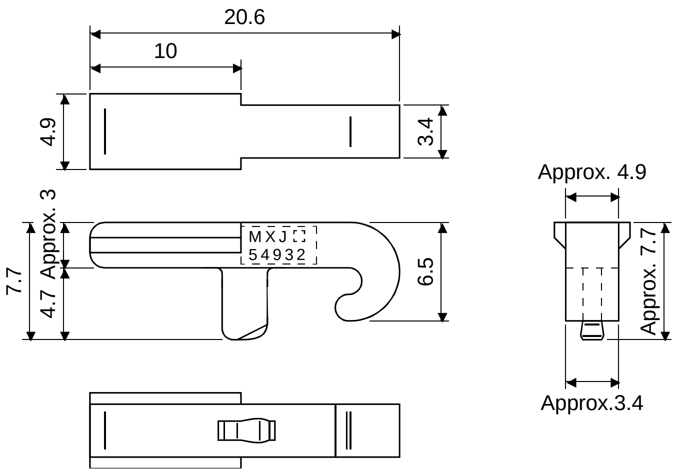
POINT
・It may be difficult for a cable to be inserted to the connector depending on wire size or ferrule configuration. In this case, change the wire type or correct it in order to prevent the end of ferrule from widening, and then insert it.

How to connect a cable to the driver power supply connector is shown below.

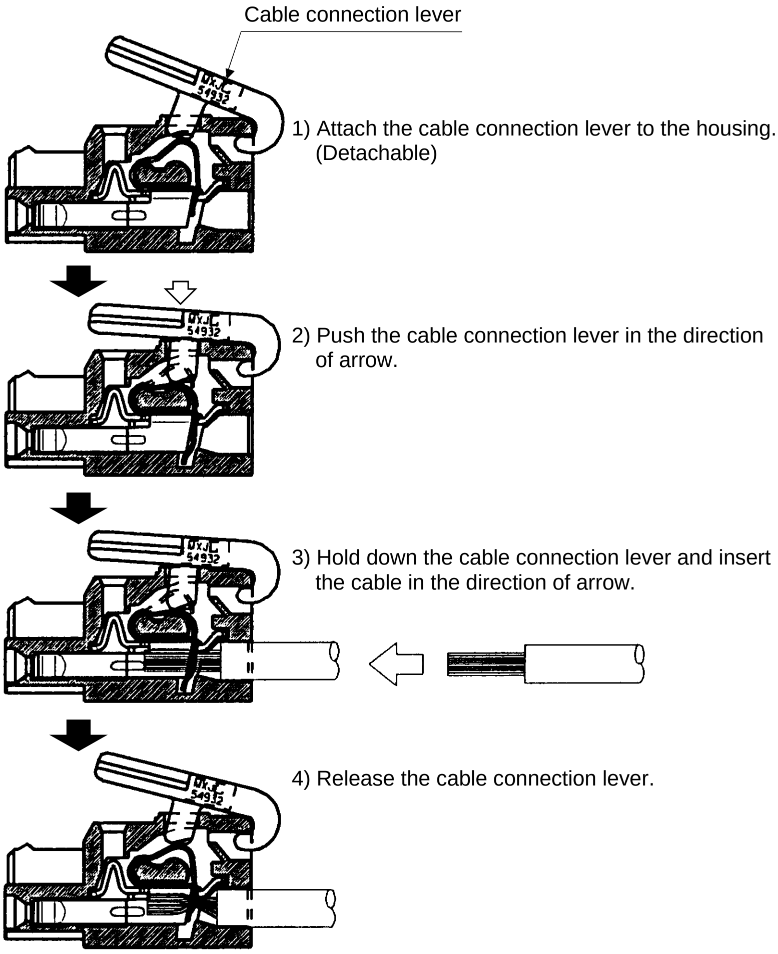
(a) When using the supplied cable connection lever

1) The driver is packed with the cable connection lever.

[Unit: mm]



2) Cable connection procedure

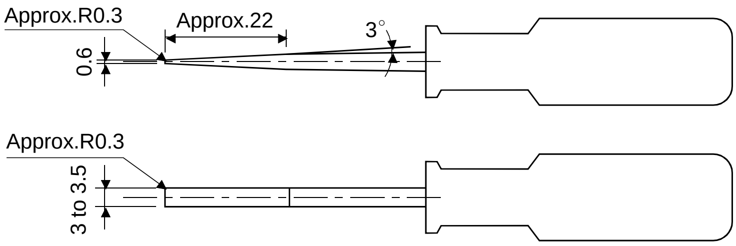


(b) Inserting the cable into the connector

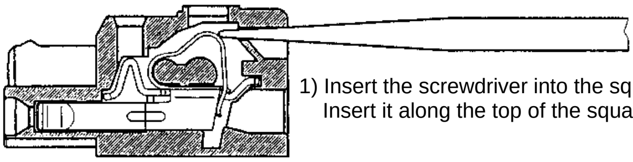
1) Applicable flat-blade screwdriver dimensions

Always use the screwdriver shown here to do the work.

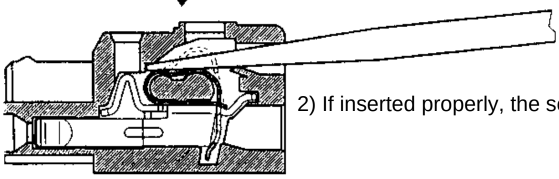
[Unit: mm]



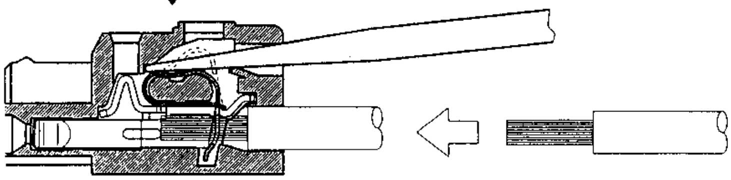
2) When using the flat-blade screwdriver - part 1



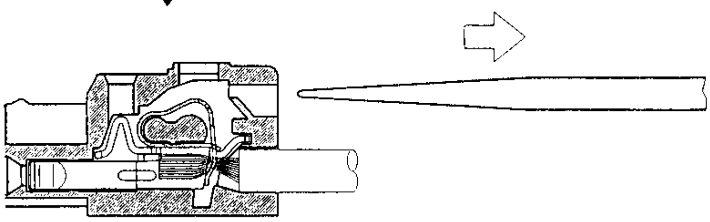
1) Insert the screwdriver into the square hole.
Insert it along the top of the square hole to insert it smoothly.



2) If inserted properly, the screwdriver is held.

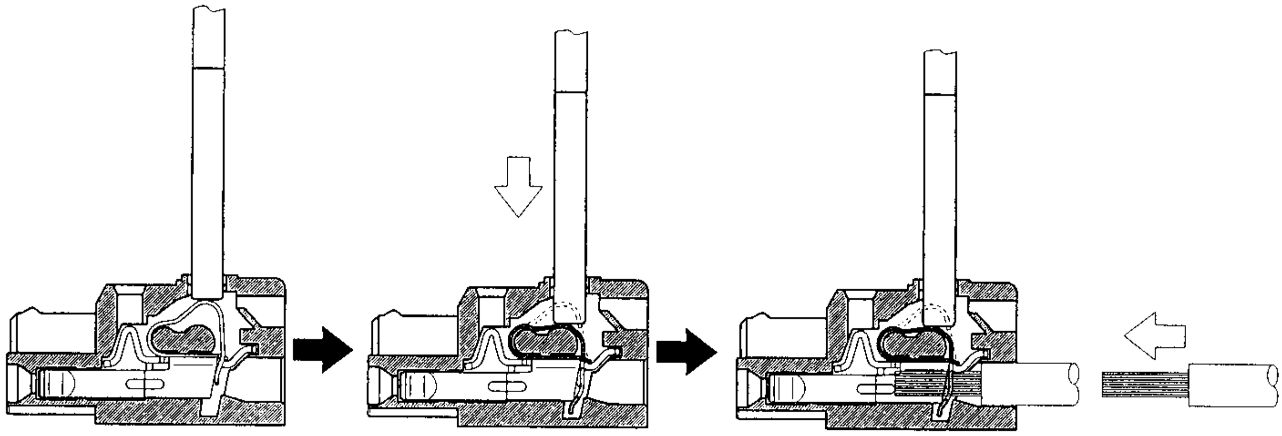


3) With the screwdriver held, insert the cable in the direction of arrow. (Insert the cable as far as it will go.)



4) Releasing the screwdriver connects the cable.

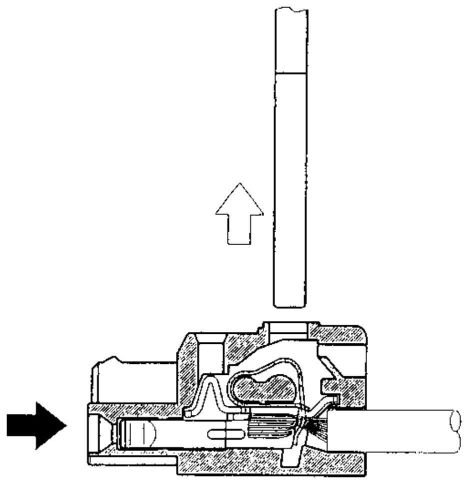
3) When using the flat-blade screwdriver - part 2



1) Insert the screwdriver into the square window at top of the connector.

2) Push the screwdriver in the direction of arrow.

3) With the screwdriver pushed, insert the cable in the direction of arrow. (Insert the cable as far as it will go.)



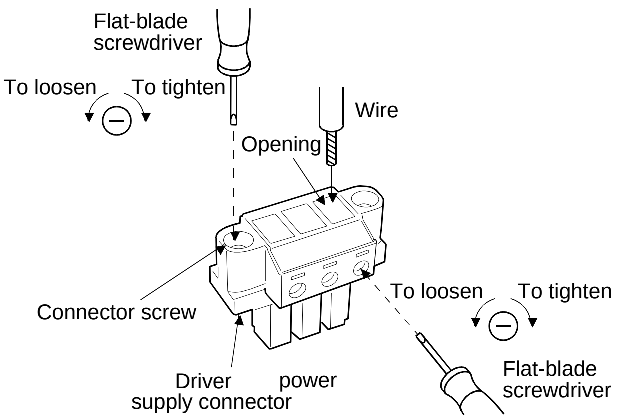
4) Releasing the screwdriver connects the cable.

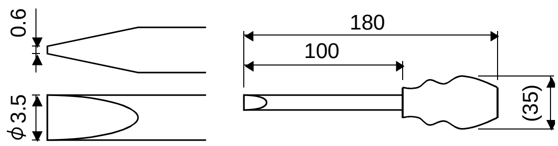
(3) How to insert the cable into Phoenix Contact connector

POINT
・Do not use a precision driver because the cable cannot be tightened with enough torque.

Insertion of cables into Phoenix Contact connector PC 4/6-STF-7,62-CRWH or PC 4/3-STF-7,62-CRWH is shown as follows.
Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose. Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver. When the cable is not tightened enough to the connector, the cable or connector may generate heat because of the poor contact. (When using a cable of 1.5mm^2 or less, two cables may be inserted into one opening.)
Secure the connector to the driver by tightening the connector screw.
For securing the cable and the connector, use a flat-blade driver with 0.6mm blade edge thickness and 3.5mm diameter (Recommended flat-blade screwdriver. Phoenix Contact SZS 0.6×3.5). Apply 0.5 to 0.6 N・m torque to screw.

[Unit: mm]





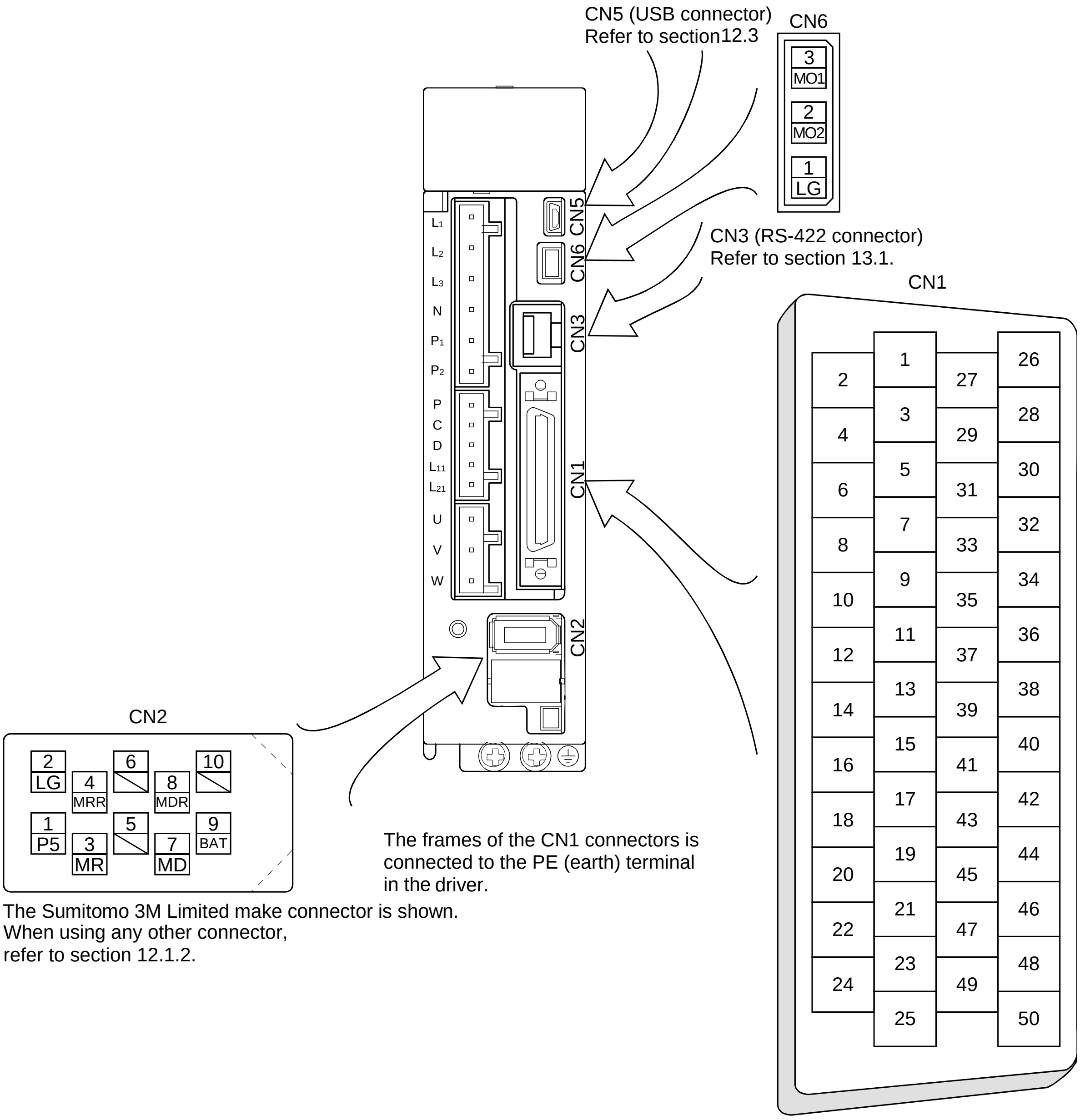
Recommended flat-blade screwdriver dimensions

3.4 Connectors and signal arrangements

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section. ・Refer to (2) of this section for CN1 signal assignment.

(1) Signal arrangement

The driver front view shown is that of the LECSB□-S5、LECSB□-S7. Refer to chapter 10 Outline Drawings for the appearances and connector layouts of the other drivers.



(2) CN1 signal assignment

The signal assignment of connector changes with the control mode as indicated below.

For the pins which are given parameter No.s in the related parameter column, their signals can be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter No.
		P	P/S	S	S/T	T	T/P	
1		P15R	P15R	P15R	P15R	P15R	P15R	
2	I		−/VC	VC	VC/VLA	VLA	VLA/−	
3		LG	LG	LG	LG	LG	LG	
4	O	LA	LA	LA	LA	LA	LA	
5	O	LAR	LAR	LAR	LAR	LAR	LAR	
6	O	LB	LB	LB	LB	LB	LB	
7	O	LBR	LBR	LBR	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	LZR	LZR	LZR	
10	I	PP	PP/−				−/PP	
11	I	PG	PG/−				−/PG	
12		OPC	OPC/−				−/OPC	
13								
14								
15	I	SON	SON	SON	SON	SON	SON	PD03
16	I		−/SP2	SP2	SP2/SP2	SP2	SP2/−	PD04
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD05
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD06
19	I	RES	RES	RES	RES	RES	RES	PD07
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/−		−/INP	PD13
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD14
24	O	INP	INP/SA	SA	SA/−		−/INP	PD15
25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD16
26								
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29								
30		LG	LG	LG	LG	LG	LG	
31								
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/−				−/NP	
36	I	NG	NG/−				−/NG	
37								
38								
39								
40								
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD08
42	I	EMG	EMG	EMG	EMG	EMG	EMG	

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter No.
		P	P/S	S	S/T	T	T/P	
43	I	LSP	LSP	LSP	LSP/−		−/LSP	PD10
44	I	LSN	LSN	LSN	LSN/−		−/LSN	PD11
45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD12
46		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	ALM	ALM	ALM	
49	O	RD	RD	RD	RD	RD	RD	PD18
50								

Note 1. I: Input signal, O: Output signal

2. P: Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control changeover mode, S/T: Speed/torque control changeover mode, T/P: Torque/position control changeover mode

3. TLA can be used when TL is made usable by setting the parameter No.PD03 to PD08/PD10 to PD12.

(3) Explanation of abbreviations

Abbreviation	Signal name	Abbreviation	Signal name
SON	Servo-on	TLC	Limiting torque
LSP	Forward rotation stroke end	VLC	Limiting speed
LSN	Reverse rotation stroke end	RD	Ready
CR	Clear	ZSP	Zero speed detection
SP1	Speed selection 1	INP	In-position
SP2	Speed selection 2	SA	Speed reached
PC	Proportion control	ALM	Trouble
ST1	Forward rotation start	WNG	Warning
ST2	Reverse rotation start	BWNG	Battery warning
TL	External torque limit selection	OP	Encoder Z-phase pulse (open collector)
RES	Reset	MBR	Electromagnetic brake interlock
EMG	Emergency stop	LZ	Encoder Z-phase pulse (differential line driver)
LOP	Control selection	LZR	
VC	Analog speed command	LA	Encoder A-phase pulse (differential line driver)
VLA	Analog speed limit	LAR	
TLA	Analog torque limit	LB	Encoder B-phase pulse (differential line driver)
TC	Analog torque command	LBR	
RS1	Forward rotation selection	DICOM	Digital I/F power supply input
RS2	Reverse rotation selection	OPC	Open collector power input
PP	Forward/reverse rotation pulse train	DOCOM	Digital I/F common
NP		P15R	15VDC power supply
PG		LG	Control common
NG		SD	Shield

3.5 Signal explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
In the control mode field of the table
P : Position control mode, S: Speed control mode, T: Torque control mode
○ : Denotes that the signal may be used in the initial setting status.
△ : Denotes that the signal may be used by setting the corresponding parameter No.PD03 to PD08, PD10 to PD12, PD13 to PD16, PD18.
The pin No.s in the connector pin No. column are those in the initial status.

(1) I/O devices

(a) Input devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-15</td><td>Turn SON on to power on the base circuit and make the driver ready to operate (servo-on).
Turn it off to shut off the base circuit and coast the servo motor.
Set "□□□4" in parameter No.PD01 to switch this signal on (keep terminals connected) automatically in the driver.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1-19</td><td>Turn RES on for more than 50ms to reset the alarm.
Some alarms cannot be deactivated by the reset (RES). Refer to section 9.1.
Turning RES on in an alarm-free status shuts off the base circuit. The base circuit is not shut off when "□□1□" is set in parameter No.PD20.
This device is not designed to make a stop. Do not turn it ON during operation.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1-43</td><td rowspan="2">To start operation, turn LSP/LSN on. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Set "□□□1" in parameter No.PD20 to make a slow stop.
(Refer to section 5.4.3.)
<table>
<tr><th colspan="2">(Note) Input device</th><th colspan="2">Operation</th></tr>
<tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr>
<tr><td>1</td><td>1</td><td>○</td><td>○</td></tr>
<tr><td>0</td><td>1</td><td></td><td>○</td></tr>
<tr><td>1</td><td>0</td><td>○</td><td></td></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
</table>
Note. 0: off
1: on
Set parameter No.PD01 as indicated below to switch on the signals (keep terminals connected) automatically in the driver.
<table>
<tr><th rowspan="2">Parameter No.PD01</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>□4□□</td><td>Automatic ON</td><td></td></tr>
<tr><td>□8□□</td><td></td><td>Automatic ON</td></tr>
<tr><td>□C□□</td><td>Automatic ON</td><td>Automatic ON</td></tr>
</table>
When LSP or LSN turns OFF, an external stroke limit warning (AL. 99) occurs, and Warning (WNG) turns OFF. However, when using WNG, set the parameter No.PD13 to PD16/PD18 to make it usable.</td><td rowspan="2">DI-1</td><td rowspan="2">○</td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1-44</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>External torque limit selection</td><td>TL</td><td>CN1-18</td><td>Turn TL off to make Forward torque limit (parameter No.PA11) and Reverse torque limit (parameter No.PA12) valid, or turn it on to make Analog torque limit (TLA) valid.
For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>When using this signal, make it usable by making the setting of parameter No.PD03 to PD08, PD10 to PD12.
For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td>CN1-17</td><td rowspan="2">Used to start the servo motor in any of the following directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Servo motor starting direction</th></tr>
<tr><th>ST2</th><th>ST1</th></tr>
<tr><td>0</td><td>0</td><td>Stop (servo lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop (servo lock)</td></tr>
</table>
Note. 0: off
1: on

If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the parameter No.PC02 setting and servo-locked.
When "□□□1" is set in parameter No.PC23, the servo motor is not servo-locked after deceleration to a stop.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td>CN1-18</td></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td>CN1-18</td><td rowspan="2">Used to select any of the following servo motor torque generation directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Torque generation direction</th></tr>
<tr><th>RS2</th><th>RS1</th></tr>
<tr><td>0</td><td>0</td><td>Torque is not generated.</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation in driving mode/
reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in driving mode/
forward rotation in regenerative mode</td></tr>
<tr><td>1</td><td>1</td><td>Torque is not generated.</td></tr>
</table>
Note. 0: off
1: on</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">○</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td>CN1-17</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td>CN1-41</td><td rowspan="3"><Speed control mode>
Used to select the command speed for operation.
When using SP3, make it usable by making the setting of parameter No.PD03 to PD08, PD10 to PD12.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed command 1 (parameter No.PC05)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No.PC06)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No.PC07)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed command 4 (parameter No.PC08)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed command 5 (parameter No.PC09)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed command 6 (parameter No.PC10)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed command 7 (parameter No.PC11)</td></tr>
</table>
Note. 0: off
1: on

<Torque control mode>
Used to select the limit speed for operation.
When using SP3, make it usable by making the setting of parameter No.PD03 to PD08, PD10 to PD12.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed limit 1 (parameter No.PC05)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed limit 2 (parameter No.PC06)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed limit 3 (parameter No.PC07)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed limit 4 (parameter No.PC08)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed limit 5 (parameter No.PC09)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed limit 6 (parameter No.PC10)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed limit 7 (parameter No.PC11)</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td>CN1-16</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 3</td><td>SP3</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Proportion control</td><td>PC</td><td>CN1-17</td><td>Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.
If the servo motor at a stop is rotated even one pulse due to any external factor, it generates torque to compensate for a position shift. When the servo motor shaft is to be locked mechanically after positioning completion (stop), switching on the proportion control (PC) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.
When the shaft is to be locked for a long time, switch on the proportion control (PC) and external torque limit selection (TL) at the same time to make the torque less than the rated by the analog torque limit (TLA).</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Emergency stop</td><td>EMG</td><td>CN1-42</td><td>Turn EMG off (open between commons) to bring the motor to an emergency stop state, in which the base circuit is shut off and the dynamic brake is operated. Turn EMG on (short between commons) in the emergency stop state to reset that state.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1-41</td><td>Turn CR on to clear the position control counter droop pulses on its leading edge. The pulse width should be 10ms or longer.
The delay amount set in parameter No.PB03 (position command acceleration/deceleration time constant) is also cleared. When the parameter No.PD22 setting is "□□□1", the pulses are always cleared while CR is on.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 1</td><td>CM1</td><td></td><td rowspan="2">When using CM1 and CM2, make them usable by the setting of parameters No.PD03 to PD08, PD10 to PD12.
The combination of CM1 and CM2 gives you a choice of four different electronic gear numerators set in the parameters.
CM1 and CM2 cannot be used in the absolute position detection system.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Electronic gear molecule</th></tr>
<tr><th>CM2</th><th>CM1</th></tr>
<tr><td>0</td><td>0</td><td>Parameter No.PA06</td></tr>
<tr><td>0</td><td>1</td><td>Parameter No.PC32</td></tr>
<tr><td>1</td><td>0</td><td>Parameter No.PC33</td></tr>
<tr><td>1</td><td>1</td><td>Parameter No.PC34</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 2</td><td>CM2</td><td></td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Gain changing</td><td>CDP</td><td></td><td>When using this signal, make it usable by the setting of parameter No.PD03 to PD08, PD10 to PD12.
Turn CDP on to change the load inertia moment ratio and gain values into the parameter No.PB29 to PB34 values.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

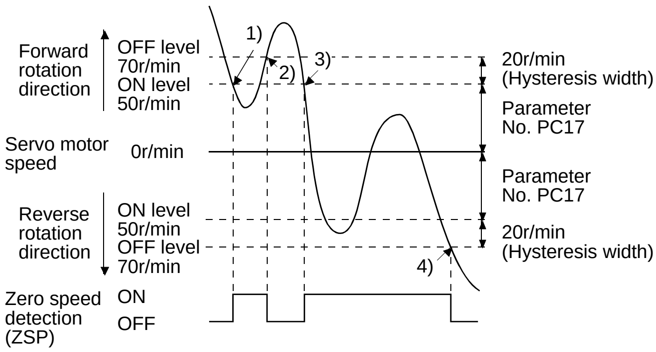
<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Control change</td><td>LOP</td><td>CN1-45</td><td><Position/speed control change mode>
Used to select the control mode in the position/speed control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Position</td></tr><tr><td>1</td><td>Speed</td></tr></table>
Note. 0: off
1: on

<Speed/torque control change mode>
Used to select the control mode in the speed/torque control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Speed</td></tr><tr><td>1</td><td>Torque</td></tr></table>
Note. 0: off
1: on

<Torque/position control mode>
Used to select the control mode in the torque/position control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Torque</td></tr><tr><td>1</td><td>Position</td></tr></table>
Note. 0: off
1: on</td><td>DI-1</td><td colspan="3">Refer to Functions/ Appli-cations.</td></tr>
<tr><td>Second acceleration/deceleration selection</td><td>STAB2</td><td></td><td>When using this signal, set the parameter No.PD03 to PD08/PD10 to PD12 to make it usable.
This signal allows selection of the acceleration/deceleration time constant at servo motor rotation in the speed control mode or torque control mode. The S-pattern acceleration/deceleration time constant is always uniform.
<table><tr><th>(Note) STAB2</th><th>Acceleration/deceleration time constant</th></tr><tr><td>0</td><td>Acceleration time constant (parameter No.PC01)
Deceleration time constant (parameter No.PC02)</td></tr><tr><td>1</td><td>Acceleration time constant 2 (parameter No.PC30)
Deceleration time constant 2 (parameter No.PC31)</td></tr></table>
Note. 0: off
1: on</td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>ABS transfer mode</td><td>ABSM</td><td>CN1-17</td><td>ABS transfer mode request device.
The CN1-17 pin acts as ABSM only during absolute position data transfer. (Refer to chapter 14.)</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS request</td><td>ABSR</td><td>CN1-18</td><td>ABS request device.
The CN1-18 pin acts as ABSR only during absolute position data transfer. (Refer to chapter 14.)</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
</table>

(b) Output devices

Device	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Trouble	ALM	CN1-48	ALM turns off when power is switched off or the protective circuit is activated to shut off the base circuit. Without alarm occurring, ALM turns on within 1s after power-on.	DO-1	○	○	○
Dynamic brake interlock	DB		When using the signal, make it usable by the setting of parameter No.PD13 to PD16 and PD18. DB turns off when the dynamic brake needs to operate. When using the external dynamic brake on the driver of 11 kW or more, this device is required. (Refer to section 12.6) For the driver of 7kW or less, it is not necessary to use this device.	DO-1	○	○	○
Ready	RD	CN1-49	RD turns on when the servo is switched on and the driver is ready to operate.	DO-1	○	○	○
In-position	INP	CN1-24	INP turns on when the number of droop pulses is in the preset in-position range. The in-position range can be changed using parameter No.PA10. When the in-position range is increased, may be kept connected during low-speed rotation. INP turns on when servo on turns on.	DO-1	○		
Speed reached	SA		SA turns on when the servo motor speed has nearly reached the preset speed. When the preset speed is 20r/min or less, SA always turns on. SA does not turn on even when the servo on (SON) is turned off or the servo motor speed by the external force reaches the preset speed while both the forward rotation start (ST1) and the reverse rotation start (ST2) are off.	DO-1		○	
Limiting speed	VLC	CN1-25	VLC turns on when speed reaches the value limited using any of the internal speed limits 1 to 7 (parameter No.PC05 to PC11) or the analog speed limit (VLA) in the torque control mode. VLC turns off when servo on (SON) turns off.	DO-1			○
Limiting torque	TLC		TLC turns on when the torque generated reaches the value set to the Forward torque limit (parameter No.PA11), Reverse torque limit (parameter No.PA12) or analog torque limit (TLA).	DO-1	○	○	

Device	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Zero speed detection	ZSP	CN1-23	ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No.PC17. Example Zero speed is 50r/min  ZSP turns on 1) when the servo motor is decelerated to 50r/min, and ZSP turns off 2) when the servo motor is accelerated to 70r/min again. ZSP turns on 3) when the servo motor is decelerated again to 50r/min, and turns off 4) when the servo motor speed has reached -70r/min. The range from the point when the servo motor speed has reached ON level, and ZSP turns on, to the point when it is accelerated again and has reached OFF level is called hysteresis width. Hysteresis width is 20r/min for the LECSB□-□ driver.	DO-1	○	○	○
Electromagnetic brake interlock	MBR		Set the parameter No.PD13 to PD16/PD18 or parameter No.PA04 to make this signal usable. Note that ZSP will be unusable. MBR turns off when the servo is switched off or an alarm occurs.	DO-1	△	△	△
Warning	WNG		To use this signal, assign the connector pin for output using parameter No.PD13 to PD16, PD18. The old signal before assignment will be unusable. When warning has occurred, WNG turns on. When there is no warning, WNG turns off within about 1.5s after power-on.	DO-1	△	△	△
Battery warning	BWNG		To use this signal, assign the connector pin for output using parameter No.PD13 to PD16, PD18. The old signal before assignment will be unusable. BWNG turns on when battery cable disconnection warning (AL. 92) or battery warning (AL. 9F) has occurred. When there is no battery warning, BWNG turns off within about 1.5s after power-on.	DO-1	△	△	△

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Alarm code</td><td>ACD 0
ACD 1
ACD 2</td><td>CN1-24
CN1-23
CN1-22</td><td>To use this signal, set "□□□1" in parameter No.PD24.
This signal is output when an alarm occurs. When there is no alarm, respective ordinary signals (RD, INP, SA, ZSP) are output.
Alarm codes and alarm names are listed below.
<table>
<tr><th colspan="3">(Note) Alarm code</th><th rowspan="2">Alarm display</th><th rowspan="2">Name</th></tr>
<tr><th>CN1-22</th><th>CN1-23</th><th>CN1-24</th></tr>
<tr><td rowspan="9">0</td><td rowspan="9">0</td><td rowspan="9">0</td><td>88888</td><td>Watchdog</td></tr>
<tr><td>AL.12</td><td>Memory error 1</td></tr>
<tr><td>AL.13</td><td>Clock error</td></tr>
<tr><td>AL.15</td><td>Memory error 2</td></tr>
<tr><td>AL.17</td><td>Board error</td></tr>
<tr><td>AL.19</td><td>Memory error 3</td></tr>
<tr><td>AL.37</td><td>Parameter error</td></tr>
<tr><td>AL.8A</td><td>Serial communication time-out error</td></tr>
<tr><td>AL.8E</td><td>Serial communication error</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td>AL.30</td><td>Regenerative error</td></tr>
<tr><td>AL.33</td><td>Overvoltage</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>AL.10</td><td>Undervoltage</td></tr>
<tr><td rowspan="5">0</td><td rowspan="5">1</td><td rowspan="5">1</td><td>AL.45</td><td>Main circuit device overheat</td></tr>
<tr><td>AL.46</td><td>Servo motor overheat</td></tr>
<tr><td>AL.47</td><td>Cooling fan alarm</td></tr>
<tr><td>AL.50</td><td>Overload 1</td></tr>
<tr><td>AL.51</td><td>Overload 2</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td>AL.24</td><td>Main circuit error</td></tr>
<tr><td>AL.32</td><td>Overcurrent</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">0</td><td rowspan="3">1</td><td>AL.31</td><td>Overspeed</td></tr>
<tr><td>AL.35</td><td>Command pulse frequency alarm</td></tr>
<tr><td>AL.52</td><td>Error excessive</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">1</td><td rowspan="4">0</td><td>AL.16</td><td>Encoder error 1</td></tr>
<tr><td>AL.1A</td><td>Monitor combination error</td></tr>
<tr><td>AL.20</td><td>Encoder error 2</td></tr>
<tr><td>AL.25</td><td>Absolute position erase</td></tr>
</table>
Note. 0: off
1: on</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Variable gain selection</td><td>CDPS</td><td></td><td>CDPS is on during gain changing.</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Absolute position erasing</td><td>ABSV</td><td></td><td>ABSV turns on when the absolute position is erased.</td><td>DO-1</td><td>△</td><td></td><td></td></tr>
<tr><td>ABS transmission data bit 0</td><td>ABSB0</td><td>CN1-22</td><td>Outputs ABS transmission data bit 0. CN1-22 acts as ABSB0 only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS transmission data bit 1</td><td>ABSB1</td><td>CN1-23</td><td>Outputs ABS transmission data bit 1. CN1-23 acts as ABSB1 only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS transmission data ready</td><td>ABST</td><td>CN1-25</td><td>Outputs ABS transmission data ready. CN1-25 acts as ABST only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
</table>

(2) Input signals

Signal	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode		
					P	S	T
Analog torque limit	TLA	CN1-27	To use this signal in the speed control mode, set any of parameters No.PD13 to PD16, PD18 to make external torque limit selection (TL) available. When the analog torque limit (TLA) is valid, torque is limited in the full servo motor output torque range. Apply 0 to +10VDC across TLA-LG. Connect the positive terminal of the power supply to TLA. Maximum torque is generated at +10V. (Refer to section 3.6.1 (5).) Resolution:10bit	Analog input	○	△	
Analog torque command	TC		Used to control torque in the full servo motor output torque range. Apply 0 to ±8VDC across TC-LG. Maximum torque is generated at ±8V. (Refer to section 3.6.3 (1).) The torque at ±8V input can be changed using parameter No.PC13.	Analog input			○
Analog speed command	VC	CN1-2	Apply 0 to ±10VDC across VC-LG. Speed set in parameter No.PC12 is provided at ±10V. (Refer to section 3.6.2 (1).) Resolution:14bit or equivalent	Analog input		○	
Analog speed limit	VLA		Apply 0 to ±10VDC across VLA-LG. Speed set in parameter No.PC12 is provided at +10V. (Refer to section 3.6.3 (3).)	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PG NG	CN1-10 CN1-35 CN1-11 CN1-36	Used to enter a command pulse train. ・In the open collector system (max. input frequency 200kpps) Forward rotation pulse train across PP-DOCOM Reverse rotation pulse train across NP-DOCOM If the command pulse train input is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface. ・In the differential receiver system (max. input frequency 1Mpps) Forward rotation pulse train across PG-PP Reverse rotation pulse train across NG-NP The command pulse train form can be changed using parameter No. PA13.	DI-2	○		

(3) Output signals

Signal	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode P	S	T
Encoder Z-phase pulse (Open collector)	OP	CN1-33	Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP turns on when the zero-point position is reached. (Negative logic) The minimum pulse width is about 400μs. For home position return using this pulse, set the creep speed to 100r/min. or less.	DO-2	○	○	○
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1-4 CN1-5	Outputs pulses per servo motor revolution set in parameter No.PA15 in the differential line driver system. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2. The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. PC19.	DO-2	○	○	○
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1-6 CN1-7					
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1-8 CN1-9	The same signal as OP is output in the differential line driver system.	DO-2	○	○	○
Analog monitor 1	MO1	CN6-3	Used to output the data set in parameter No.PC14 to across MO1-LG in terms of voltage. Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN6-2	Used to output the data set in parameter No.PC15 to across MO2-LG in terms of voltage. Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

POINT

- Refer to chapter 13 for the communication function.

Signal	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode P	S	T
RS-422 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	Terminals for RS-422 communication. (Refer to chapter 13.)		○	○	○

(5) Power supply

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Used to input 24VDC (24VDC 10% 300mA) for I/O interface of the driver. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect ⊕ of 24VDC external power supply. For source interface, connect ⊖ of 24VDC external power supply.		○	○	○
Open collector power input	OPC	CN1-12	When inputting a pulse train in the open collector system, supply this terminal with the positive (+) power of 24VDC.		○		
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal for input device such as SON and EMG of the driver. Pins are connected internally. For sink interface, connect ⊖ of 24VDC external power supply. For source interface, connect ⊕ of 24VDC external power supply.		○	○	○
15VDC power supply	P15R	CN1-1	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34 CN3-1 CN3-7 CN6-1	Common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2 and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shield cable.		○	○	○

3.6 Detailed description of the signals

3.6.1 Position control mode

(1) Pulse train input

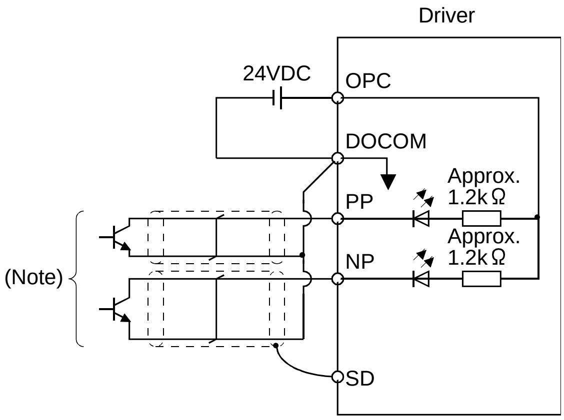
(a) Input pulse waveform selection

Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command pulse train form in parameter No.PA13. Refer to section 5.1.10 for details.

(b) Connections and waveforms

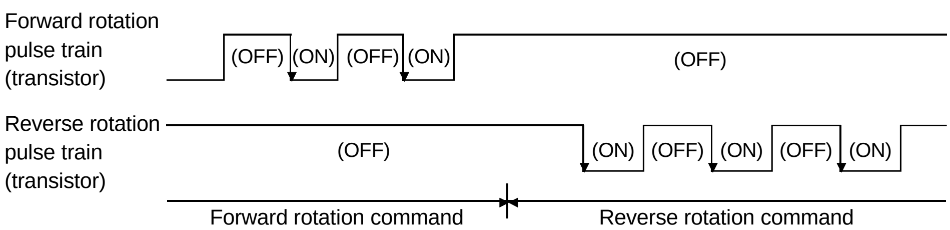
1) Open collector system

Connect as shown below.

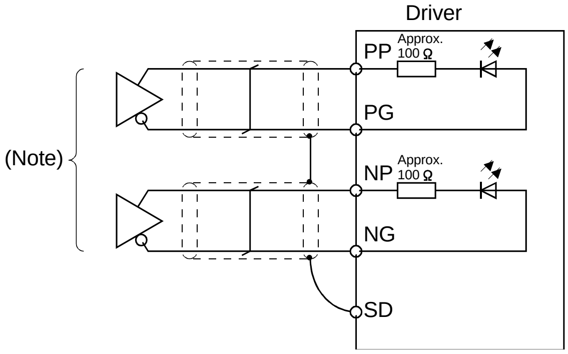


Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.
If the command pulse train input is open collector method, it supports only to the sink (NPN) type interface.
It does not correspond to the source (PNP) type interface.

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.PA13 has been set to 0010). Their relationships with transistor ON/OFF are as follows.

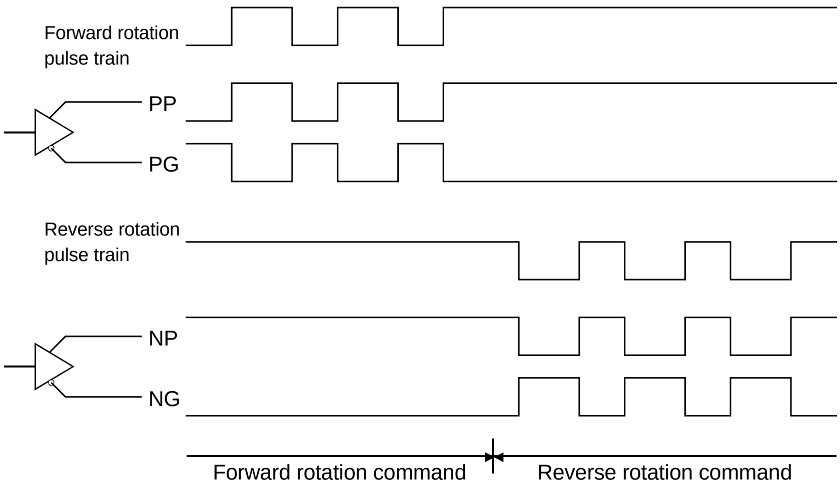


2) Differential line driver system
Connect as shown below.

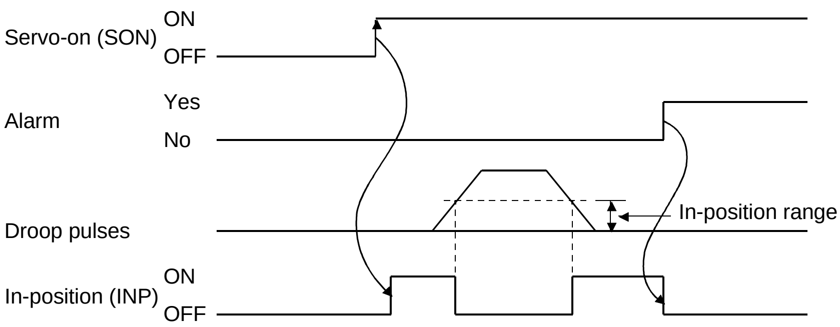


Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

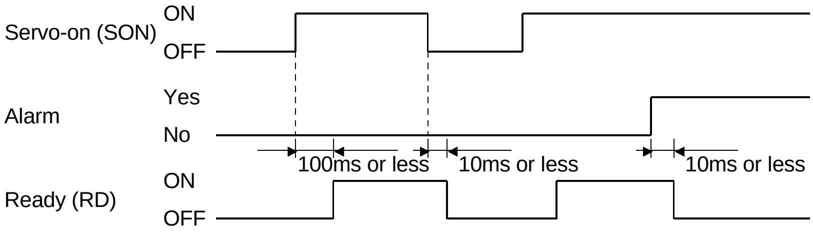
The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.PA13 has been set to 0010).
The waveforms of PP, PG, NP and NG are based on that of the LG of the differential line driver.



(2) In-position (INP)
INP turns on when the number of droop pulses in the deviation counter falls within the preset in-position range (parameter No.PA10). INP turns on when low-speed operation is performed with a large value set as the in-position range.



(3) Ready (RD)



(4) Electronic gear switching

The combination of CM1 and CM2 gives you a choice of four different electronic gear numerators set in the parameters.

As soon as CM1/CM2 is turned ON or OFF, the molecule of the electronic gear changes. Therefore, if any shock occurs at this change, use position smoothing (parameter No.PB03) to relieve shock.

(Note) Input device		Electronic gear molecule
CM2	CM1	
0	0	Parameter No.PA06
0	1	Parameter No.PC32
1	0	Parameter No.PC33
1	1	Parameter No.PC34

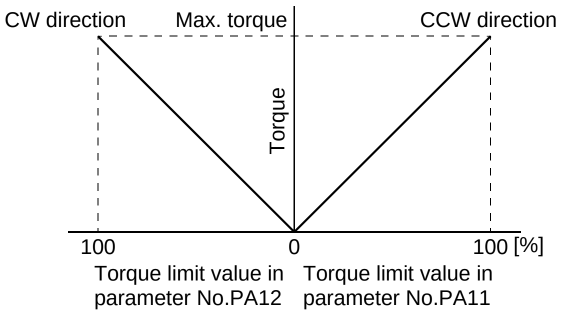
Note. 0: off
1: on

(5) Torque limit

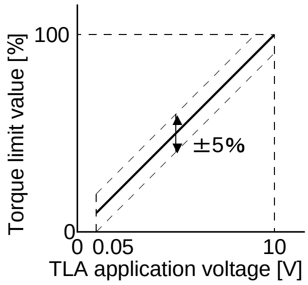
CAUTION	・If the torque limit is canceled during servo lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

(a) Torque limit and torque

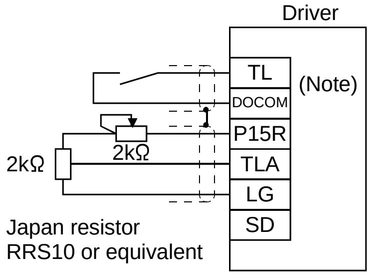
By setting parameter No.PA11 (forward rotation torque limit) or parameter No.PA12 (reverse rotation torque limit), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor torque is shown below.



A relationship between the applied voltage of the analog torque limit (TLA) and the torque limit value of the servo motor is shown below. Torque limit values will vary about 5% relative to the voltage depending on products.
At the voltage of less than 0.05V, torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



TLA application voltage vs. torque limit value



Connection example

Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Torque limit value selection
As shown below, the forward rotation torque limit (parameter No.PA11), or reverse rotation torque limit (parameter No. PA12) and the analog torque limit (TLA) can be chosen using the external torque limit selection (TL).
When internal torque limit selection (TL1) is made usable by parameter No.PD03 to PD08, PD10 to PD12, internal torque limit 2 (parameter No.PC35) can be selected. However, if the parameter No.PA11 and parameter No.PA12 value is less than the limit value selected by TL/TL1, the parameter No.PA11 and parameter No.PA12 value is made valid.

(Note) Input device		Limit value status	Validated torque limit values	
TL1	TL		CCW driving/CW regeneration	CW driving/CCW regeneration
0	0		Parameter No.PA11	Parameter No.PA12
0	1	TLA > Parameter No.PA11 Parameter No.PA12	Parameter No.PA11	Parameter No.PA12
		TLA < Parameter No.PA11 Parameter No.PA12	TLA	TLA
1	0	Parameter No.PC35 > Parameter No.PA11 Parameter No.PA12	Parameter No.PA11	Parameter No.PA12
		Parameter No.PC35 < Parameter No.PA11 Parameter No.PA12	Parameter No.PC35	Parameter No.PC35
1	1	TLA > Parameter No.PC35	Parameter No.PC35	Parameter No.PC35
		TLA < Parameter No.PC35	TLA	TLA

Note. 0: off
1: on

(c) Limiting torque (TLC)
TLC turns on when the servo motor torque reaches the torque limited using the forward rotation torque limit, reverse rotation torque limit or analog torque limit.

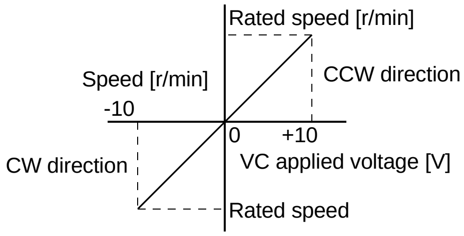
3.6.2 Speed control mode

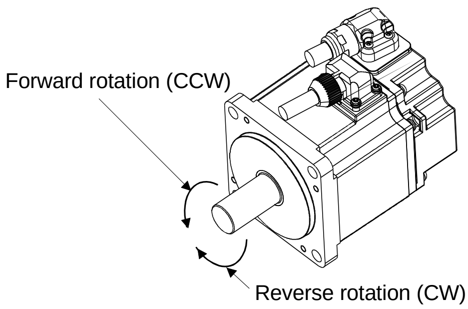
(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of the analog speed command (VC). A relationship between the analog speed command (VC) applied voltage and the servo motor speed is shown below.

Rated speed is achieved at ±10V with initial setting. The speed at ±10V can be changed using parameter No.PC12.





The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination.

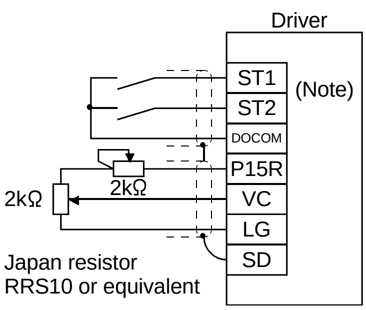
(Note 1) Input device		(Note 2) Rotation direction			
ST2	ST1	Analog speed command (VC)			Internal speed commands
		+ Polarity	0V	−Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)

Note 1. 0: off

1: on

2. If the torque limit is canceled during servo lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

Generally, make connection as shown below.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1), speed selection 2 (SP2) and speed command value

Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the analog speed command (VC).

(Note) Input device		Speed command value
SP2	SP1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No.PC05)
1	0	Internal speed command 2 (parameter No.PC06)
1	1	Internal speed command 3 (parameter No.PC07)

Note. 0: off
1: on

By making speed selection 3 (SP3) usable by setting of parameter No.PD03 to PD08/PD10 to PD12, you can choose the speed command values of analog speed command (VC) and internal speed commands 1 to 7.

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	Analog speed command (VC)
0	0	1	Internal speed command 1 (parameter No.PC05)
0	1	0	Internal speed command 2 (parameter No.PC06)
0	1	1	Internal speed command 3 (parameter No.PC07)
1	0	0	Internal speed command 4 (parameter No.PC08)
1	0	1	Internal speed command 5 (parameter No.PC09)
1	1	0	Internal speed command 6 (parameter No.PC10)
1	1	1	Internal speed command 7 (parameter No.PC11)

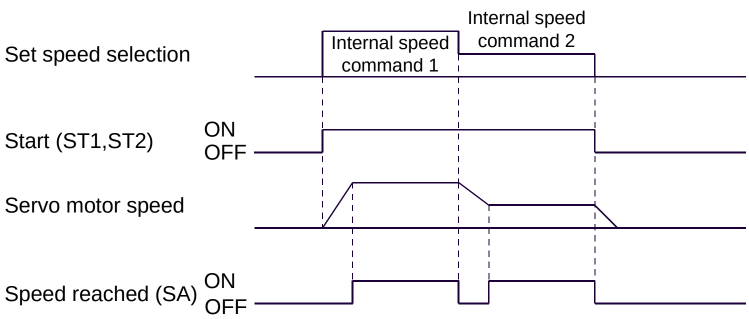
Note. 0: off
1: on

The speed may be changed during rotation. In this case, the values set in parameters No.PC01 and PC02 are used for acceleration/deceleration.

When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(2) Speed reached (SA)

SA turns on when the servo motor speed has nearly reached the speed set to the internal speed command or analog speed command.



(3) Torque limit

As in section 3.6.1 (5).

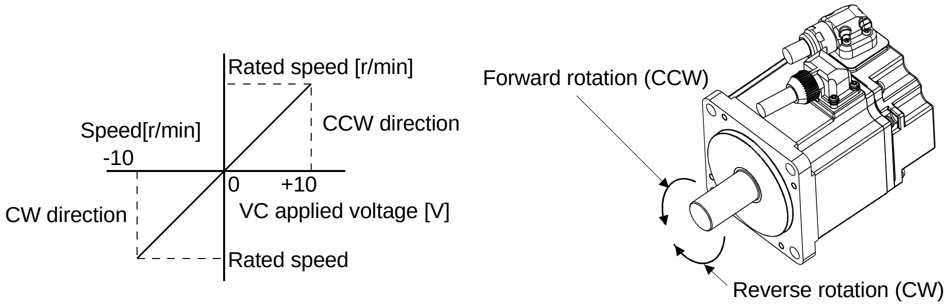
3.6.3 Torque control mode

(1) Torque control

(a) Torque command and torque

A relationship between the applied voltage of the analog torque command (TC) and the torque by the servo motor is shown below.

The maximum torque is generated at ±8V. Note that the torque at ±8V input can be changed with parameter No.PC13.



Generated torque limit values will vary about 5% relative to the voltage depending on products.

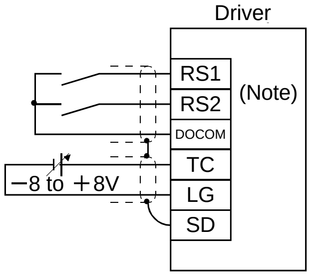
Also the torque may vary if the voltage is low (−0.05 to +0.05V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and reverse rotation selection (RS2) when the analog torque command (TC) is used.

(Note) Input device		Rotation direction		
		Torque control command (TC)		
RS2	RS1	+Polarity	0V	−Polarity
0	0	Torque is not generated.	Torque is not generated.	Torque is not generated.
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)		CW (forward rotation in driving mode/reverse rotation in regenerative mode)
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)		CCW (reverse rotation in driving mode/forward rotation in regenerative mode)
1	1	Torque is not generated.		Torque is not generated.

Note. 0: off
1: on

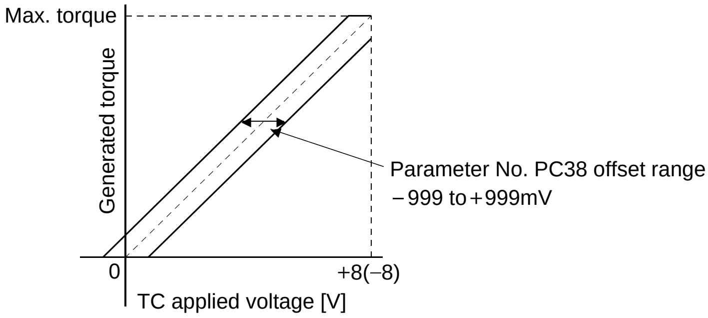
Generally, make connection as shown below.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Analog torque command offset

Using parameter No.PC38, the offset voltage of −999 to +999mV can be added to the TC applied voltage as shown below.



(2) Torque limit

By setting parameter No.PA11 (forward rotation torque limit) or parameter No.PA12 (reverse rotation torque limit), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor torque is as in section 3.6.1 (5). Note that the analog torque limit (TLA) is unavailable.

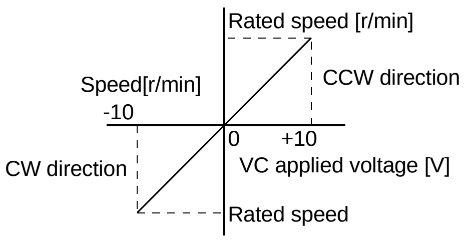
(3) Speed limit

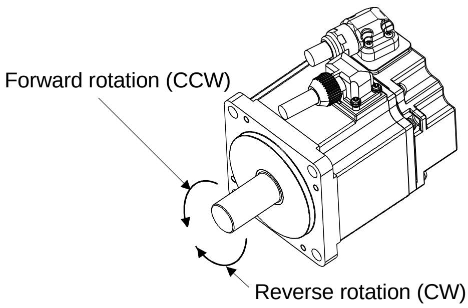
(a) Speed limit value and speed

The speed is limited to the values set in parameters No.PC05 to PC11 (internal speed limits 1 to 7) or the value set in the applied voltage of the analog speed limit (VLA).

A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is shown below.

When the servo motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/min greater than the desired speed limit value.



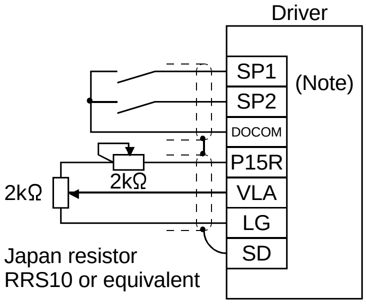


The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination.

(Note) Input device		Speed limit direction		
RS1	RS2	Analog speed limit (VLA)		Internal speed commands
		+Polarity	−Polarity	
1	0	CCW	CW	CCW
0	1	CW	CCW	CW

Note. 0: off
1: on

Generally, make connection as shown below.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1(SP1)/speed selection 2(SP2)/speed selection 3(SP3) and speed limit values
Choose any of the speed settings made by the internal speed limits 1 to 7 using speed selection 1(SP1), speed selection 2(SP2) and speed selection 3(SP3) or the speed setting made by the analog speed limit (VLA), as indicated below.

(Note) Input device			Speed limit value
SP3	SP2	SP1	
0	0	0	Analog speed limit (VLA)
0	0	1	Internal speed limit 1 (parameter No.PC05)
0	1	0	Internal speed limit 2 (parameter No.PC06)
0	1	1	Internal speed limit 3 (parameter No.PC07)
1	0	0	Internal speed limit 4 (parameter No.PC08)
1	0	1	Internal speed limit 5 (parameter No.PC09)
1	1	0	Internal speed limit 6 (parameter No.PC10)
1	1	1	Internal speed limit 7 (parameter No.PC11)

Note. 0: off
1: on

When the internal speed limits 1 to 7 are used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)
VLC turns on when the servo motor speed reaches the speed limited using any of the internal speed limits 1 to 7 or the analog speed limit (VLA).

3.6.4 Position/speed control change mode

Set "□□□1" in parameter No.PA01 to switch to the position/speed control change mode. This function is not available in the absolute position detection system.

(1) Control change (LOP)

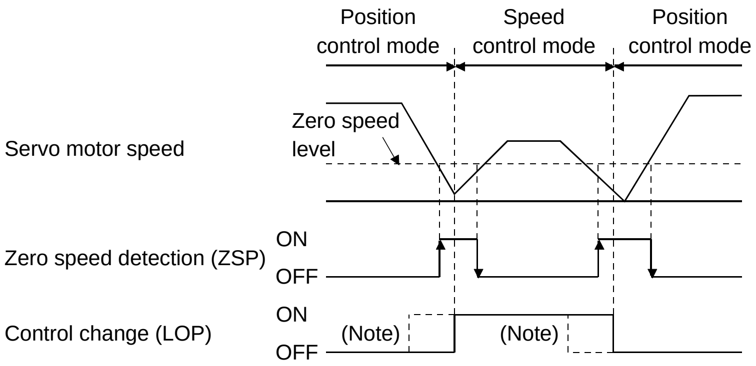
Use control change (LOP) to switch between the position control mode and the speed control mode from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Servo control mode
0	Position control mode
1	Speed control mode

Note. 0: off
1: on

The control mode may be changed in the zero speed status. To ensure safety, change control after the servo motor has stopped. When position control mode is changed to speed control mode, droop pulses are reset.

If the LOP has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below.



Note. When ZSP is not on, control cannot be changed if LOP is switched on-off.
If ZSP switches on after that, control cannot be changed.

(2) Torque limit in position control mode

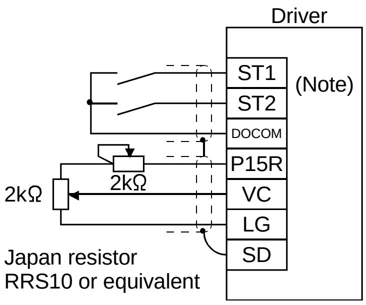
As in section 3.6.1 (5).

(3) Speed setting in speed control mode

(a) Speed command and speed

The servo motor is run at the speed set in parameter No.8 (internal speed command 1) or at the speed set in the applied voltage of the analog speed command (VC). A relationship between analog speed command (VC) applied voltage and servo motor speed and the rotation directions determined by the forward rotation start (ST1) and reverse rotation start (ST2) are as in (a), (1) in section 3.6.2.

Generally, make connection as shown below.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1), speed selection 2 (SP2) and speed command value

Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the analog speed command (VC).

(Note) Input device		Speed command value
SP2	SP1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No.PC05)
1	0	Internal speed command 2 (parameter No.PC06)
1	1	Internal speed command 3 (parameter No.PC07)

Note. 0: off
1: on

By making speed selection 3 (SP3) usable by setting of parameter No.PD03 to PD08/PD10 to PD12, you can choose the speed command values of analog speed command (VC) and internal speed commands 1 to 7.

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	Analog speed command (VC)
0	0	1	Internal speed command 1 (parameter No.PC05)
0	1	0	Internal speed command 2 (parameter No.PC06)
0	1	1	Internal speed command 3 (parameter No.PC07)
1	0	0	Internal speed command 4 (parameter No.PC08)
1	0	1	Internal speed command 5 (parameter No.PC09)
1	1	0	Internal speed command 6 (parameter No.PC10)
1	1	1	Internal speed command 7 (parameter No.PC11)

Note. 0: off
1: on

The speed may be changed during rotation. In this case, the values set in parameters No.PC01 and PC02 are used for acceleration/deceleration.
When the internal speed command 1 to 7 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Speed reached (SA)
As in section 3.6.2 (2).

3.6.5 Speed/torque control change mode

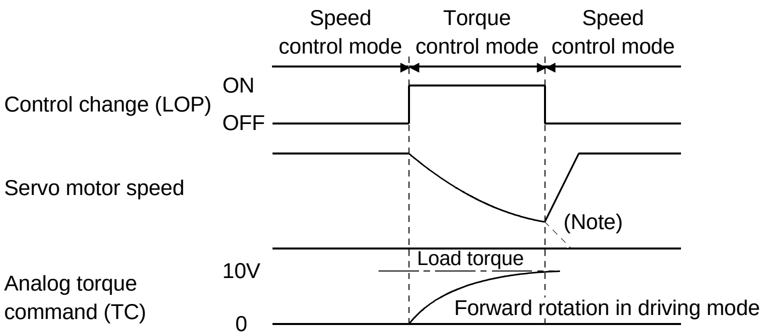
Set "□□□3" in parameter No.PA01 to switch to the speed/torque control change mode.

(1) Control change (LOP)
Use control change (LOP) to switch between the speed control mode and the torque control mode from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Servo control mode
0	Speed control mode
1	Torque control mode

Note. 0: off
1: on

The control mode may be changed at any time. A change timing chart is shown below.



Note. When the start (ST1 ・ ST2) is switched off as soon as the mode is changed to speed control, the servo motor comes to a stop according to the deceleration time constant.

(2) Speed setting in speed control mode
As in section 3.6.2 (1).

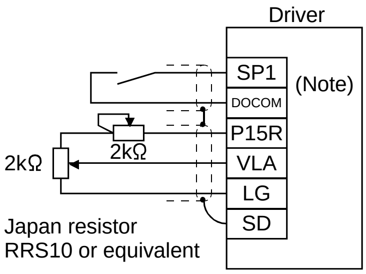
(3) Torque limit in speed control mode
As in section 3.6.1 (5).

(4) Speed limit in torque control mode

(a) Speed limit value and speed

The speed is limited to the limit value set in parameter No.8 (internal speed limit 1) or the value set in the applied voltage of the analog speed limit (VLA). A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is as in section 3.6.3 (3) (a).

Generally, make connection as shown below.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1) and speed limit value

Use speed selection 1 (SP1) to select between the speed set by the internal speed limit 1 and the speed set by the analog speed limit (VLA) as indicated in the following table.

(Note) Input device SP1	Speed command value
0	Analog speed limit (VLA)
1	Internal speed limit 1 (parameter No.PC05)

Note. 0: off

1: on

When the internal speed limit 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

As in section 3.6.3 (3) (c)

(5) Torque control in torque control mode

As in section 3.6.3 (1).

(6) Torque limit in torque control mode

As in section 3.6.3 (2).

3.6.6 Torque/position control change mode

Set "□□□5" in parameter No.PA01 to switch to the torque/position control change mode.

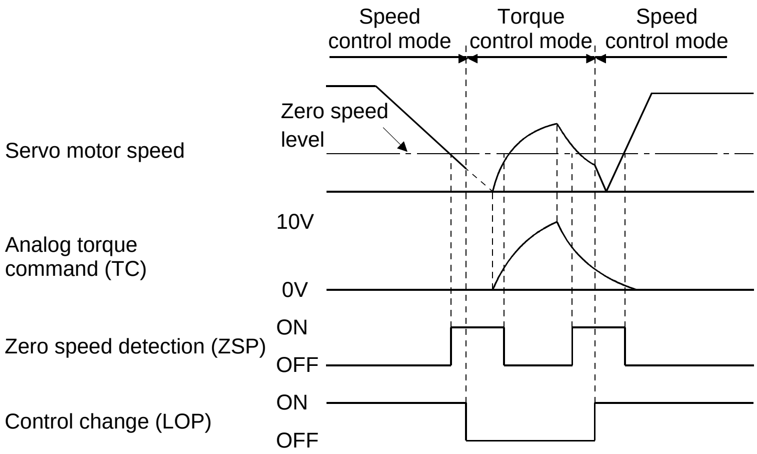
(1) Control change (LOP)

Use control change (LOP) to switch between the torque control mode and the position control mode from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Servo control mode
0	Torque control mode
1	Position control mode

Note. 0: off
1: on

The control mode may be changed in the zero speed status.
To ensure safety, change control after the servo motor has stopped. When position control mode is changed to torque control mode, droop pulses are reset.
If the LOP has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below.



(2) Speed limit in torque control mode

As in section 3.6.3 (3).

(3) Torque control in torque control mode

As in section 3.6.3 (1).

(4) Torque limit in torque control mode

As in section 3.6.3 (2).

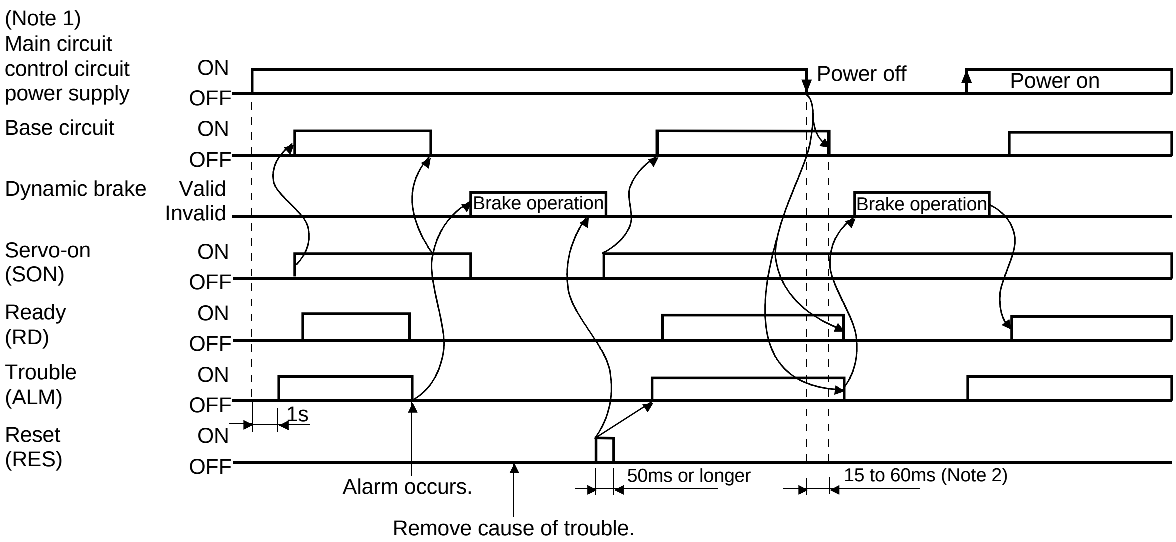
(5) Torque limit in position control mode

As in section 3.6.1 (5).

3.7 Alarm occurrence timing chart

CAUTION	・When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation. ・As soon as an alarm occurs, turn off Servo-on (SON) and power off.

When an alarm occurs in the driver, the base circuit is shut off and the servo motor is coated to a stop. Switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply from off to on, press the " SET " button on the current alarm screen, or turn the reset (RES) from off to on. However, the alarm cannot be reset unless its cause is removed.



Note 1. Shut off the main circuit power as soon as an alarm occurs.
2. Changes depending on the operating status.

(1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching control circuit power off, then on to reset the overcurrent (AL.32), overload 1 (AL.50) or overload 2 (AL.51) alarm after its occurrence, without removing its cause, the driver and servo motor may become faulty due to temperature rise. Securely remove the cause of the alarm and also allow about 30 minutes for cooling before resuming operation.

(2) Regenerative alarm

If operation is repeated by switching control circuit power off, then on to reset the regenerative (AL.30) alarm after its occurrence, the external regenerative resistor will generate heat, resulting in an accident.

(3) Instantaneous power failure

Undervoltage (AL.10) occurs when the input power is in either of the following statuses.

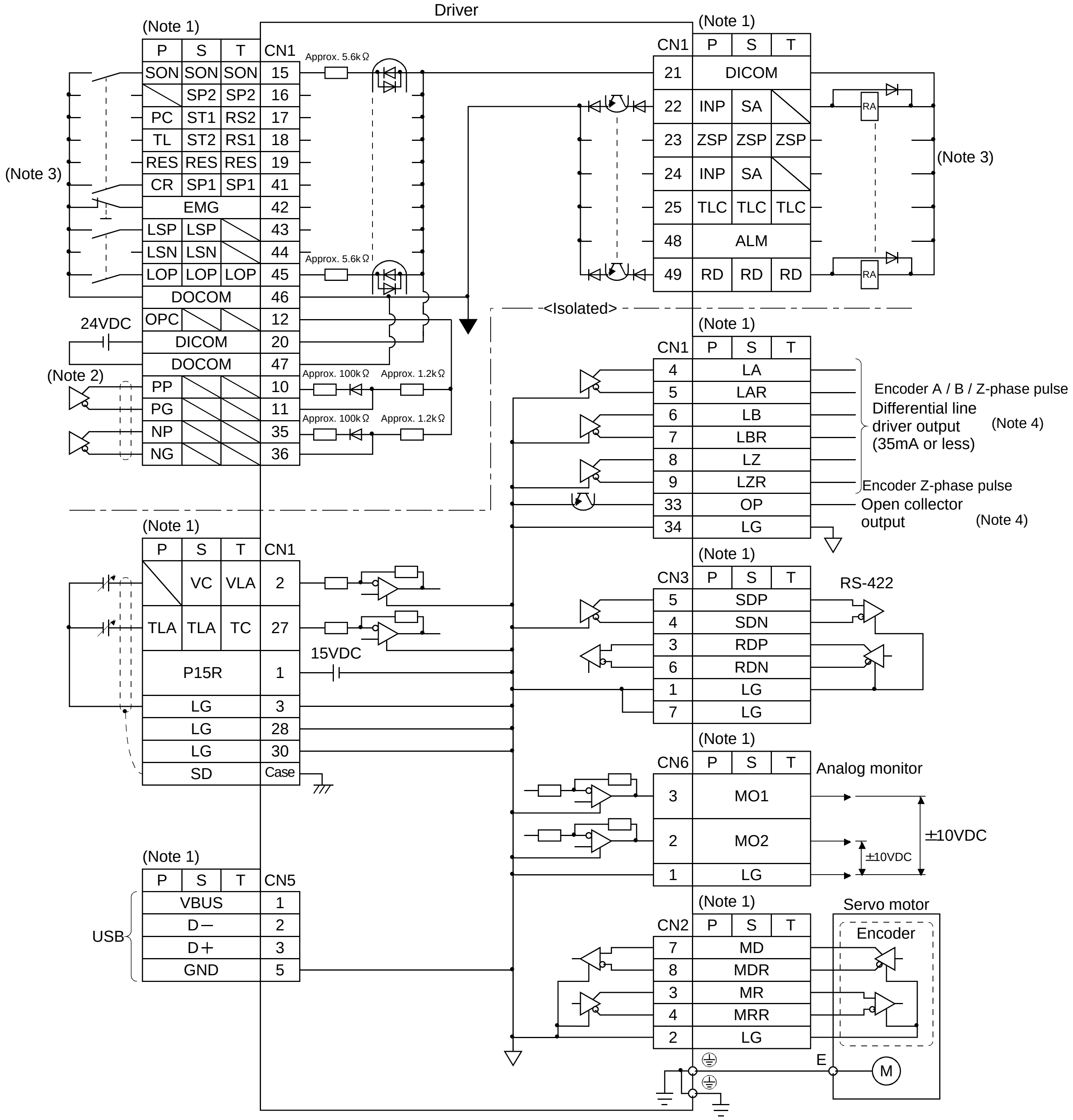
・A power failure of the control circuit power supply continues for 60ms or longer, then the power restores.
・During the servo-on status, the bus voltage dropped to 200VDC or less for LECSB2-□, 158VDC or less for LECSB1-□.

(4) In position control mode (incremental)

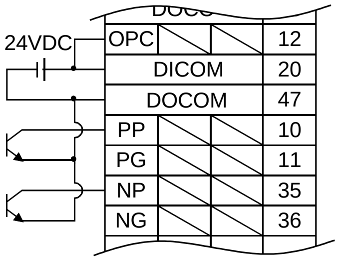
When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a home position return.

3.8 Interfaces

3.8.1 Internal connection diagram



Note 1. P: Position control mode S: Speed control mode T: Torque control mode
2. For the differential line driver pulse train input. For the open collector pulse train input, make the following connection.
If the command pulse train input is open collector method, it supports only to the sink (NPN) type interface.
It does not correspond to the source (PNP) type interface.



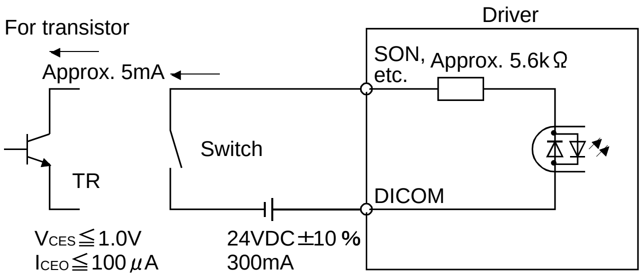
3. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
4. Encoder Z-phase pulse will correspond to the differential line driver system and the open collector system.
If the encoder Z-phase pulse is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.

3.8.2 Detailed description of interfaces

This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 3.5. Refer to this section and make connection with the external equipment.

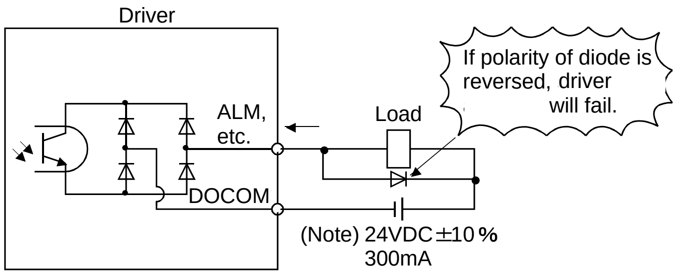
(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor. Refer to section 3.8.3 for source input.



(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the driver.
Refer to section 3.8.3 for the source output.



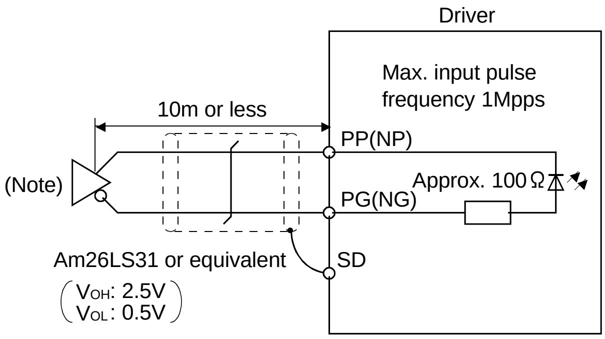
Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (up to 26.4V) from external source.

(3) Pulse train input interface DI-2

Give a pulse train signal in the differential line driver system or open collector system.

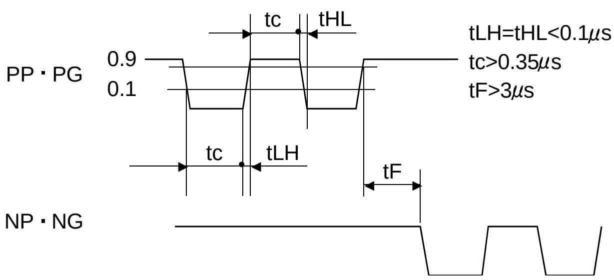
(a) Differential line driver system

1) Interface



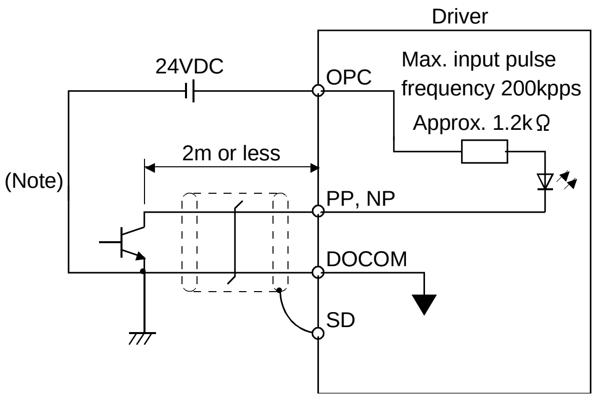
Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

2) Input pulse condition



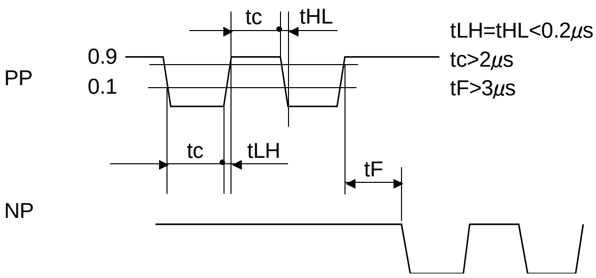
(b) Open collector system

1) Interface



Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.
If the command pulse train input is open collector method, it supports only to the sink (NPN) type interface.
It does not correspond to the source (PNP) type interface.

2) Input pulse condition



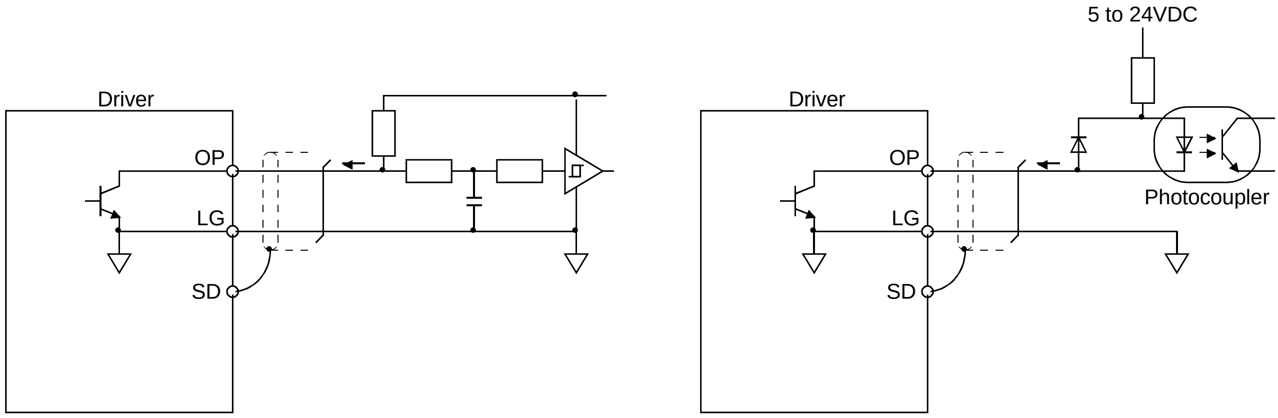
(4) Encoder output pulse DO-2

Encoder Z-phase pulse will correspond to the differential line driver system and the open collector system.

(a) Open collector system

Interface

Max. output current: 35mA

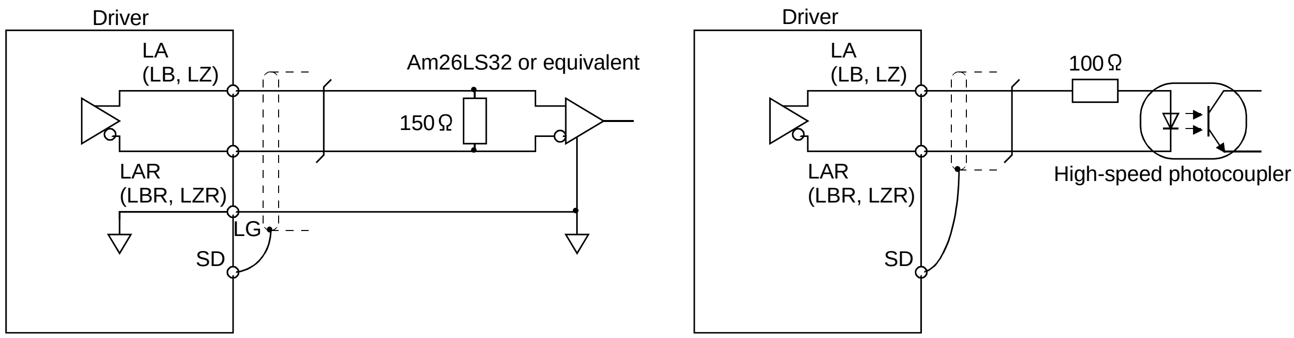


If the encoder Z-phase pulse is open collector method, it supports only to the sink (NPN) type interface. It does not correspond to the source (PNP) type interface.

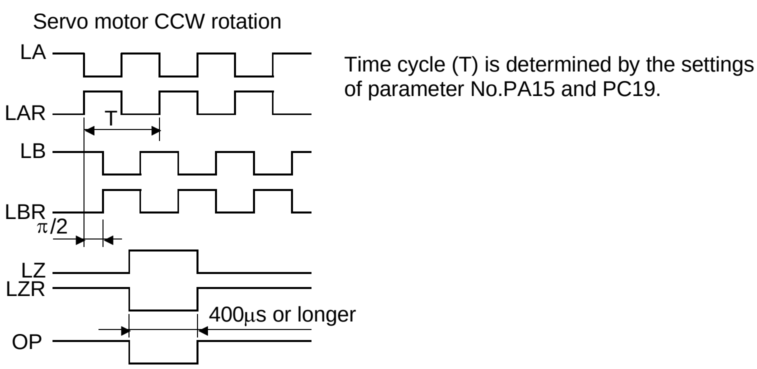
(b) Differential line driver system (Encoder A / B / Z-phase pulse)

1) Interface

Max. output current: 35mA

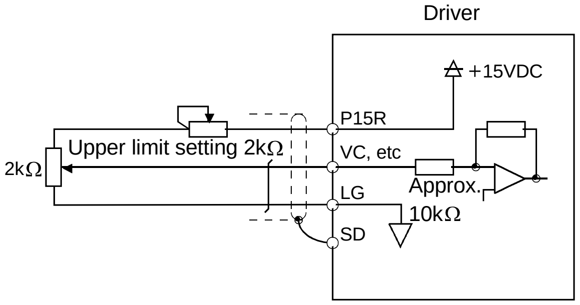


2) Output pulse

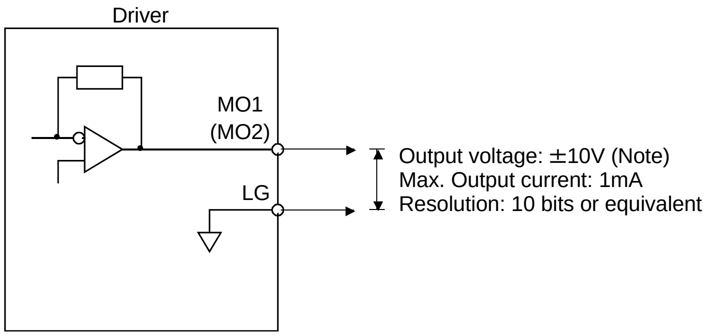


(5) Analog input

Input impedance 10 to 12kΩ



(6) Analog output

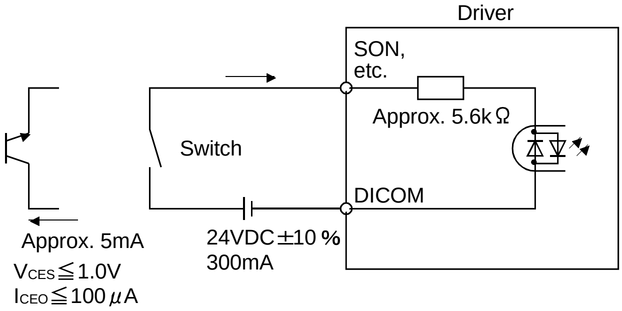


Note. Output voltage range varies depending on the monitored signal. (Refer to section 5.3.3.)
When connecting an analog output to an external device, use one whose withstand voltage is ±15VDC or more.

3.8.3 Source I/O interfaces

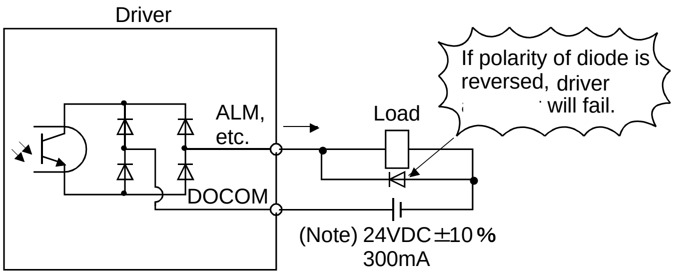
In this driver, source type I/O interfaces can be used. In this case, all DI-1 input signals and DO-1 output signals are of source type. Perform wiring according to the following interfaces.

(1) Digital input interface DI-1



(2) Digital output interface DO-1

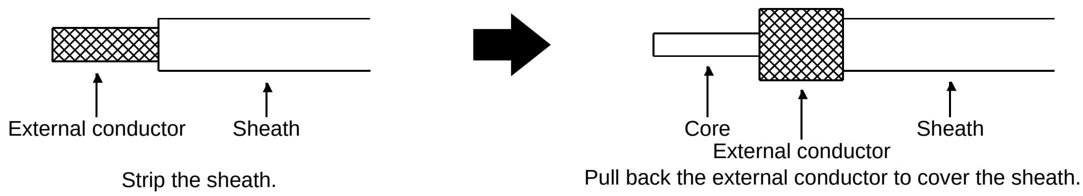
A maximum of 2.6V voltage drop occurs in the driver.



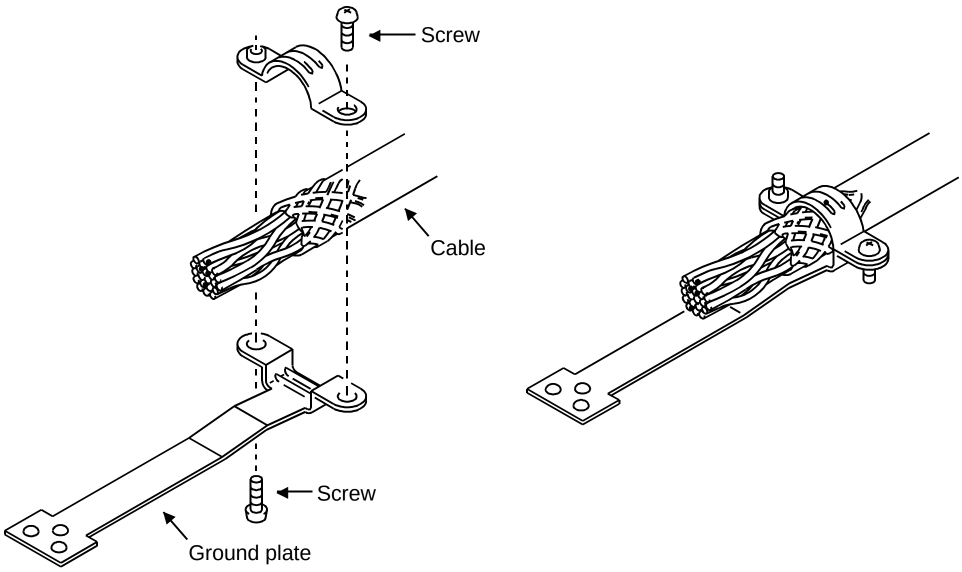
Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (up to 26.4V) from external source.

3.9 Treatment of cable shield external conductor

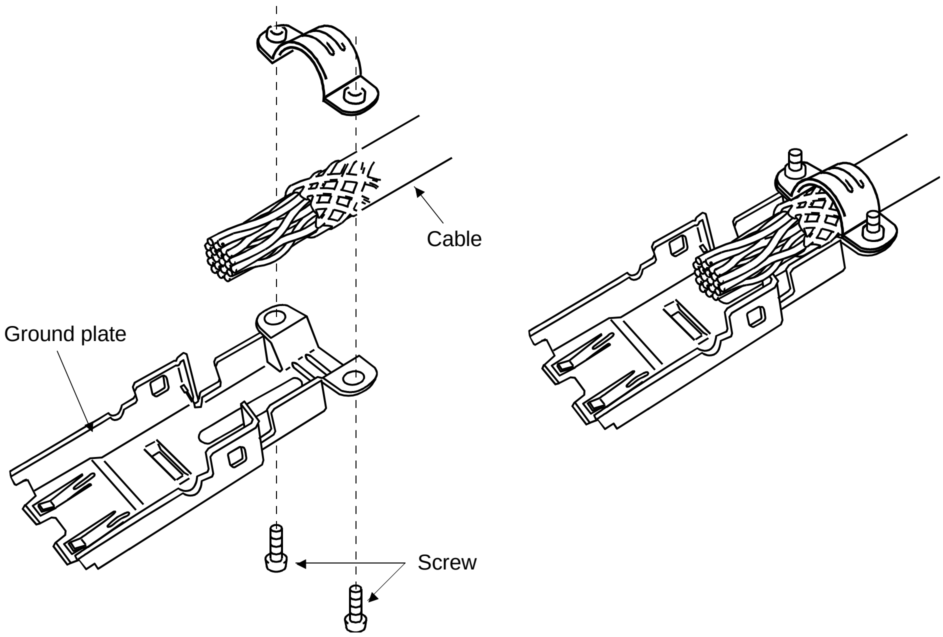
In the case of the CN1 and CN2 connectors, securely connect the shielded external conductor of the cable to the ground plate as shown in this section and fix it to the connector shell.



(1) For CN1 connector (Sumitomo 3M Limited connector)



(2) For CN2 connector (Sumitomo 3M Limited or Molex connector)



3.10 Connection of driver and servo motor

⚠WARNING	･During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

3.10.1 Connection instructions

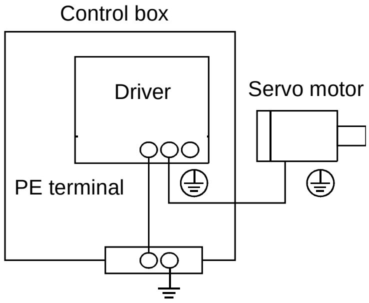
⚠WARNING	･Insulate the connections of the power supply terminals to prevent an electric shock.

⚠CAUTION	･Connect the wires to the correct phase terminals (U, V, W) of the driver and servo motor. Not doing so may cause unexpected operation. ･Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur. ･Do not use the 24VDC interface power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake. Otherwise, a fault may occur.

POINT
･Refer to section 12.1 for the selection of the encoder cable. ･Refer to the Servo Motor Instruction Manual (Vol.2) for the selection of a surge absorber for the electromagnetic brake.

This section indicates the connection of the motor power supply (U, V, W). Use of the optional cable or connector set is recommended for connection between the driver and servo motor. Refer to section 12.1 for details of the options.

(1) For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal of the driver and connect the ground cable of the driver to the earth via the protective earth of the control box. Do not connect them directly to the protective earth of the control panel.

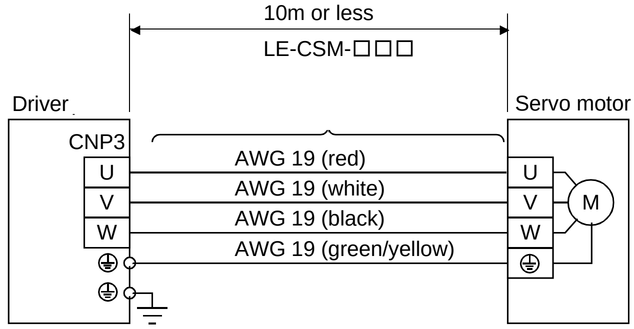


(2) Do not use the 24VDC interface power supply for the lock. Always use the power supply designed exclusively for the lock.

3.10.2 Power supply cable wiring diagrams

(1) LE-□-□ series servo motor

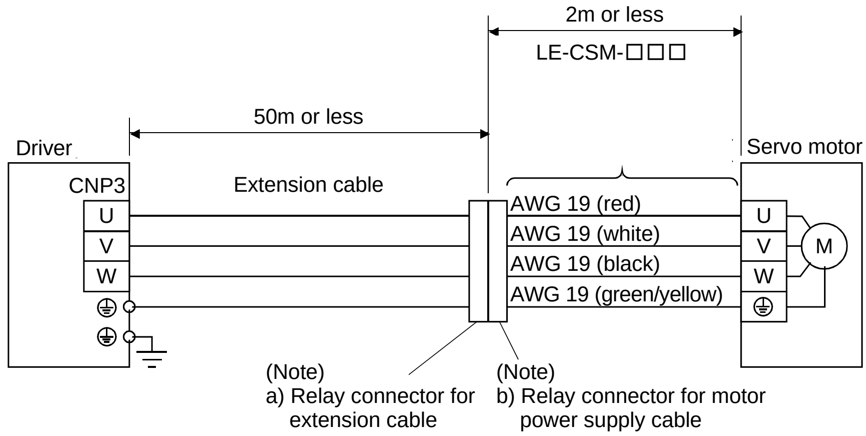
(a) When cable length is 10m or less



(b) When cable length exceeds 10m

When the cable length exceeds 10m, fabricate an extension cable as shown below. In this case, the motor power supply cable should be within 2m long.

Refer to section 12.5 for the wire used for the extension cable.



Note. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

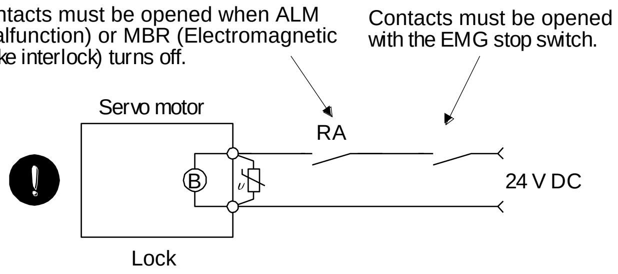
Relay connector	Description	IP rating
a) Relay connector for extension cable	Connector: RM15WTPZ-4P(71) Cord clamp: JR13WCC-5(72) (Hirose Electric) Numeral changes depending on the cable OD.	IP65
b) Relay connector for motor power supply cable	Connector: RM15WTJZ-4S(71) Cord clamp: JR13WCC-8(72) (Hirose Electric) Numeral changes depending on the cable OD.	IP65

3.11 Servo motor with a lock

3.11.1 Safety precautions

⚠ CAUTION

- Configure a lock circuit so that it is activated also by an external emergency stop switch.



- The lock is provided for holding purpose and must not be used for ordinary braking.
- Before performing the operation, be sure to confirm that the lock operates properly.
- Do not use the 24VDC interface power supply for the lock. Always use the power supply designed exclusively for the lock. Otherwise, a fault may occur.

POINT

- Refer to chapter 15 for specifications such as the power supply capacity and operation delay time of the lock.
- Refer to chapter 15 for the selection of a surge absorber for the lock.

Note the following when the servo motor with a lock is used.

1) Set "□□□1"in parameter No.PA04 to make the electromagnetic brake interlock (MBR) valid.

2) The lock will operate when the power (24VDC) switches off.

3) While the reset (RES) is on, the base circuit is shut off. When using the servo motor with a vertical shaft, use the electromagnetic brake interlock (MBR).

4) Switch off the servo-on (SON) after the servo motor has stopped.

3.11.2 Setting

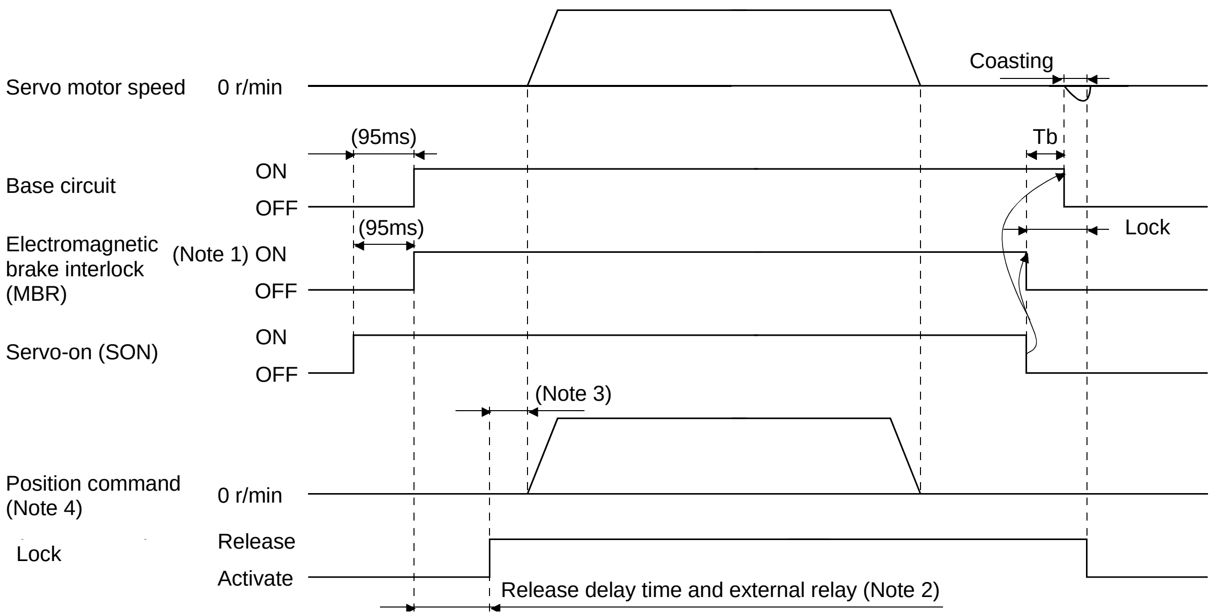
(1) Set "□□□1" in parameter No.PA04 to make the electromagnetic brake interlock (MBR) valid.

(2) Using parameter No.PC16 (electromagnetic brake sequence output), set a delay time (Tb) at servo-off from lock operation to base circuit shut-off as in the timing chart shown in section 3.11.3(1).

3.11.3 Timing charts

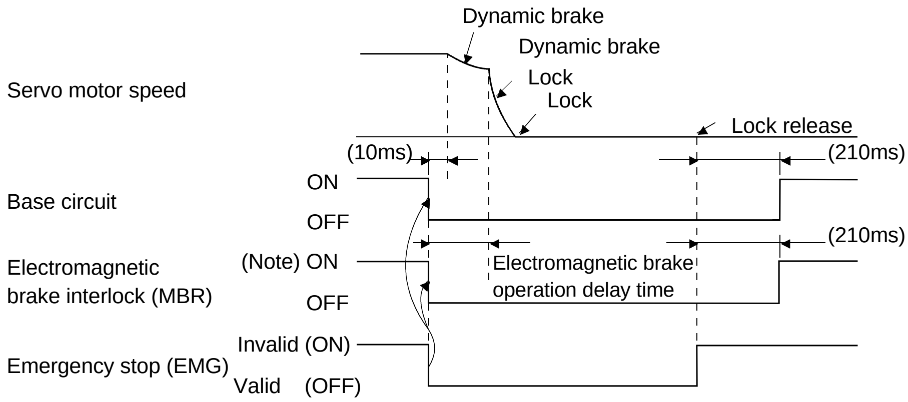
(1) Servo-on (SON) command (from driver) ON/OFF

Tb [ms] after the servo-on (SON) signal is switched off, the servo lock is released and the servo motor coasts. If the lock is made valid in the servo lock status, the lock life may be shorter. Therefore, when using the lock in a vertical lift application or the like, set Tb to about the same as the lock operation delay time to prevent a drop.



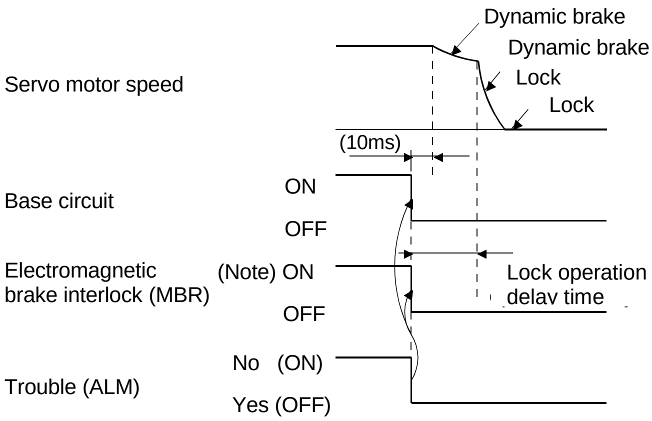
Note 1. ON: Lock is not activated.
OFF: Lock is activated.
2. Lock is released after delaying for the release delay time of lock and operation time of external circuit relay. For the release delay time of lock, refer to chapter 15.
3. Give a position command after the lock is released.
4. For the position control mode.

(2) Emergency stop (EMG) ON/OFF



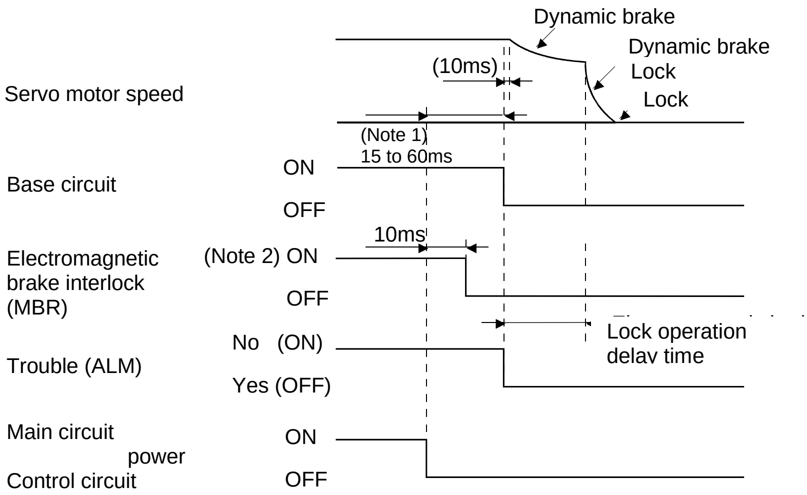
Note. ON: Lock is not activated.
OFF: Lock is activated.

(3) Alarm occurrence



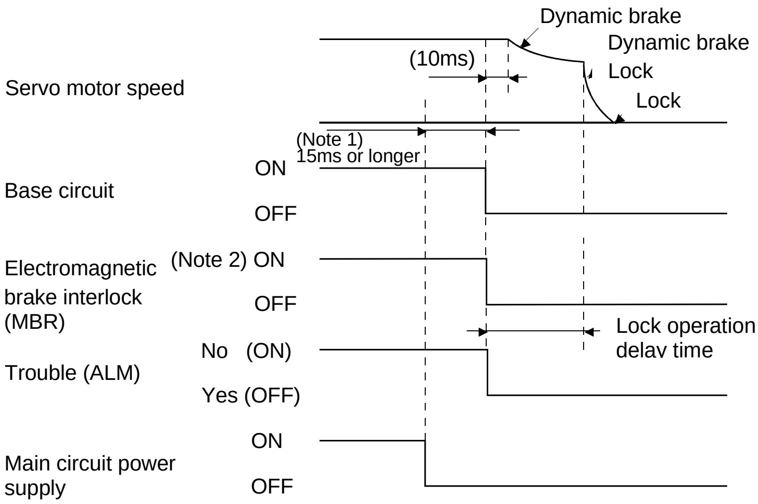
Note. ON: Lock is not activated.
OFF: Lock is activated.

(4) Both main and control circuit power supplies off



Note 1. Changes with the operating status.
2. ON: Lock is not activated.
OFF: Lock is activated.

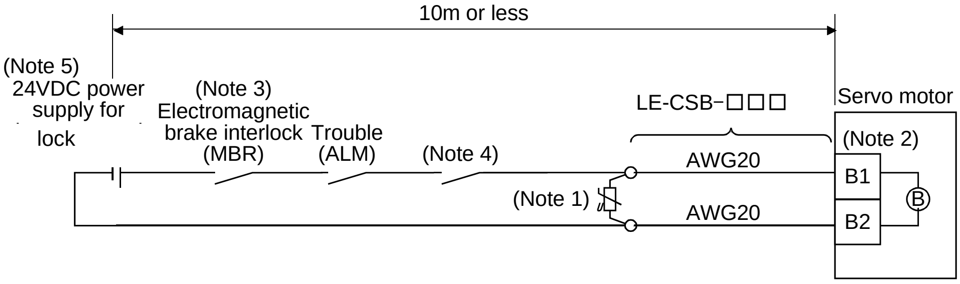
(5) Only main circuit power supply off (control circuit power supply remains on)



Note 1. Changes with the operating status.
2. ON: Lock is not activated.
OFF: Lock is activated.

3.11.4 Wiring diagrams (LE-□-□ series servo motor)

(1) When cable length is 10m or less



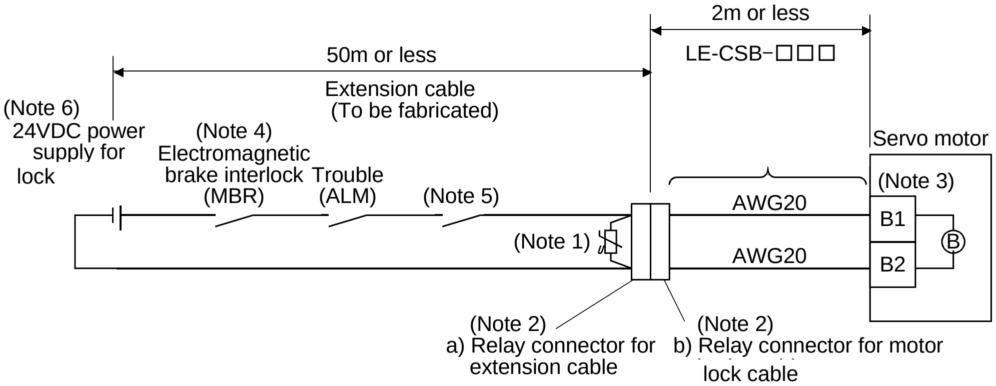
Note 1. Connect a surge absorber as close to the servo motor as possible.
2. There is no polarity in lock terminals (B1 and B2).
3. When using a servo motor with a lock, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.PA04, PD13 to PD16 and PD18.
4. Shut off the circuit by interlocking with the emergency stop switch.
5. Do not use the 24VDC interface power supply for the lock.

When fabricating the lock cable LE-CSB-R□A, refer to section 12.1.4.

(2) When cable length exceeds 10m

When the cable length exceeds 10m, fabricate an extension cable as shown below on the customer side. In this case, the lock cable should be within 2m long.

Refer to section 12.11 for the wire used for the extension cable.



Note 1. Connect a surge absorber as close to the servo motor as possible.

2. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

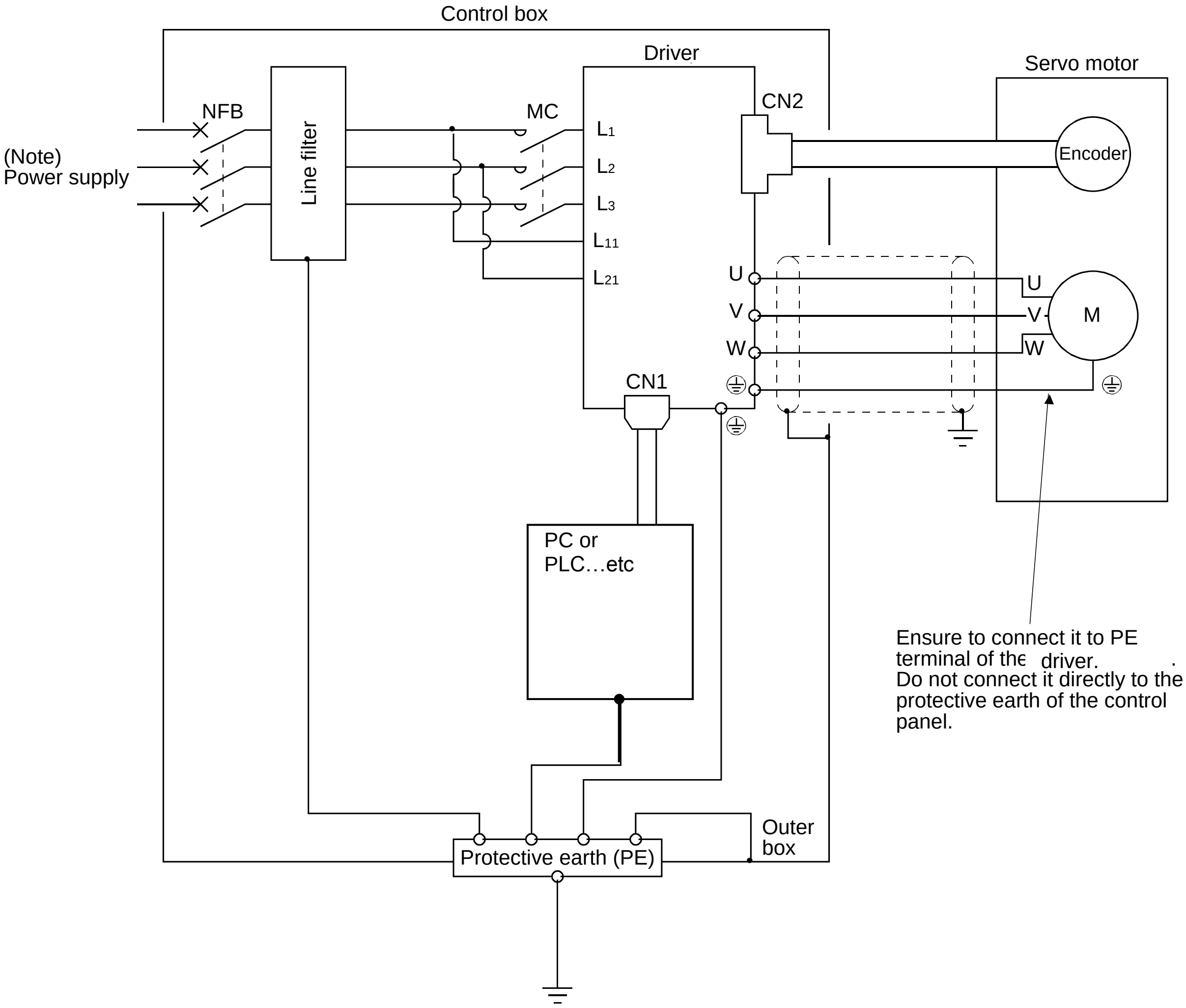
Relay connector	Description	IP rating
a) Relay connector for extension cable	CM10-CR2P-∗ (DDK) └ Wire size: S, M, L	IP65
b) Relay connector for lock cable	CM10-SP2S-∗ (D6) (DDK) └ Wire size: S, M, L	IP65

3. There is no polarity in lock terminals (B1 and B2).
4. When using a servo motor with a lock, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.PA04, PD13 to PD16 and PD18.
5. Shut off the circuit by interlocking with the emergency stop switch.
6. Do not use the 24VDC interface power supply for the lock.

3.12 Grounding

⚠ WARNING	・Ground the driver and servo motor securely. ・To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the driver with the protective earth (PE) of the control box.

The driver switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cable routing, the driver may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.
To conform to the EMC Directive, refer to the EMC Installation Guidelines (IB(NA)67310).



Note. For 1-phase 200 to 230VAC or 1-phase 100 to 120VAC, connect the power supply to L_1 ・ L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. For the specification of power supply, refer to section 1.3.

4. STARTUP

4. STARTUP

⚠ WARNING	· Do not operate the switches with wet hands. You may get an electric shock.

⚠ CAUTION	· Before starting operation, check the parameters. Some machines may perform unexpected operation. · Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the driver heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged. · During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

4.1 Switching power on for the first time

When switching power on for the first time, follow this section to make a startup.

4.1.1 Startup procedure

Wiring check	Check whether the driver and servo motor are wired correctly using visual inspection, output signal (DO) forced output (section 6.8), etc. (Refer to section 4.1.2.)
↓	
Surrounding environment check	Check the surrounding environment of the driver and servo motor. (Refer to section 4.1.3.)
↓	
Parameter setting	Set the parameters as necessary, such as the used control mode and regenerative option selection. (Refer to chapter 5 and sections 4.2.4, 4.3.4 and 4.4.4.)
↓	
Test operation of servo motor alone in test operation mode	For the test operation, with the servo motor disconnected from the machine and operated at the speed as low as possible, check whether the servo motor rotates correctly. (Refer to sections 6.9, 4.2.3, 4.3.3 and 4.4.3.)
↓	
Test operation of servo motor alone by commands	For the test operation with the servo motor disconnected from the machine and operated at the speed as low as possible, give commands to the driver and check whether the servo motor rotates correctly.
↓	
Test operation with servo motor and machine connected	Connect the servo motor with the machine, give operation commands from the host command device, and check machine motions.
↓	
Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 7.)
↓	
Actual operation	
↓	
Stop	Stop giving commands and stop operation. The other conditions where the servo motor will come to a stop are indicated in sections 4.2.2, 4.3.2 and 4.4.2.

4.1.2 Wiring check

(1) Power supply system wiring

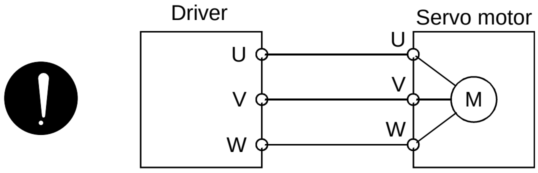
Before switching on the main circuit and control circuit power supplies, check the following items.

(a) Power supply system wiring

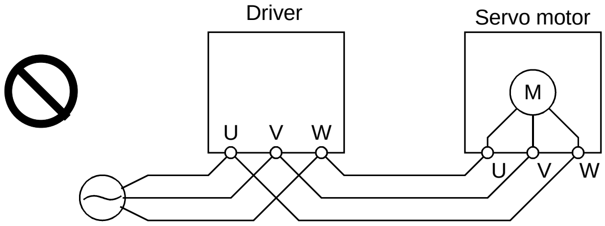
The power supplied to the power input terminals (L_1, L_2, L_3, L_{11}, L_{21}) of the driver should satisfy the defined specifications. (Refer to section 1.3.)

(b) Connection of driver and servo motor

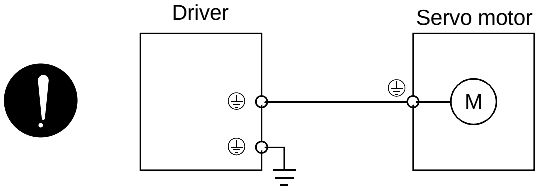
1) The servo motor power supply terminals (U, V, W) of the driver match in phase with the power input terminals (U, V, W) of the servo motor.



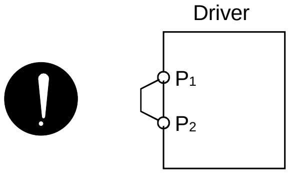
2) The power supplied to the driver should not be connected to the servo motor power supply terminals (U, V, W). To do so will fail the connected driver and servo motor.



3) The earth terminal of the servo motor is connected to the PE terminal of the driver.



4) P1-P2 (For 11k to 22kW, P1-P) should be connected.



(c) When option and auxiliary equipment are used

1) When regenerative option is used under 3.5kW for 200V class and 2kW for 400V class

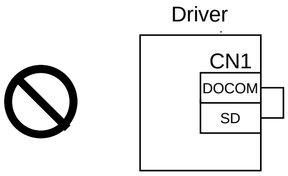
- The lead between P terminal and D terminal of CNP2 connector should not be connected.
- The generative brake option should be connected to P terminal and C terminal.
- A twisted cable should be used. (Refer to section 12.2)

(2) I/O signal wiring

(a) The I/O signals should be connected correctly.
Use DO forced output to forcibly turn on/off the pins of the CN1 connector. This function can be used to perform a wiring check. (Refer to section 6.8.) In this case, switch on the control circuit power supply only.

(b) 24VDC or higher voltage is not applied to the pins of connectors CN1.

(c) SD and DOCOM of connector CN1 is not shorted.



4.1.3 Surrounding environment

(1) Cable routing

(a) The wiring cables are free from excessive force.

(b) The encoder cable should not be used in excess of its flex life. (Refer to section 11.4.)

(c) The connector part of the servo motor should not be strained.

(2) Environment

Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

4.2 Startup in position control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the position control mode.

4.2.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off the servo-on (SON).

2) Make sure that a command pulse train is not input.

3) Switch on the main circuit power supply and control circuit power supply.
At power-on, "88888" appears instantaneously, but it is not an error.
When main circuit power/control circuit power is switched on, the display shows "C (Cumulative feedback pulses)", and in two second later, shows data.

In the absolute position detection system, first power-on results in the absolute position lost (AL.25) alarm and the servo system cannot be switched on.
The alarm can be deactivated then switching power off once and on again.
Also in the absolute position detection system, if power is switched on at the servo motor speed of 3000r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(2) Power-off

1) Make sure that a command pulse train is not input.

2) Switch off the Servo-on (SON).

3) Switch off the main circuit power supply and control circuit power supply.

4.2.2 Stop

In any of the following statuses, the driver interrupts and stops the operation of the servo motor.
Refer to section 3.11 for the servo motor with a lock.

(a) Servo-on (SON) OFF
The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF
The droop pulses are erased and the servo motor is stopped and servo-locked. It can be run in the opposite direction.

4.2.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.2.1 for the power on and off methods of the driver.

Test operation of servo motor alone in JOG operation of test operation mode

In this step, confirm that the driver and servo motor operate normally.
With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 6.9 for the test operation mode.

↓

Test operation of servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When a pulse train is input from the command device, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the servo motor does not operate in the intended direction, check the input signal.

↓

Test operation with servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When a pulse train is input from the command device, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display or software (MR Configurator2™), check for any problems of the servo motor speed, command pulse frequency, load ratio, etc.
4) Then, check automatic operation with the program of the command device.

4.2.4 Parameter setting

POINT
・The encoder cable LE-CSE-□□□ requires the parameter No.PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (At power on) (AL.16) will occur at power-on.

Servo motor	Encoder cable	Parameter No.PC22 setting
LE-□-□ series	LE-CSE-□□□	0□□□(initial value)

In the position control mode, the driver can be used by merely changing the basic setting parameters (No.PA□□) mainly.
As necessary, set the gain filter parameters (No.PB□□), extension setting parameters (No.PC□□) and I/O setting parameters (No.PD□□).

Parameter group	Main description
Basic setting parameter (No.PA□□)	Set the basic setting parameters first. Generally, operation can be performed by merely setting this parameter group. In this parameter group, set the following items. Control mode selection (select the position control mode) Regenerative option selection Absolute position detection system selection Setting of command input pulses per revolution Electronic gear setting Auto tuning selection and adjustment In-position range setting Torque limit setting Command pulse input form selection Servo motor rotation direction selection Encoder output pulse setting
Gain filter parameter (No.PB□□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain changing function is used.
Extension setting parameter (No.PC□□)	This parameter group must be set when multiple electronic gears, analog monitor outputs or analog inputs are used.
(Note) I/O setting parameter (No.PD□□)	Used when changing the I/O devices of the driver.

Note. The parameter No.PA19 setting must be changed when this parameter group is used.

4.2.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings. Perform a home position return as necessary.

4.2.6 Trouble at start-up

CAUTION	
	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT

・Using the optional software (MR Configurator2™), you can refer to unrotated servo motor reasons, etc.

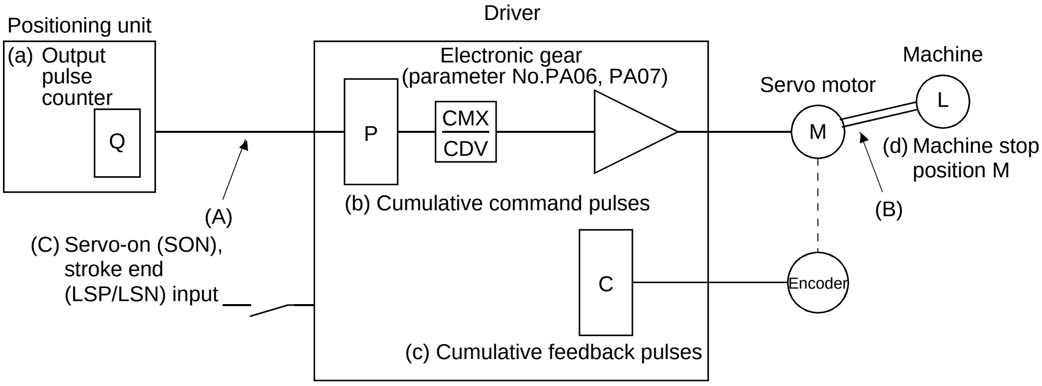
The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

(1) Troubleshooting

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Driver is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to section 9.2 and remove cause.		Section 9.2
2	Switch on servo-on (SON).	Alarm occurs.	Refer to section 9.2 and remove cause.		Section 9.2
		Servo motor shaft is not servo-locked (is free).	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 6.7) to see if the servo-on (SON) is ON.	1. Servo-on (SON) is not input. (Wiring mistake) 2. 24VDC power is not supplied to DICOM.	Section 6.7
3	Enter input command. (Test operation)	Servo motor does not rotate.	Check the cumulative command pulse on the status display or software (MR Configurator2™) (section 6.3).	1. Wiring mistake (a) For open collector pulse train input, 24VDC power is not supplied to OPC. (b) LSP and LSN are not on. 2. Pulse train is not input from the driver. 3. Electromagnetic brake is operating.	Section 6.3
			Check if the Ready (RD) is ON.		
			Check the parameter No.PA13 (command pulse input form) setting.		
			Check if the Electromagnetic brake interlock (MBR) is ON.		
		Servo motor run in reverse direction.	Check the cumulative command pulse on the status display or software (MR Configurator2™).	1. Mistake in wiring to driver. 2. Mistake in setting of parameter No.PA14.	Chapter 5
			Check the parameter No.PA14 (rotation direction selection) setting.		

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
5	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	(2) in this section

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter, (b) cumulative command pulse display, (c) cumulative feedback pulse display, and (d) machine stop position in the above diagram.
(A), (B) and (C) indicate position shift causes. For example, (A) indicates that noise entered the wiring between positioning unit and driver, causing pulses to be miss-counted.

In a normal status without position shift, there are the following relationships.

1) Q = P (positioning unit's output counter = driver's cumulative command pulses)

2) When using the electronic gear

$$P \cdot \frac{\text{CMX (parameter No.PA06)}}{\text{CDV (parameter No.PA07)}}$$

= C (cumulative command pulses × electronic gear = cumulative feedback pulses)

3) When using parameter No.PA05 to set the number of pulses per servo motor one rotation.

$$P \cdot \frac{262144}{\text{FBP (parameter No.PA05)}} = C$$

4) $C \cdot \Delta \ell = M$ (cumulative feedback pulses × travel per pulse = machine position)

Check for a position shift in the following sequence.

1) When $Q \neq P$

Noise entered the pulse train signal wiring between positioning unit and driver, causing pulses to be miss-counted. (Cause A)

Make the following check or take the following measures.

- Check how the shielding is done.
- Change the open collector system to the differential line driver system.
- Run wiring away from the power circuit.
- Install a data line filter. (Refer to section 12.17 (2)(a).)

2) When $P \cdot \frac{CMX}{CDV} \neq C$

During operation, the servo-on (SON) or forward/reverse rotation stroke end was switched off or the clear (CR) and the reset (RES) switched on. (Cause C)

If a malfunction may occur due to much noise, increase the input filter setting (parameter No.PD19).

3) When $C \cdot \Delta \ell \neq M$

Mechanical slip occurred between the servo motor and machine. (Cause B)

4.3 Startup in speed control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the speed control mode.

4.3.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

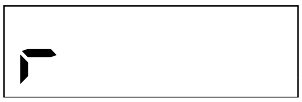
1) Switch off the servo-on (SON).

2) Make sure that the Forward rotation start (ST1) and Reverse rotation start (ST2) are off.

3) Switch on the main circuit power supply and control circuit power supply.

At power-on, "88888" appears instantaneously, but it is not an error.

When main circuit power/control circuit power is switched on, the display shows "r (servo motor speed)", and in two second later, shows data.



(2) Power-off

1) Switch off the Forward rotation start (ST1) or Reverse rotation start (ST2).

2) Switch off the Servo-on (SON).

3) Switch off the main circuit power supply and control circuit power supply.

4.3.2 Stop

In any of the following statuses, the driver interrupts and stops the operation of the servo motor.
Refer to section 3.11 for the servo motor with a lock.

(a) Servo-on (SON) OFF
The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Stroke end (LSP/LSN) OFF
The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2)
The servo motor is decelerated to a stop.

POINT
・A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

4.3.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.3.1 for the power on and off methods of the driver.

Test operation of servo motor alone in JOG operation of test operation mode

In this step, confirm that the driver and servo motor operate normally.
With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 6.9 for the test operation mode.

↓

Test operation of servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When the analog speed command (VC) is input from the command device and the Forward rotation start (ST1) or Reverse rotation start (ST2) is switched on, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the servo motor does not operate in the intended direction, check the input signal.

↓

Test operation with servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When the analog speed command (VC) is input from the command device and the Forward rotation start (ST1) or Reverse rotation start (ST2) is switched on, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display or software (MR Configurator2™), check for any problems of the servo motor speed, load ratio, etc.
4) Then, check automatic operation with the program of the command device.

4.3.4 Parameter setting

POINT
· The encoder cable LE-CSE-□□□for the series servo motor requires the parameter No.PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (At power on) (AL.16) will occur at power-on.

Servo motor	Encoder cable	Parameter No.PC22 setting
LE-□-□ series	LE-CSE-□□□	0□□□(initial value)

When using this servo in the speed control mode, change the parameter No.PA01 setting to select the speed control mode. In the speed control mode, the servo can be used by merely changing the basic setting parameters (No.PA□□) and extension setting parameters (No.PC□□) mainly.
As necessary, set the gain filter parameters (No.PB□□) and I/O setting parameters (No.PD□□).

Parameter group	Main description
Basic setting parameter (No.PA□□)	Set the basic setting parameters first. In this parameter group, set the following items. Control mode selection (select the speed control mode) Regenerative option selection Auto tuning selection and adjustment Torque limit setting Encoder output pulse setting
Gain filter parameter (No.PB□□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain changing function is used.
Extension setting parameter (No.PC□□)	In this parameter group, set the following items. Acceleration/deceleration time constant S-pattern acceleration/deceleration time constant Internal speed command Analog speed command maximum speed Analog speed command offset In addition, this parameter group must be set when analog monitor output, torque limit, etc. are used.
(Note) I/O setting parameter (No.PD□□)	Used when changing the I/O devices of the driver.

Note. The parameter No.PA19 setting must be changed when this parameter group is used.

4.3.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.3.6 Trouble at start-up

CAUTION	
⚠ CAUTION	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT

- Using the software (MR Configurator2™), you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Driver is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to section 9.2 and remove cause.		Section 9.2
2	Switch on servo-on (SON).	Alarm occurs.	Refer to section 9.2 and remove cause.		Section 9.2
		Servo motor shaft is not servo-locked (is free).	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 6.7) to see if the servo-on (SON) is ON.	1. Servo-on (SON) is not input. (Wiring mistake) 2. 24VDC power is not supplied to DICOM.	Section 6.7
3	Switch on forward rotation start (ST1) or reverse rotation start (ST2).	Servo motor does not rotate.	Call the status display or software (MR Configurator2™) and check the input voltage of the analog speed command (VC).	Analog speed command is 0V.	Section 6.3
			Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	LSP, LSN, ST1 or ST2 is off.	Section 6.7
			Check the internal speed commands 1 to 7 (parameters No.PC05 to PC11).	Set value is 0.	Section 5.1.9
			Check the forward rotation torque limit (Parameter No.PA11) or reverse rotation torque limit (Parameter No.PA12)	Torque limit level is too low as compared to the load torque.	
			When the analog torque limit (TLA) is usable, check the input voltage on the status display or software (MR Configurator2™).	Torque limit level is too low as compared to the load torque.	

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure. Increase the auto tuning response level. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7

4.4 Startup in torque control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the torque control mode.

4.4.1 Power on and off procedures

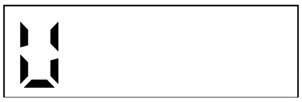
(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off the servo-on (SON).

2) Make sure that the Forward rotation selection (RS1) and Reverse rotation selection (RS2) are off.

3) Switch on the main circuit power supply and control circuit power supply.
At power-on, "88888" appears instantaneously, but it is not an error.
When main circuit power/control circuit power is switched on, the display shows "U (torque command voltage)", and in two second later, shows data.



(2) Power-off

1) Switch off the Forward rotation selection (RS1) or Reverse rotation selection (RS2).

2) Switch off the Servo-on (SON).

3) Switch off the main circuit power supply and control circuit power supply.

4.4.2 Stop

In any of the following statuses, the driver interrupts and stops the operation of the servo motor.
Refer to section 3.11 for the servo motor with a lock.

(a) Servo-on (SON) OFF
The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Simultaneous ON or simultaneous OFF of forward rotation selection (RS1) and reverse rotation selection (RS2)
The servo motor coasts.

POINT
· A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

4.4.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.4.1 for the power on and off methods of the driver.

Step	Description
Test operation of servo motor alone in JOG operation of test operation mode	In this step, confirm that the driver and servo motor operate normally. With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor correctly rotates at the slowest speed. Refer to section 6.9 for the test operation.
↓	
Test operation of servo motor alone by commands	In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device. Make sure that the servo motor rotates in the following procedure. 1) Switch on the Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on. 2) When the analog speed command (TC) is input from the command device and the Forward rotation start (RS1) or Reverse rotation start (RS2) is switched on, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the servo motor does not operate in the intended direction, check the input signal.
↓	
Test operation with servo motor and machine connected	In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the command device. Make sure that the servo motor rotates in the following procedure. 1) Switch on the Servo-on (SON). When the driver is put in a servo-on status, the Ready (RD) switches on. 2) When the analog speed command (TC) is input from the command device and the Forward rotation start (RS1) or Reverse rotation start (RS2) is switched on, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. In the status display or software (MR Configurator2™), check for any problems of the servo motor speed, load ratio, etc. 3) Then, check automatic operation with the program of the command device.

4.4.4 Parameter setting

POINT
・The encoder cable LE-CSE-□□□ for the LE-□-□ series servo motor requires the parameter No.PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (At power on) (AL.16) will occur at power-on.

Servo motor	Encoder cable	Parameter No.PC22 setting
LE-□-□ series	LE-CSE-□□□	0□□□(initial value)

When using this servo in the torque control mode, change the parameter No.PA01 setting to select the torque control mode. In the torque control mode, the servo can be used by merely changing the basic setting parameters (No.PA□□) and extension setting parameters (No.PC□□) mainly.
As necessary, set the I/O setting parameters (No.PD□□).

Parameter group	Main description
Basic setting parameter (No.PA□□)	Set the basic setting parameters first. In this parameter group, set the following items. Control mode selection (select the torque control mode) Regenerative option selection Torque limit setting Encoder output pulse setting
Gain filter parameter (No.PB□□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain changing function is used.
Extension setting parameter (No.PC□□)	In this parameter group, set the following items. Acceleration/deceleration time constant S-pattern acceleration/deceleration time constant Internal torque command Analog torque command maximum speed Analog torque command offset In addition, this parameter group must be set when analog monitor output, speed limit, etc. are used.
(Note) I/O setting parameter (No.PD□□)	Used when changing the I/O devices of the driver.

Note. The parameter No.PA19 setting must be changed when this parameter group is used.

4.4.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.4.6 Trouble at start-up

CAUTION	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT
・Using the software (MR Configurator2 ™), you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Driver is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
2	Switch on servo-on (SON).	Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
		Servo motor shaft is free.	Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	1. Servo-on (SON) is not input. (Wiring mistake) 2. 24VDC power is not supplied to DICOM.	Section 6.7
3	Switch on forward rotation start (RS1) or reverse rotation start (RS2).	Servo motor does not rotate.	Call the status display or software (MR Configurator2 ™) (section 6.3) and check the analog torque command (TC).	Analog torque command is 0V.	Section 6.3
			Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	RS1 or RS2 is off.	Section 6.7
			Check the internal speed limits 1 to 7 (parameters No.PC05 to PC11).	Set value is 0.	Section 5.3
			Check the analog torque command maximum output (parameter No.26) value.	Torque command level is too low as compared to the load torque.	
			Check the internal torque limit 1 (parameter No.PC13).	Set value is 0.	Section 5.1.11

5. PARAMETERS

⚠CAUTION	・Never adjust or change the parameter values extremely as it will make operation instable. ・When a fixed number is indicated in each digit of a parameter, do not change the value by any means.

In this driver, the parameters are classified into the following groups on a function basis.

Parameter group	Main description
Basic setting parameters (No.PA□□)	When using this driver in the position control mode, make basic setting with these parameters.
Gain/filter parameters (No.PB□□)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No.PC□□)	When using this driver in the speed control mode or torque control mode, mainly use these parameters.
I/O setting parameters (No.PD□□)	Use these parameters when changing the I/O signals of the driver.

When using this servo in the position control mode, mainly setting the basic setting parameters (No.PA□□) allows the setting of the basic parameters at the time of introduction.

5.1 Basic setting parameters (No.PA□□)

POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

5.1.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PA01	*STY	Control mode	0000h		○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○
PA03	*ABS	Absolute position detection system	0000h		○		
PA04	*AOP1	Function selection A-1	0000h		○	○	○
PA05	*FBP	Number of command input pulses per revolution	0		○		
PA06	CMX	Electronic gear numerator (Command pulse multiplying factor numerator)	1		○		
PA07	CDV	Electronic gear denominator (Command pulse multiplying factor denominator)	1		○		
PA08	ATU	Auto tuning mode	0001h		○	○	
PA09	RSP	Auto tuning response	12		○	○	
PA10	INP	In-position range	100	pulse	○		
PA11	TLP	Forward rotation torque limit	100.0	%	○	○	○
PA12	TLN	Reverse rotation torque limit	100.0	%	○	○	○
PA13	*PLSS	Command pulse input form	0000h		○		
PA14	*POL	Rotation direction selection	0		○		
PA15	*ENR	Encoder output pulses	4000	pulse/rev	○	○	○

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PA16		For manufacturer setting	0000h				
PA17			0000h				
PA18			0000h				
PA19	*BLK	Parameter write inhibit	000Bh		○	○	○

5.1.2 Parameter write inhibit

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA19	*BLK	Parameter write inhibit	000Bh		Refer to the text.	○	○	○

POINT

- Turn off the power and then on again after setting the parameter to validate the parameter value.

In the factory setting, this driver allows changes to the basic setting parameter, gain/filter parameter and extension setting parameter settings. With the setting of parameter No.PA19, writing can be disabled to prevent accidental changes.
The following table indicates the parameters which are enabled for reference and writing by the setting of parameter No.PA19. Operation can be performed for the parameters marked ○.

Parameter No.PA19 setting	Setting operation	Basic setting parameters No.PA□□	Gain/Filter parameters No.PB□□	Extension setting parameters No.PC□□	I/O setting parameters No.PD□□
0000h	Reference	○			
	Writing	○			
000Bh (initial value)	Reference	○	○	○	
	Writing	○	○	○	
000Ch	Reference	○	○	○	○
	Writing	○	○	○	○
100Bh	Reference	○			
	Writing	Parameter No. PA19 only			
100Ch	Reference	○	○	○	○
	Writing	Parameter No. PA19 only			

5.1.3 Selection of control mode

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA01	*STY	Control mode	0000h		Refer to the text.	○	○	○

> POINT
>
> ・Turn off the power and then on again after setting the parameter to validate the parameter value.

Parameter No.PA01

0	0	0	

Selection of control mode
0: Position control mode
1: Position control mode and speed control mode
2: Speed control mode
3: Speed control mode and torque control mode
4: Torque control mode
5: Torque control mode and position control mode

The following control mode can be selected for applicable actuators.
Please refer 「3. SIGNALS AND WIRING」 and「5. PARAMETERS」 about wiring and parameter setting.

Table. Applicable control mode.

（○：Applicable, ×：Inapplicable）

Driver type	Actuator type	Control mode Note 1) 2) （Selected by parameter number PA1.）		
		Position control	**Speed control**	**Torque control**
LECSB（Absolute）	LEY	○	○Note 2)	○Note2)
	LEF	○	×	×
	LEJ	○	×	×
Command method		[Pulse train]	[ON/OFF Signal]	[ON/OFF Signal]
Operation method		Positioning operation	Setting speed operation	Setting torque operation

Note 1. The control change mode cannot be used.
Note 2. Make the moving range limitation by external sensor etc to avoid actuator hitting to the work piece or stroke end.
When using the thrush control, the following parameter should be set.
If not, it will cause malfunction.
LECSB ： The value of the parameter value [PC13] “Analog torque maximum output command” should be 30 (Maximum thrush of the product) or less. (LEY63 : 50% or less).

When the control equivalent to the pushing operation of the controller LECP series is performed, select the LECSS / LECSS-T driver and combine it with the Motion or Simple Motion (manufactured by Mitsubishi Electric Corporation) which has a pushing operation function.

5.1.4 Selection of regenerative option

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA02	*REG	Regenerative option	0000h		Refer to the text.	○	○	○

POINT

- Turn off the power and then on again after setting the parameter to validate the parameter value.
- Incorrect setting may cause the regenerative option to burn.
- If the regenerative option selected is not for use with the driver, parameter error (AL.37) occurs.

Set this parameter when using the regenerative option, brake unit, power regenerative converter, or power regenerative common converter.

Parameter No.PA02

0	0		

Selection of regenerative option
00: Regenerative option is not used
- For 100W driver regenerative resistor is not used
- For 200W driver regenerative resistor is used

02: LEC-MR-RB-032
03: LEC-MR-RB-12

5.1.5 Using absolute position detection system

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA03	*ABS	Absolute position detection system	0000h		Refer to the text.	○		

> **POINT**
> - Turn off the power and then on again after setting the parameter to validate the parameter value.

Set this parameter when using the absolute position detection system in the position control mode.

Parameter No.PA03

0	0	0	

Selection of absolute position detection system (Refer to chapter 14)
0: Used in incremental system
1: Used in absolute position detection system
ABS transfer by DI0
2: Used in absolute position detection system
ABS transfer by communication

5.1.6 Using electromagnetic brake interlock (MBR)

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA04	*AOP1	Function selection A-1	0000h		Refer to the text.	○	○	○

> **POINT**
> - Turn off the power and then on again after setting the parameter to validate the parameter value.

Set this parameter when assigning the electromagnetic brake to the CN1-23 pin.

Parameter No.PA04

0	0	0	

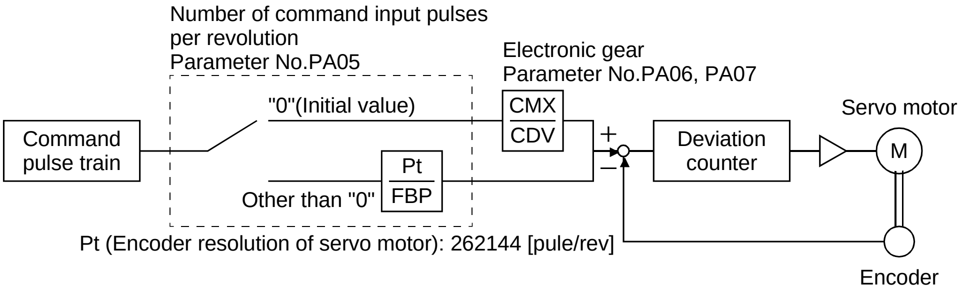
CN1-23 pin function selection
0: Output device assigned with parameter No.PD14
1: Electromagnetic brake interlock (MBR)

5.1.7 Number of command input pulses per servo motor revolution

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA05	*FBP	Number of command input pulses per revolution	0		0・1000 to 50000	○		

POINT
・Turn off the power and then on again after setting the parameter to validate the parameter value.

When "0" (initial value) is set in parameter No.PA05, the electronic gear (parameter No.PA06, PA07) is made valid. When the setting is other than "0", that value is used as the command input pulses necessary to rotate the servo motor one turn. At this time, the electronic gear is made invalid.



Parameter No.PA05 setting	Description
0	Electronic gear (parameter No.PA06, PA07) is made valid.
1000 to 50000	Number of command input pulses necessary to rotate the servo motor one turn [pulse]

5.1.8 Electronic gear

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA06	CMX	Electronic gear numerator (command pulse multiplying factor numerator)	1		1 to 1048576	○		
PA07	CDV	Electronic gear denominator (command pulse multiplying factor denominator)	1		1 to 1048576	○		

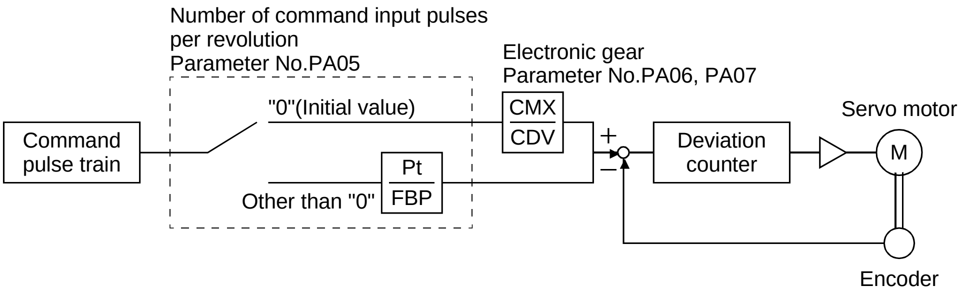
CAUTION · Incorrect setting can lead to unexpected fast rotation, causing injury.

POINT

- The electronic gear setting range is $\frac{1}{10} < \frac{CMX}{CDV} < 2000$.
  If the set value is outside this range, noise may be generated during acceleration/ deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.
- Always set the electronic gear with servo off state to prevent unexpected operation due to improper setting.

(1) Concept of electronic gear

The machine can be moved at any multiplication factor to input pulses.



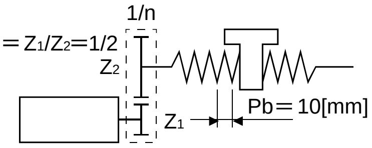
$$\frac{CMX}{CDV} = \frac{\text{Parameter No.PA06}}{\text{Parameter No.PA07}}$$

The following setting examples are used to explain how to calculate the electronic gear.

POINT

- The following specification symbols are required to calculate the electronic gear
  - Pb : Ball screw lead [mm]
  - 1/n : Reduction ratio
  - Pt : Encoder resolution of servo motor [pulses/rev]
  - $\Delta \ell 0$: Travel per command pulse [mm/pulse]
  - ΔS : Travel per servo motor revolution [mm/rev]
  - $\Delta\theta^{\circ}$: Angle per pulse [° /pulse]
  - $\Delta\theta$: Angle per revolution [° /rev]

(a) For motion in increments of 10μm per pulse



Encoder resolution of servo motor
262144[pulse/rev]

Machine specifications

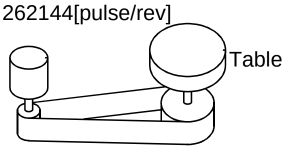
Ball screw lead Pb =10 [mm]
Reduction ratio: $1/n = Z_1/Z_2 = 1/2$
Z_1: Number of gear teeth at the servo motor side
Z_2: Number of gear teeth at the axis side
Encoder resolution of servo motor: Pt = 262144 [pulse/rev]

$$\frac{CMX}{CDV} = \Delta\ell_0 \cdot \frac{Pt}{\Delta S} = \Delta\ell_0 \cdot \frac{Pt}{n \cdot Pb} = 10\times10^{-3} \cdot \frac{262144}{1/2 \cdot 10} = \frac{524288}{1000} = \frac{65536}{125}$$

Hence, set 65538 to CMX and 125 to CDV.

(b) Conveyor setting example
For rotation in increments of 0.01° per pulse

Encoder resolution of servo motor
262144[pulse/rev]



Timing belt: 625/12544

Machine specifications

Table : 360° /rev
Reduction ratio: $1/n = P_1/P_2 = 625/12544$
P_1: Pulley diameter at the servo motor side
P_2: Pulley diameter at the axis side
Encoder resolution of servo motor: Pt = 262144 [pulse/rev]

$$\frac{CMX}{CDV} = \Delta\theta^\circ \cdot \frac{Pt}{\Delta\theta} = 0.01 \cdot \frac{262144}{625/12544 \cdot 360} = \frac{102760448}{703125} \quad \text{(5.1)}$$

Since CMX is not within the setting range in this status, it must be reduced to the lowest term.
When CMX has been reduced to a value within the setting range, round off the value to the nearest unit.

$$\frac{CMX}{CDV} = \frac{102760448}{703125} = \frac{822083.6}{5625} \cong \frac{822084}{5625}$$

Hence, set 822084 to CMX and 5625 to CDV.

POINT

- For unlimited one-way rotation, e.g. an index table, indexing positions will be missed due to cumulative error produced by rounding off.
- For example, entering a command of 36000 pulses in the above example causes the table to rotate only.

$$36000 \cdot \frac{822084}{5625} \cdot \frac{1}{262144} \cdot \frac{625}{12544} \cdot 360^\circ = 360.00018^\circ$$

- Therefore, indexing cannot be done in the same position on the table.

(2) Instructions for reduction

The calculated value before reduction must be as near as possible to the calculated value after reduction. In the case of (1), (b) in this section, an error will be smaller if reduction is made to provide no fraction for CDV. The fraction of Expression (5.1) before reduction is calculated as follows.

$$\frac{CMX}{CDV}=\frac{102760448}{703125}=146.1481927 \quad \cdots\cdots (5.2)$$

The result of reduction to provide no fraction for CMX is as follows.

$$\frac{CMX}{CDV}=\frac{102760448}{703125}=\frac{917504}{6277.9}\fallingdotseq\frac{917504}{6278}=146.1459063 \quad \cdots\cdots (5.3)$$

The result of reduction to provide no fraction for CDV is as follows.

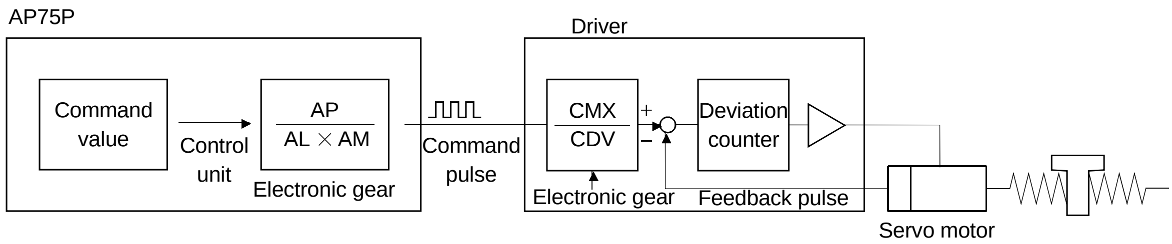
$$\frac{CMX}{CDV}=\frac{102760448}{703125}=\frac{822083.6}{5625}\fallingdotseq\frac{822084}{5625}=146.1482667 \quad \cdots\cdots (5.4)$$

As a result, it is understood that the value nearer to the calculation result of Expression (5.2) is the result of Expression (5.4). Accordingly, the set values of (1), (b) in this section are CMX=822084, CDV=5625.

(3) Setting for use of QD75

The QD75 also has the following electronic gear parameters. Normally, the driver side electronic gear must also be set due to the restriction on the command pulse frequency (differential 1Mpulse/s, open collector 200kpulse/s).

AP: Number of pulses per servo motor revolution
AL: Moving distance per servo motor revolution
AM: Unit scale factor



The encoder resolution of the servo motor is 262144 pulses/rev. For example, the pulse command required to rotate the servo motor is as follows.

Servo motor speed [r/min]	Required pulse command
2000	262144 × 2000/60=8738133 [pulse/s]
3000	262144 × 3000/60=13107200 [pulse/s]

Use the electronic gear of the driver to rotate the servo motor under the maximum output pulse command of the QD75.

To rotate the servo motor at 3000r/min in the open collector system (200kpulse/s), set the electronic gear as follows.

$$f \cdot \frac{CMX}{CDV} = \frac{N_0}{60} \cdot Pt$$

f : Input pulses frequency [pulse/s]
N_0 : Servo motor speed [r/min]
Pt : Encoder resolution of servo motor [pulse/rev]

$$200 \cdot 10^3 \cdot \frac{CMX}{CDV} = \frac{3000}{60} \cdot 262144$$

$$\frac{CMX}{CDV} = \frac{3000}{60} \cdot \frac{262144}{200 \cdot 10^3} = \frac{3000 \cdot 262144}{60 \cdot 200000} = \frac{8192}{125}$$

The following table indicates the electronic gear setting example (ball screw lead = 10mm) when the QD75 is used in this way.

Rated servo motor speed				3000r/min		2000r/min	
Driver	Input system			Open collector	Differential line driver	Open collector	Differential line driver
	Max. input pulse frequency [pulse/s]			200k	1M	200k	1M
	Feedback pulse/revolution [pulse/rev]			262144		262144	
	Electronic gear (CMX/CDV)			8192/125	8192/625	16384/375	16384/1875
QD75	Command pulse frequency [kpulse/s] (Note)			200k	1M	200k	1M
	Number of pulses per servo motor revolution as viewed from QD75[pulse/rev]			4000	20000	6000	30000
	Electronic gear	Minimum command unit 1pulse	AP	1	1	1	1
			AL	1	1	1	1
			AM	1	1	1	1
		Minimum command unit 0.1μm	AP	4000	20000	6000	30000
			AL	100.0[μm]	100.0[μm]	100.0[μm]	100.0[μm]
			AM	10	10	10	10

Note. Command pulse frequency at rated speed

POINT

- In addition to the setting method using the electronic gear given here, the number of pulses per servo motor revolution can also be set directly using parameter No.PA05. In this case, parameter No.PA05 is the "Number of pulses per servo motor revolution as viewed from QD75".

5.1.9 Auto tuning

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA08	ATU	Auto tuning mode	0001h		Refer to the text.	○	○	
PA09	RSP	Auto tuning response	12		1 to 32	○	○	

Make gain adjustment using auto tuning. Refer to section 7.2 for details.

(1) Auto tuning mode (parameter No.PA08)

Select the gain adjustment mode.

Parameter No.PA08

0	0	0	

Gain adjustment mode setting

Setting	Gain adjustment mode	Automatically set parameter No. (Note)
0	Interpolation mode	PB06・PB08・PB09・PB10
1	Auto tuning mode 1	PB06・PB07・PB08・PB09・PB10
2	Auto tuning mode 2	PB07・PB08・PB09・PB10
3	Manual mode	

Note. The parameters have the following names.

Parameter No.	Name
PB06	Ratio of load inertia moment to servo motor inertia moment
PB07	Model loop gain
PB08	Position loop gain
PB09	Speed loop gain
PB10	Speed integral compensation

(2) Auto tuning response (parameter No.PA09)

If the machine hunts or generates large gear sound, decrease the set value. To improve performance, e.g. shorten the settling time, increase the set value.

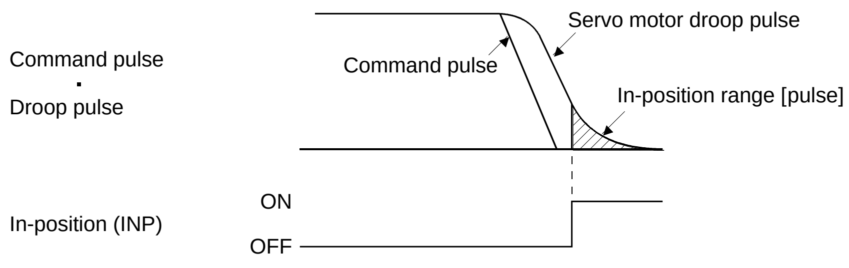
Setting	Response	Guideline for machine resonance frequency [Hz]	Setting	Response	Guideline for machine resonance frequency [Hz]
1	Low response	10.0	17	Middle response	67.1
2		11.3	18		75.6
3		12.7	19		85.2
4		14.3	20		95.9
5		16.1	21		108.0
6		18.1	22		121.7
7		20.4	23		137.1
8		23.0	24		154.4
9		25.9	25		173.9
10		29.2	26		195.9
11		32.9	27		220.6
12		37.0	28		248.5
13		41.7	29		279.9
14		47.0	30		315.3
15		52.9	31		355.1
16	Middle response	59.6	32	High response	400.0

5.1.10 In-position range

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA10	INP	In-position range	100	pulse	0 to 65535 (Note)	○		

Note. For the software version C0 or older drivers, the setting range is 0 to 10,000.

Set the range, where In-position (INP) is output, in the command pulse unit before calculation of the electronic gear. With the setting of parameter No.PC24, the range can be changed to the encoder output pulse unit.



5.1.11 Torque limit

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA11	TLP	Forward rotation torque limit	100.0	%	0 to 100.0	○	○	○
PA12	TLN	Reverse rotation torque limit	100.0	%	0 to 100.0	○	○	○

The torque generated by the servo motor can be limited. Refer to section 3.6.1 (5) and use these parameters. When torque is output with the analog monitor output, the smaller torque of the values in the parameter No.PA11 (forward rotation torque limit) and parameter No.PA12 (reverse rotation torque limit) is the maximum output voltage (8V).

(1) Forward rotation torque limit (parameter No.PA11)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CCW driving mode or CW regeneration mode. Set this parameter to "0.0" to generate no torque.

(2) Reverse rotation torque limit (parameter No.PA12)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CW driving mode or CCW regeneration mode. Set this parameter to "0.0" to generate no torque.

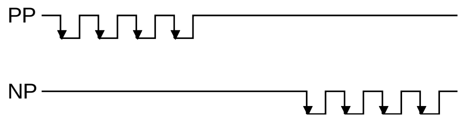
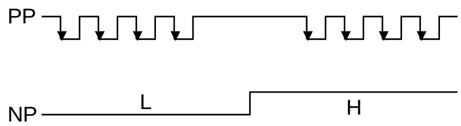
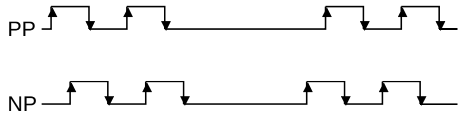
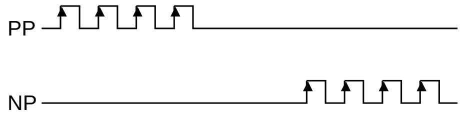
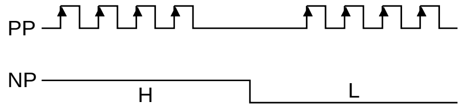
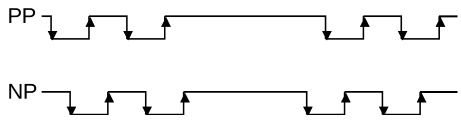
5.1.12 Selection of command pulse input form

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA13	*PLSS	Command pulse input form	0000h		Refer to the text.	○		

> **POINT**
> - Turn off the power and then on again after setting the parameter to validate the parameter value.

Select the input form of the pulse train input signal. Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen.
Arrow or in the table indicates the timing of importing a pulse train.
A- and B-phase pulse trains are imported after they have been multiplied by 4.

Selection of command pulse input form

Setting	Pulse train form		Forward rotation command	Reverse rotation command
0010h	Negative logic	Forward rotation pulse train Reverse rotation pulse train		
0011h		Signed pulse train		
0012h		A-phase pulse train B-phase pulse train		
0000h	Positive logic	Forward rotation pulse train Reverse rotation pulse train		
0001h		Signed pulse train		
0002h		A-phase pulse train B-phase pulse train		

5.1.13 Selection of servo motor rotation direction

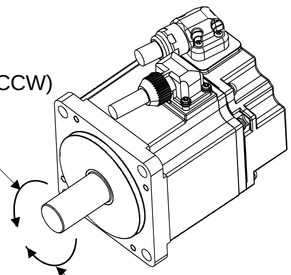
Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA14	*POL	Rotation direction selection	0		0・1	○		

POINT

- Turn off the power and then on again after setting the parameter to validate the parameter value.

Select servo motor rotation direction relative to the input pulse train.

Parameter No.PA14 setting	Servo motor rotation direction	
	When forward rotation pulse is input	When reverse rotation pulse is input
0	CCW	CW
1	CW	CCW



5.1.14 Encoder output pulse

Parameter			Initial value	Unit	Setting range	Control mode		
No.	Symbol	Name				Position	Speed	Torque
PA15	*ENR	Encoder output pulse	4000	pulse/rev	1 to 100000	○	○	○

POINT

- Turn off the power and then on again after setting the parameter to validate the parameter value.

Used to set the encoder pulses (A-phase, B-phase) output by the driver.
Set the value 4 times greater than the A-phase or B-phase pulses.
You can use parameter No.PC19 to choose the output pulse setting or output division ratio setting.
The number of A/B-phase pulses actually output is 1/4 times greater than the preset number of pulses.
The maximum output frequency is 4.6Mpps (after multiplication by 4). Use this parameter within this range.

(1) For output pulse designation
Set "□□0□" (initial value) in parameter No.PC19.
Set the number of pulses per servo motor revolution.
Output pulse = set value [pulses/rev]
For instance, set "5600" to parameter No.PA15, the actually output A/B-phase pulses are as indicated below.

A/B-phase output pulses $= \frac{5600}{4} = 1400$ [pulse]

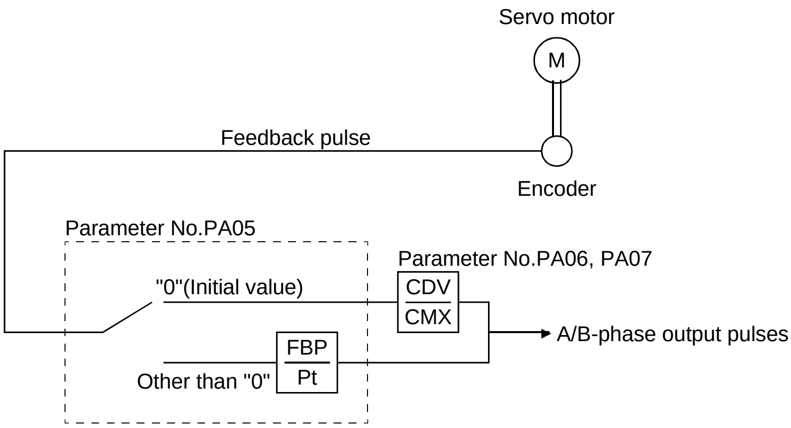
(2) For output division ratio setting
Set "□□1□" in parameter No.PC19.
The number of pulses per servo motor revolution is divided by the set value.

Output pulse $= \frac{\text{Resolution per servo motor revolution}}{\text{Set value}}$ [pulses/rev]

For instance, set "8" to parameter No.PA15, the actually A/B-phase pulses output are as indicated below.

A/B-phase output pulses $= \frac{262144}{8} \cdot \frac{1}{4} = 8192$ [pulse]

(3) When outputting pulse train similar to command pulses
Set parameter No.PC19 to "□□2□". The feedback pulses from the servo motor encoder are processed and output as shown below. The feedback pulses can be output in the same pulse unit as the command pulses.



5.2 Gain/filter parameters (No.PB□□)

POINT

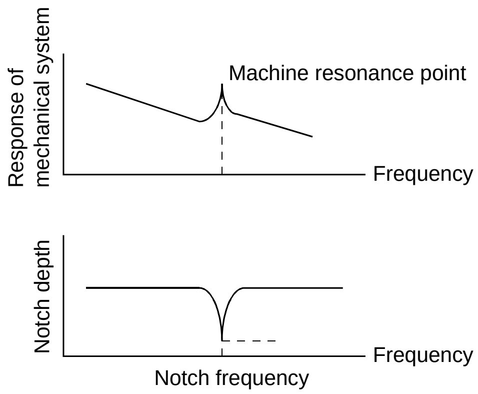
- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

5.2.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	0000h		○	○	
PB02	VRFT	Vibration suppression control tuning mode (Advanced vibration suppression control)	0000h		○		
PB03	PST	Position command acceleration/deceleration time constant (Position smoothing)	0	ms	○		
PB04	FFC	Feed forward gain	0	%	○		
PB05		For manufacturer setting	500				
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	7.0	Multiplier (×1)	○	○	
PB07	PG1	Model loop gain	24	rad/s	○	○	
PB08	PG2	Position loop gain	37	rad/s	○		
PB09	VG2	Speed loop gain	823	rad/s	○	○	
PB10	VIC	Speed integral compensation	33.7	ms	○	○	
PB11	VDC	Speed differential compensation	980		○	○	
PB12	OVA	Overshoot amount compensation	0	%	○		
PB13	NH1	Machine resonance suppression filter 1	4500	Hz	○	○	
PB14	NHQ1	Notch shape selection 1	0000h		○	○	
PB15	NH2	Machine resonance suppression filter 2	4500	Hz	○	○	
PB16	NHQ2	Notch shape selection 2	0000h		○	○	
PB17		Automatic setting parameter					
PB18	LPF	Low-pass filter setting	3141	rad/s	○	○	
PB19	VRF1	Vibration suppression control vibration frequency setting	100.0	Hz	○		
PB20	VRF2	Vibration suppression control resonance frequency setting	100.0	Hz	○		
PB21		For manufacturer setting	0.00				
PB22			0.00				
PB23	VFBF	Low-pass filter selection	0000h		○	○	
PB24	*MVS	Slight vibration suppression control selection	0000h		○		
PB25	*BOP1	Function selection B-1	0000h		○		
PB26	*CDP	Gain changing selection	0000h		○	○	
PB27	CDL	Gain changing condition	10		○	○	
PB28	CDT	Gain changing time constant	1	ms	○	○	
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	7.0	Multiplier (×1)	○	○	
PB30	PG2B	Gain changing position loop gain	37	rad/s	○		
PB31	VG2B	Gain changing speed loop gain	823	rad/s	○	○	
PB32	VICB	Gain changing speed integral compensation	33.7	ms	○	○	
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	100.0	Hz	○		
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	100.0	Hz	○		

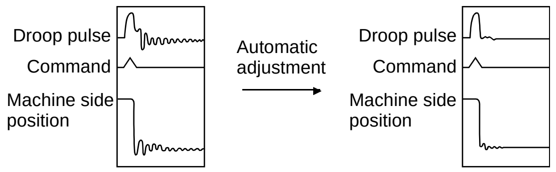
No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PB35		For manufacturer setting	0.00				
PB36			0.00				
PB37			100				
PB38			0.0				
PB39			0.0				
PB40			0.0				
PB41			1125				
PB42			1125				
PB43			0004h				
PB44			0000h				
PB45	CNHF	Vibration suppression control filter 2	0000h		○		

5.2.2 Detail list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB01</td><td>FILT</td><td>Adaptive tuning mode (adaptive filter Ⅱ)
Select the setting method for filter tuning. Setting this parameter to "□□□1" (filter tuning mode) automatically changes the machine resonance suppression filter 1 (parameter No.PB13) and notch shape selection 1 (parameter No.PB14).


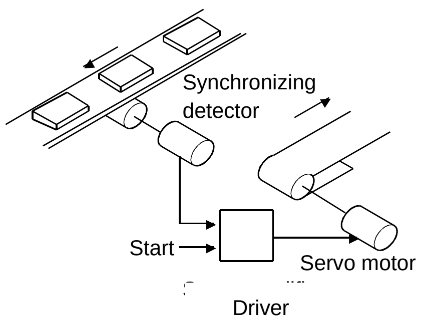
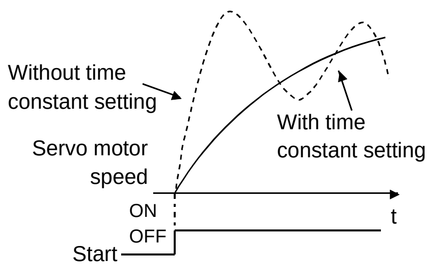
0 0 0 □
Adaptive tuning mode selection
<table>
<tr><th>Setting</th><th>Adaptive tuning mode</th><th>Automatically set parameter</th></tr>
<tr><td>0</td><td>Filter OFF</td><td>(Note)</td></tr>
<tr><td>1</td><td>Filter tuning mode</td><td>Parameter No.PB13
Parameter No.PB14</td></tr>
<tr><td>2</td><td>Manual mode</td><td></td></tr>
</table>
Note. Parameter No.PB13 and PB14 are fixed to the initial values.

When this parameter is set to "□□□1", the tuning is completed after positioning operation is done the predetermined number or times for the predetermined period of time, and the setting changes to "□□□2". When the adaptive tuning is not necessary, the setting changes to "□□□0". When this parameter is set to "□□□0", the initial values are set to the machine resonance suppression filter 1 and notch shape selection 1. However, this does not occur when the servo off.</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB02</td><td>VRFT</td><td>Vibration suppression control tuning mode (advanced vibration suppression control)
The vibration suppression is valid when the parameter No.PA08 (auto tuning mode) setting is "□□□2" or "□□□3". When PA08 is "□□□1", vibration suppression is always invalid.
Select the setting method for vibration suppression control tuning. Setting this parameter to "□□□1" (vibration suppression control tuning mode) automatically changes the vibration suppression control - vibration frequency (parameter No.PB19) and vibration suppression control - resonance frequency (parameter No.PB20) after positioning is done the predetermined number of times.


0 0 0 □
Vibration suppression control tuning mode
<table>
<tr><th>Setting</th><th>Vibration suppression control tuning mode</th><th>Automatically set parameter</th></tr>
<tr><td>0</td><td>Vibration suppression control OFF</td><td>(Note)</td></tr>
<tr><td>1</td><td>Vibration suppression control tuning mode (Advanced vibration suppression control)</td><td>Parameter No.PB19
Parameter No.PB20</td></tr>
<tr><td>2</td><td>Manual mode</td><td></td></tr>
</table>
Note. Parameter No.PB19 and PB20 are fixed to the initial values.

When this parameter is set to "□□□1", the tuning is completed after positioning operation is done the predetermined number or times for the predetermined period of time, and the setting changes to "□□□2". When the vibration suppression control tuning is not necessary, the setting changes to "□□□0". When this parameter is set to "□□□0", the initial values are set to the vibration suppression control - vibration frequency and vibration suppression control - resonance frequency. However, this does not occur when the servo off.</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td></td><td></td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PB03	PST	Position command acceleration/deceleration time constant (position smoothing) Used to set the time constant of a low-pass filter in response to the position command. You can use parameter No.PB25 to choose the primary delay or linear acceleration/deceleration control system. When you choose linear acceleration/deceleration, the setting range is 0 to 10ms. Setting of longer than 10ms is recognized as 10ms. **POINT** ・When you have chosen linear acceleration/deceleration, do not select control selection (parameter No.PA01) and restart after instantaneous power failure (parameter No.PC22). Doing so will cause the servo motor to make a sudden stop at the time of position control switching or restart. (Example) When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation.  	0	ms	0 to 20000	○		
PB04	FFC	Feed forward gain Set the feed forward gain. When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1s or longer as the acceleration time constant up to the rated speed.	0	%	0 to 100	○		

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PB05		For manufacturer setting Do not change this value by any means.	500					
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used. (Refer to section 7.1.1) In this case, it varies between 0 and 100.0.	7.0	Multi-plier (×1)	0 to 300.0	○	○	
PB07	PG1	Model loop gain Set the response gain up to the target position. Increase the gain to improve track ability in response to the command. When auto turning mode 1・2 is selected, the result of auto turning is automatically used.	24	rad/s	1 to 2000	○	○	
PB08	PG2	Position loop gain Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1・2 and interpolation mode is selected, the result of auto tuning is automatically used.	37	rad/s	1 to 1000	○		
PB09	VG2	Speed loop gain Used to set the gain of the speed loop. Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1・2, manual mode and interpolation mode is selected, the result of auto tuning is automatically used.	823	rad/s	20 to 50000 (Note)	○	○	
PB10	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. Lower setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1・2 and interpolation mode is selected, the result of auto tuning is automatically used.	33.7	ms	0.1 to 1000.0	○	○	
PB11	VDC	Speed differential compensation Used to set the differential compensation. Made valid when the proportion control (PC) is switched on.	980		0 to 1000	○	○	

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB12</td><td>OVA
(Note)</td><td>Overshoot amount compensation
Used to suppress overshoot in position control.
Overshoot can be suppressed in machines with high friction.
Set a control ratio against the friction torque in percentage unit.
Overshoot amount compensation can be set as shown in the following table in parameter No.PA01 (control mode).

<table><tr><th>Parameter No.PA01</th><th>Overshoot amount compensation</th></tr><tr><td>0</td><td rowspan="2">Set value of parameter No.PB12</td></tr><tr><td>3</td></tr><tr><td>4</td><td rowspan="2">Automatically set (5%) when "0" is set in parameter No.PB12
Set value of parameter No.PB12 when a value other than "0" is set in parameter No.PB12</td></tr><tr><td>5</td></tr></table></td><td>0</td><td>%</td><td>0
to
100</td><td>○</td><td></td><td></td></tr>
<tr><td>PB13</td><td>NH1</td><td>Machine resonance suppression filter 1
Set the notch frequency of the machine resonance suppression filter 1.
Setting parameter No.PB01 (Adaptive tuning mode (Adaptive filter Ⅱ)) to "□□□1" automatically changes this parameter.
When the parameter No.PB01 setting is "□□□0", the setting of this parameter is ignored.</td><td>4500</td><td>Hz</td><td>100
to
4500</td><td>○</td><td>○</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB14</td><td>NHQ1</td><td>Notch shape selection 1
Used to selection the machine resonance suppression filter 1.

0 □ □ 0

Notch depth selection
<table>
<tr><th>Setting value</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width selection
<table>
<tr><th>Setting value</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table>

Setting parameter No.PB01 (Adaptive tuning mode (Adaptive filter Ⅱ)) to "□□□1" automatically changes this parameter.
When the parameter No.PB01 setting is "□□□0", the setting of this parameter is ignored.</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB15</td><td>NH2</td><td>Machine resonance suppression filter 2
Set the notch frequency of the machine resonance suppression filter 2.
Set parameter No.PB16 (notch shape selection 2) to "□□□1" to make this parameter valid.</td><td>4500</td><td>Hz</td><td>100
to
4500</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB16</td><td>NHQ2</td><td>Notch shape selection 2
Select the shape of the machine resonance suppression filter 2.
0 □ □ □
Machine resonance suppression filter 2 selection
0: Invalid
1: Valid
Notch depth selection
<table>
<tr><th>Setting value</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width selection
<table>
<tr><th>Setting value</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table>
</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB17</td><td></td><td>Automatic setting parameter
The value of this parameter is set according to a set value of parameter No.PB06 (Ratio of load inertia moment to servo motor inertia moment).</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PB18</td><td>LPF</td><td>Low-pass filter setting
Set the low-pass filter.
Setting parameter No.PB23 (low-pass filter selection) to "□□0□" automatically changes this parameter.
When parameter No.PB23 is set to "□□1□", this parameter can be set manually.</td><td>3141</td><td>rad/s</td><td>100
to
18000</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB19</td><td>VRF1</td><td>Vibration suppression control vibration frequency setting
Set the vibration frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration.
Setting parameter No.PB02 (vibration suppression control tuning mode) to "□□□1" automatically changes this parameter. When parameter No.PB02 is set to "□□□2", this parameter can be set manually.</td><td>100.0</td><td>Hz</td><td>0.1
to
100.0</td><td>○</td><td></td><td></td></tr>
<tr><td>PB20</td><td>VRF2</td><td>Vibration suppression control resonance frequency setting
Set the resonance frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration.
Setting parameter No.PB02 (vibration suppression control tuning mode) to "□□□1" automatically changes this parameter. When parameter No.PB02 is set to "□□□2", this parameter can be set manually.</td><td>100.0</td><td>Hz</td><td>0.1
to
100.0</td><td>○</td><td></td><td></td></tr>
<tr><td>PB21</td><td rowspan="2"></td><td>For manufacturer setting</td><td>0.00</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>PB22</td><td>Do not change this value by any means.</td><td>0.00</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PB23	VFBF	Low-pass filter selection Select the low-pass filter. 0 0 □ 0 Low-pass filter selection 0: Automatic setting 1: Manual setting (parameter No.PB18 setting) When automatic setting has been selected, select the filter that has the band width close to the one calculated with $\frac{VG2 \cdot 10}{1 + GD2}$ [rad/s]	0000h		Refer to name and function column.	○	○	
PB24	*MVS	Slight vibration suppression control selection Select the slight vibration suppression control. When parameter No.PA08 (auto tuning mode) is set to "□□□3", the slight vibration suppression control is made valid. 0 0 0 □ Slight vibration suppression control selection 0: Invalid 1: Valid	0000h		Refer to name and function column.	○		
PB25	*BOP1	Function selection B-1 Select the control systems for position command acceleration/deceleration time constant (parameter No.PB03). 0 0 □ 0 Control of position command acceleration/deceleration time constant 0: Primary delay 1: Linear acceleration/deceleration When linear acceleration/deceleration is selected, do not execute control switching after instantaneous power failure. The servo motor will make a sudden stop during the control switching or automatic restart.	0000h		Refer to name and function column.	○		

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PB26	*CDP	Gain changing selection Select the gain changing condition. (Refer to section 8.6.) 0 0 □ □ Gain changing selection (last digit) Under any of the following conditions, the gains change on the basis of the parameter No.PB29 to PB34 settings. 0: Invalid 1: Input device (Gain changing (CDP)) 2: Command frequency (Parameter No.PB27 setting) 3: Droop pulse (Parameter No.PB27 setting) 4: Servo motor speed (Parameter No.PB27 setting) Gain changing condition (third digit) 0: Valid when the input device (gain changing (CDP)) is ON, or valid when the value is equal to or larger than the value set in parameter No.PB27 1: Valid when the input device (gain changing (CDP)) is OFF, or valid when the value is equal to or smaller than the value set in parameter No.PB27	0000h		Refer to name and function column.	○	○	

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PB27	CDL	Gain changing condition Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No.PB26.The set value unit changes with the changing condition item. (Refer to section 8.6.)	10	kpps pulse r/min	0 to 9999	○	○	
PB28	CDT	Gain changing time constant Used to set the time constant at which the gains will change in response to the conditions set in parameters No.PB26 and PB27. (Refer to section 8.6.)	1	ms	0 to 100	○	○	
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment Used to set the ratio of load inertia moment to servo motor inertia moment when gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	7.0	Multi- plier (×1)	0 to 300.0	○	○	
PB30	PG2B	Gain changing position loop gain Set the position loop gain when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	37	rad/s	1 to 2000	○		
PB31	VG2B	Gain changing speed loop gain Set the speed loop gain when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	823	rad/s	20 to 20000	○	○	
PB32	VICB	Gain changing speed integral compensation Set the speed integral compensation when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	33.7	ms	0.1 to 5000.0	○	○	
PB33	VRF1B	Gain changing vibration suppression control - vibration frequency setting Set the vibration frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when the parameter No.PB02 setting is "□□□2" and the parameter No.PB26 setting is "□□□1". When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.	100.0	Hz	0.1 to 100.0	○		
PB34	VRF2B	Gain changing vibration suppression control - resonance frequency setting Set the resonance frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when the parameter No.PB02 setting is "□□□2" and the parameter No.PB26 setting is "□□□1". When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.	100.0	Hz	0.1 to 100.0	○		

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB35</td><td rowspan="10"></td><td rowspan="10">For manufacturer setting
Do not change this value by any means.</td><td>0.00</td><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10"></td><td rowspan="10"></td></tr>
<tr><td>PB36</td><td>0.00</td></tr>
<tr><td>PB37</td><td>100</td></tr>
<tr><td>PB38</td><td>0.0</td></tr>
<tr><td>PB39</td><td>0.0</td></tr>
<tr><td>PB40</td><td>0.0</td></tr>
<tr><td>PB41</td><td>1125</td></tr>
<tr><td>PB42</td><td>1125</td></tr>
<tr><td>PB43</td><td>0004h</td></tr>
<tr><td>PB44</td><td>0000h</td></tr>
<tr><td>PB45</td><td>CNHF</td><td>Vibration suppression control filter 2
Used to set the vibration suppression control filter 2.
By setting this parameter, machine side vibration, such as workpiece end vibration and base shake, can be suppressed.

0□□□

Vibration suppression control filter 2 setting frequency selection (Note 2)
<table>
<tr><th>Setting value</th><th>Frequency [Hz]</th></tr>
<tr><td>0</td><td>Invalid</td></tr>
<tr><td>1
to
5F</td><td>2250
to
4.5</td></tr>
</table>
Notch depth selection (Note 2)
<table>
<tr><th>Setting value</th><th>Depth</th></tr>
<tr><td>0
to
F</td><td>−40.0dB
to
−0.6dB</td></tr>
</table>

2. Refer to section 8.7 for the setting details.</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td></td><td></td></tr>
</table>

5.2.3 Position smoothing

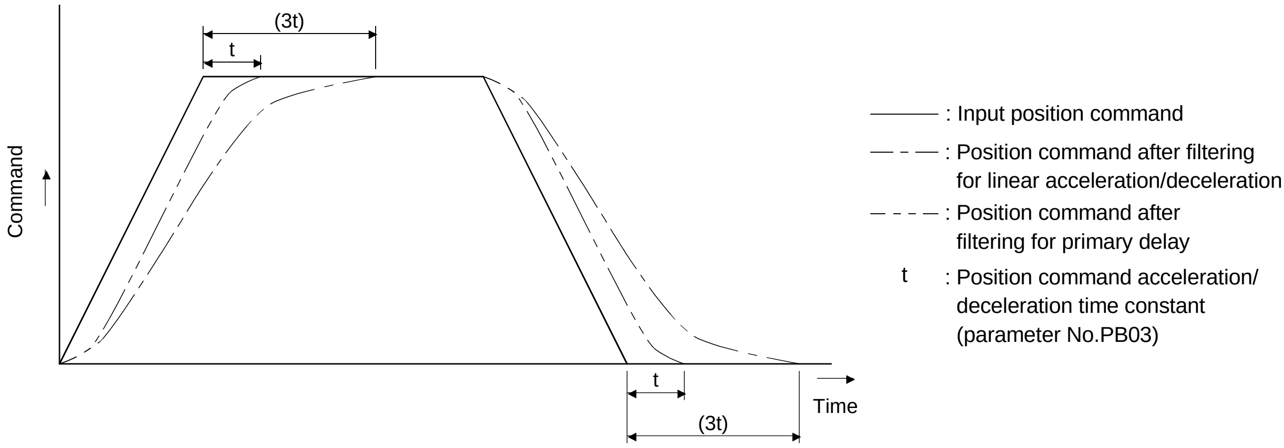
By setting the position command acceleration/deceleration time constant (parameter No.PB03), you can run the servo motor smoothly in response to a sudden position command.

The following diagrams show the operation patterns of the servo motor in response to a position command when you have set the position command acceleration/deceleration time constant.

Choose the primary delay or linear acceleration/deceleration in parameter No.PB25 according to the machine used.

(1) For trapezoidal input

For trapezoidal input (linear acceleration/deceleration), the setting range is 0 to 10ms.



5.3 Extension setting parameters (No.PC□□)

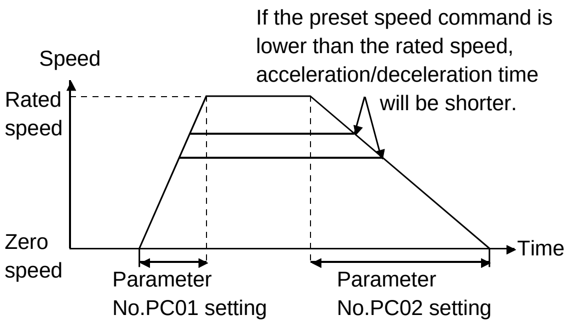
POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

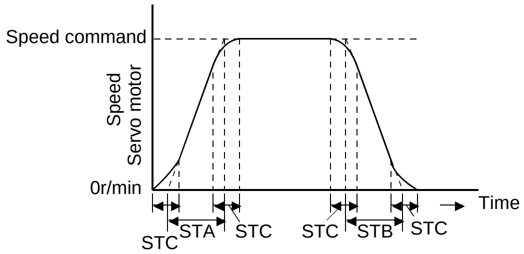
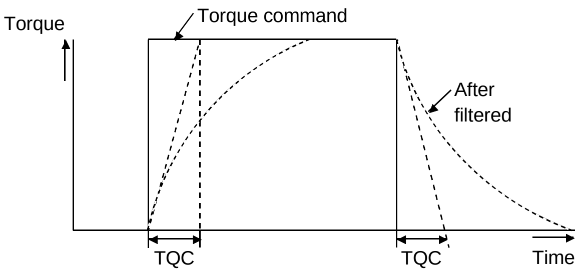
5.3.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PC01	STA	Acceleration time constant	0	ms		○	○
PC02	STB	Deceleration time constant	0	ms		○	○
PC03	STC	S-pattern acceleration/deceleration time constant	0	ms		○	○
PC04	TQC	Torque command time constant	0	ms			○
PC05	SC1	Internal speed command 1	100	r/min		○	
		Internal speed limit 1					○
PC06	SC2	Internal speed command 2	500	r/min		○	
		Internal speed limit 2					○
PC07	SC3	Internal speed command 3	1000	r/min		○	
		Internal speed limit 3					○
PC08	SC4	Internal speed command 4	200	r/min		○	
		Internal speed limit 4					○
PC09	SC5	Internal speed command 5	300	r/min		○	
		Internal speed limit 5					○
PC10	SC6	Internal speed command 6	500	r/min		○	
		Internal speed limit 6					○
PC11	SC7	Internal speed command 7	800	r/min		○	
		Internal speed limit 7					○
PC12	VCM	Analog speed command maximum speed	0	r/min		○	
		Analog speed limit maximum speed					○
PC13	TLC	Analog torque command maximum output	100.0	%			○
PC14	MOD1	Analog monitor 1 output	0000h		○	○	○
PC15	MOD2	Analog monitor 2 output	0001h		○	○	○
PC16	MBR	Electromagnetic brake sequence output	100	ms	○	○	○
PC17	ZSP	Zero speed	50	r/min	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○
PC19	*ENRS	Encoder output pulses selection	0000h		○	○	○
PC20	*SNO	Station number setting	0	station	○	○	○
PC21	*SOP	Communication function selection	0000h		○	○	○
PC22	*COP1	Function selection C-1	0000h		○	○	○
PC23	*COP2	Function selection C-2	0000h			○	○
PC24	*COP3	Function selection C-3	0000h		○		
PC25		For manufacturer setting	0000h				
PC26	*COP5	Function selection C-5	0000h		○	○	
PC27	*COP6	Function selection C-6	0000h		○	○	○
PC28		For manufacturer setting	0000h				
PC29			0000h				
PC30	STA2	Acceleration time constant 2	0	ms		○	○
PC31	STB2	Deceleration time constant 2	0	ms		○	○
PC32	CMX2	Command pulse multiplying factor numerator 2	1		○		
PC33	CMX3	Command pulse multiplying factor numerator 3	1		○		

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PC34	CMX4	Command pulse multiplying factor numerator 4	1		○		
PC35	TL2	Internal torque limit 2	100.0	%	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○
PC37	VCO	Analog speed command offset	0	mV		○	
		Analog speed limit offset					○
PC38	TPO	Analog torque command offset	0	mV			○
		Analog torque limit offset				○	
PC39	MO1	Analog monitor 1 offset	0	mV	○	○	○
PC40	MO2	Analog monitor 2 offset	0	mV	○	○	○
PC41		For manufacturer setting	0				
PC42			0				
PC43			0000h				
PC44			0000h				
PC45			0000h				
PC46			0000h				
PC47			0000h				
PC48			0000h				
PC49			0000h				
PC50			0000h				

5.3.2 List of details

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PC01	STA	Acceleration time constant Used to set the acceleration time required to reach the rated speed from 0r/min in response to the analog speed command and internal speed commands 1 to 7.  For example for the servo motor of 3000r/min rated speed, set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second.	0	ms	0 to 50000		○	○
PC02	STB	Deceleration time constant Used to set the deceleration time required to reach 0r/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PC03	STC	S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/ deceleration.  STA: Acceleration time constant (parameter No.PC01) STB: Deceleration time constant (parameter No.PC02) STC: S-pattern acceleration/deceleration time constant (parameter No.PC03) Long setting of STA (acceleration time constant) or STB (deceleration time constant) may produce an error in the time of the arc part for the setting of the S-pattern acceleration/deceleration time constant. The upper limit value of the actual arc part time is limited by $\frac{2000000}{\text{STA}}$ for acceleration or by $\frac{2000000}{\text{STB}}$ for deceleration. (Example) At the setting of STA=20000, STB=5000 and STC=200, the actual arc part times are as follows. During acceleration: 100[ms] $\left(\text{Limited to 100[ms] since } \frac{2000000}{20000} = 100\text{[ms]} < 200\text{[ms]}.\right)$ During deceleration: 200[ms] $\left(\text{200[ms] as set since } \frac{2000000}{5000} = 400\text{[ms]} > 200\text{[ms]}.\right)$	0	ms	0 to 1000		○	○
PC04	TQC	Torque command time constant Used to set the constant of a low-pass filter in response to the torque command.  TQC: Torque command time constant	0	ms	0 to 20000			○
PC05	SC1	Internal speed command 1 Used to set speed 1 of internal speed commands.	100	r/min	0 to instan- taneous permi- ssible speed		○	
		Internal speed limit 1 Used to set speed 1 of internal speed limits.						○

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PC06	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 2 Used to set speed 2 of internal speed limits.						○
PC07	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 3 Used to set speed 3 of internal speed limits.						○
PC08	SC4	Internal speed command 4 Used to set speed 4 of internal speed commands.	200	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 4 Used to set speed 4 of internal speed limits.						○
PC09	SC5	Internal speed command 5 Used to set speed 5 of internal speed commands.	300	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 5 Used to set speed 5 of internal speed limits.						○
PC10	SC6	Internal speed command 6 Used to set speed 6 of internal speed commands.	500	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 6 Used to set speed 6 of internal speed limits.						○
PC11	SC7	Internal speed command 7 Used to set speed 7 of internal speed commands.	800	r/min	0 to instan-taneous permi-ssible speed		○	
		Internal speed limit 7 Used to set speed 7 of internal speed limits.						○
PC12	VCM	Analog speed command maximum speed Used to set the speed at the maximum input voltage (10V) of the analog speed command (VC). When "0" is set, the analog speed command maximum speed would be the rated speed of the servo motor connected. The speed is as indicated below for motorless operation of test operation.	0	 r/min	0 1 to 50000		○	

Driver capacity [W]		Servo motor speed [r/min]
100V class	100 to 400	3000
200V class	100 to 750	
	1k to 37k	2000
400V class	600 to 55k	

No.	Symbol	Name and function	Initial value	Unit	Setting range	Position	Speed	Torque
PC12	VCM	Analog speed limit maximum speed Used to set the speed at the maximum input voltage (10V) of the analog speed limit (VLA). Set "0" to select the rated speed of the servo motor connected.	0	 r/min	0 1 to 50000			○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PC13</td><td>TLC</td><td>Analog torque command maximum output
Used to set the output torque at the analog torque command voltage (TC = ±8V) of +8V on the assumption that the maximum torque is 100[%]. For example, set 50 to output (maximum torque × 50/100) at the TC of +8V.</td><td>100.0</td><td>%</td><td>0
to
1000.0</td><td></td><td></td><td>○</td></tr>
<tr><td>PC14</td><td>MOD1</td><td>Analog monitor 1 output
Used to selection the signal provided to the analog monitor 1 (MO1) output. (Refer to section 5.3.3.)

0 0 0 □
Analog monitor 1 (MO1) output selection
<table>
<tr><th>Setting</th><th>Item</th></tr>
<tr><td>0</td><td>Servo motor speed (±8V/max. speed)</td></tr>
<tr><td>1</td><td>Torque (±8V/max. torque) (Note 2)</td></tr>
<tr><td>2</td><td>Servo motor speed (+8V/max. speed)</td></tr>
<tr><td>3</td><td>Torque (+8V/max. torque) (Note 2)</td></tr>
<tr><td>4</td><td>Current command (±8V/max. current command)</td></tr>
<tr><td>5</td><td>Command pulse frequency (±10V/1Mpps)</td></tr>
<tr><td>6</td><td>Droop pulses (±10V/100 pulses) (Note 1)</td></tr>
<tr><td>7</td><td>Droop pulses (±10V/1000 pulses) (Note 1)</td></tr>
<tr><td>8</td><td>Droop pulses (±10V/10000 pulses) (Note 1)</td></tr>
<tr><td>9</td><td>Droop pulses (±10V/100000 pulses) (Note 1)</td></tr>
<tr><td>A</td><td>Feedback position (±10V/1 Mpulses) (Note 1)</td></tr>
<tr><td>B</td><td>Feedback position (±10V/10 Mpulses) (Note 1)</td></tr>
<tr><td>C</td><td>Feedback position (±10V/100 Mpulses) (Note 1)</td></tr>
<tr><td>D</td><td>Bus voltage (±8V/400V) (Note 3)</td></tr>
</table>
Note1. Encoder pulse unit.
2. 8V is outputted at the maximum torque. However, when parameter No.PA11・PA12 are set to limit torque, 8V is outputted at the torque highly limited.
3. For 400V class driver, the bus voltage becomes +8V/800V.</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC15</td><td>MOD2</td><td>Analog monitor 2 output
Used to selection the signal provided to the analog monitor 2 (MO2) output. (Refer to section 5.3.3.)

0 0 0 □
Select the analog monitor 2 (MO2) output The settings are the same as those of parameter No.PC14.</td><td>0001h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC16</td><td>MBR</td><td>Electromagnetic brake sequence output
Used to set the delay time (Tb) between electronic brake interlock (MBR) and the base drive circuit is shut-off.</td><td>100</td><td>ms</td><td>0
to
1000</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC17</td><td>ZSP</td><td>Zero speed
Used to set the output range of the zero speed detection (ZSP).
Zero speed detection (ZSP) has hysteresis width of 20r/min (refer to section 3.5 (1) (b)).</td><td>50</td><td>r/min</td><td>0
to
10000</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PC18	*BPS	Alarm history clear Used to clear the alarm history. 0 0 0 □ Alarm history clear 0: Invalid 1: Valid When alarm history clear is made valid, the alarm history is cleared at next power-on. After the alarm history is cleared, the setting is automatically made invalid (reset to 0).	0000h		Refer to name and function column.	○	○	○
PC19	*ENRS	Encoder output pulses selection Use to select the, encoder output pulses direction and encoder output pulses setting. 0 0 □ □ Encoder output pulses phase changing Changes the phases of A/B-phase encoder output pulses. Set value / Servo motor rotation direction: CCW, CW 0: CCW: A-phase, B-phase; CW: A-phase, B-phase 1: CCW: A-phase, B-phase; CW: A-phase, B-phase Encoder output pulses setting selection (refer to parameter No.PA15) 0: Output pulses setting 1: Division ratio setting 2: Ratio is automatically set to command pulse unit Setting "2" makes the parameter No.PA15 (encoder output pulses) setting invalid.	0000h		Refer to name and function column.	○	○	○
PC20	*SNO	Station number setting Used to specify the station number for serial communication. Always set one station to one axis of driver. If one station number is set to two or more stations, normal communication cannot be made.	0	station	0 to 31	○	○	○
PC21	*SOP	Communication function selection Select the communication I/F and select the RS-422 communication conditions. 0 □ □ 0 RS-422 communication baud rate selection 0: 9600 [bps] 1: 19200 [bps] 2: 38400 [bps] 3: 57600 [bps] 4: 115200[bps] RS-422 communication response delay time 0: Invalid 1: Valid, reply sent after delay time of 800 μs or longer	0000h		Refer to name and function column.	○	○	○

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PC22	*COP1	Function selection C-1 Select the execution of automatic restart after instantaneous power failure selection, and encoder cable communication system selection. □ 0 0 □ Restart after instantaneous power failure selection If the power supply voltage has returned to normal after an undervoltage status caused by the reduction of the input power supply voltage in the speed control mode, the servo motor can be restarted by merely turning on the start signal without resetting the alarm. 0: Invalid (Undervoltage alarm (AL.10) occurs.) 1: Valid (If this function is enabled for the drive unit of 30kW or more, the parameter error (AL.37) occurs.) Encoder cable communication system selection 0: Two-wire type 1: Four-wire type The following cables are of 2-wire type. LE-CSE-□2□ / LE-CSE-□5□ / LE-CSE-□A□ Incorrect settinf will result in an encoder alarm1(A16)	0000h		Refer to name and function column.	 ○	○ ○	 ○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td rowspan="3">PC23</td><td rowspan="3">*COP2</td><td>Function selection C-2
Select the servo lock at speed control mode stop, the VC-VLA voltage averaging, and the speed limit in torque control mode.

□ □ 0 □

Selection of servo lock at stop
In the speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by the external force.
0: Valid (Servo-locked)
The operation to maintain the stop position is performed.
1: Invalid (Not servo-locked)
The stop position is not maintained.
The control to make the speed 0r/min is performed.</td><td rowspan="3">0000h</td><td rowspan="3"></td><td rowspan="3">Refer to name and function column.</td><td></td><td>○</td><td></td></tr>
<tr><td>VC/VLA voltage averaging
Used to set the filtering time when the analog speed command (VC) voltage or analog speed limit (VLA) is imported.
Set 0 to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.
<table><tr><th>Set value</th><th>Filtering time [ms]</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>0.444</td></tr><tr><td>2</td><td>0.888</td></tr><tr><td>3</td><td>1.777</td></tr><tr><td>4</td><td>3.555</td></tr><tr><td>5</td><td>7.111</td></tr></table></td><td></td><td>○</td><td>○</td></tr>
<tr><td>Selection of speed limit for torque control
0: Valid
1: Invalid
Do not use this function except when configuring a speed loop externally.
If the speed limit is invalid, the following parameters can be used.
Parameter No.PB01 (Adaptive tuning mode (Adaptive filter Ⅱ))
Parameter No.PB13 (machine resonance suppression filter 1)
Parameter No.PB14 (notch shape selection 1)
Parameter No.PB15 (machine resonance suppression filter 2)
Parameter No.PB16 (notch shape selection 2)</td><td></td><td></td><td>○</td></tr>
<tr><td>PC24</td><td>*COP3</td><td>Function selection C-3
Select the unit of the in-position range.

0 0 0 □

In-position range unit selection
0: Command input pulse unit
1: Servo motor encoder pulse unit</td><td>0000h</td><td></td><td>Refer to name and function column.</td><td>○</td><td></td><td></td></tr>
<tr><td>PC25</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0000h</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PC26	*COP5	Function selection C-5 Select the stroke limit warning (AL. 99). 0 0 0 □ Stroke limit warning (AL. 99) selection 0: Valid 1: Invalid When this parameter is set to "1", AL. 99 will not occur if the forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) turns OFF.	0000h		Refer to name and function column.	○	○	
PC27	*COP6	Function selection C-6 Set this function if undervoltage alarm occurs because of distorted power supply voltage waveform when using power regenerative converter or power regenerative common converter. 0 0 0 □ Setting when undervoltage alarm occurs 0: Initial value (Waveform of power supply voltage is not distorted) 1: Set "1" if undervoltage alarm occurs because of distorted power supply voltage waveform when using power regenerative converter or power regenerative common converter.	0000h		Refer to name and function column.	○	○	○
PC28		For manufacturer setting	0000h					
PC29		Do not change this value by any means.	0000h					
PC30	STA2	Acceleration time constant 2 This parameter is made valid when the acceleration/deceleration selection (STAB2) is turned ON. Used to set the acceleration time required to reach the rated speed from Or/min in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○
PC31	STB2	Deceleration time constant 2 This parameter is made valid when the acceleration/deceleration selection (STAB2) is turned ON. Used to set the deceleration time required to reach Or/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○
PC32	CMX2	Command pulse multiplying factor numerator 2 Available when the parameter No.PA05 is set to "0".	1		1 to 65535	○		
PC33	CMX3	Command pulse multiplying factor numerator 3 Available when the parameter No.PA05 is set to "0".	1		1 to 65535	○		
PC34	CMX4	Command pulse multiplying factor numerator 4 Available when the parameter No.PA05 is set to "0".	1		1 to 65535	○		

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PC35	TL2	Internal torque limit 2 Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced. When torque is output in analog monitor output, this set value is the maximum output voltage (8V). (Refer to section 3.6.1 (5)).	100.0	%	0 to 100.0	○	○	○
PC36	*DMD	Status display selection Select the status display to be provided at power-on. 0 □ □ □ Selection of status display at power-on 0: Cumulative feedback pulse 1: Servo motor speed 2: Droop pulse 3: Cumulative command pulses 4: Command pulse frequency 5: Analog speed command voltage (Note 1) 6: Analog torque command voltage (Note 2) 7: Regenerative load ratio 8: Effective load ratio 9: Peak load ratio A: Instantaneous torque B: Within one-revolution position (1 pulse unit) C: Within one-revolution position (100 pulse unit) D: ABS counter E: Load inertia moment ratio F: Bus voltage Note 1. In speed control mode. Analog speed limit voltage in torque control mode. 2. In torque control mode. Analog torque limit voltage in speed or position control mode. Status display at power-on in corresponding control mode 0: Depends on the control mode.	0000h		Refer to name and function column.	○	○	○

Control mode	Status display at power-on
Position	Cumulative feedback pulses
Position/speed	Cumulative feedback pulses/servo motor speed
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage
Torque/position	Analog torque command voltage/cumulative feedback pulses

1: Depends on the first digit setting of this parameter.

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PC37	VCO	Analog speed command offset Used to set the offset voltage of the analog speed command (VC). For example, if CCW rotation is provided by switching on forward rotation start (ST1) with 0V applied to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 6.4.) The initial value is the value provided by the automatic VC offset function before shipment at the VC-LG voltage of 0V.	Depen-ding on driver	mV	−999 to 999		○	
		Analog speed limit offset Used to set the offset voltage of the analog speed limit (VLA). For example, if CCW rotation is provided by switching on forward rotation selection (RS1) with 0V applied to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 6.4.) The initial value is the value provided by the automatic VC offset function before shipment at the VLA-LG voltage of 0V.						○
PC38	TPO	Analog torque command offset Used to set the offset voltage of the analog torque command (TC).	0	mV	−999 to 999			○
		Analog torque limit offset Used to set the offset voltage of the analog torque limit (TLA).					○	
PC39	MO1	Analog monitor 1 offset Used to set the offset voltage of the analog monitor (MO1).	0	mV	−999 to 999	○	○	○
PC40	MO2	Analog monitor 2 offset Used to set the offset voltage of the analog monitor (MO2).	0	mV	−999 to 999	○	○	○
PC41		For manufacturer setting Do not change this value by any means.	0					
PC42			0					
PC43			0000h					
PC44			0000h					
PC45			0000h					
PC46			0000h					
PC47			0000h					
PC48			0000h					
PC49			0000h					
PC50			0000h					

5.3.3 Analog monitor

The servo status can be output to two channels in terms of voltage.

(1) Setting

Change the following digits of parameter No.PC14, PC15.

Parameter No.PC14

0	0	0	

Analog monitor (MO1) output selection
(Signal output to across MO1-LG)

Parameter No.PC15

0	0	0	

Analog monitor (MO2) output selection
(Signal output to across MO2-LG)

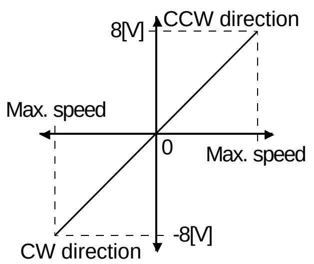
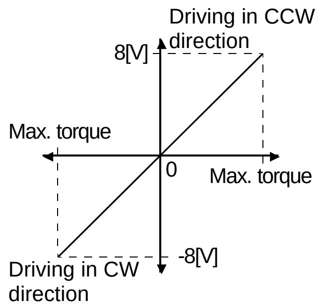
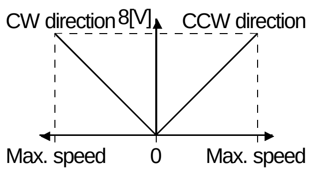
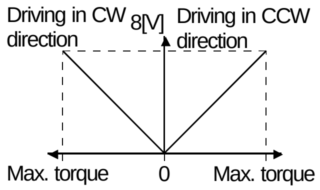
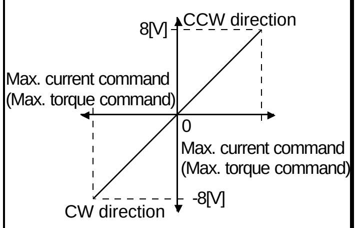
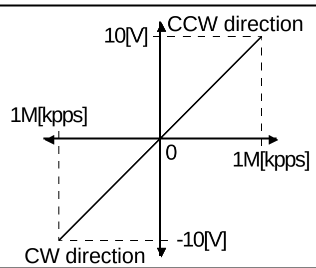
Parameters No.PC39 and PC40 can be used to set the offset voltages to the analog output voltages. The setting range is between −999 and 999mV.

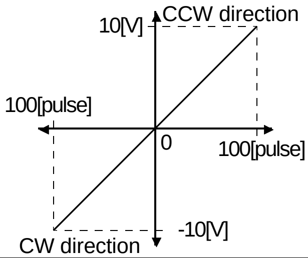
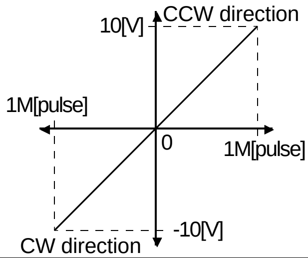
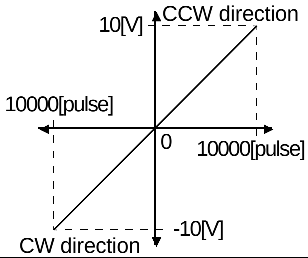
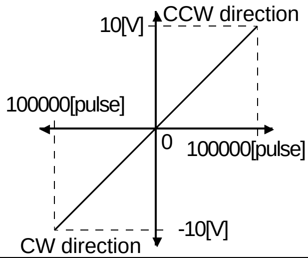
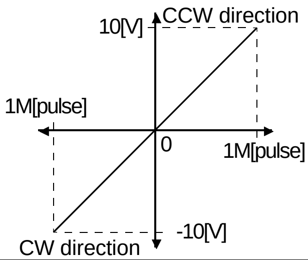
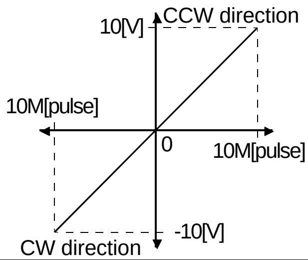
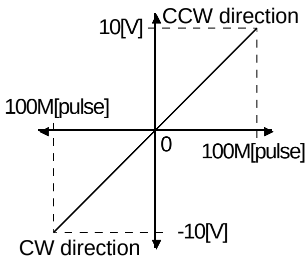
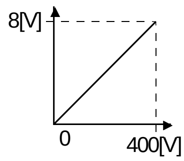
Parameter No.	Description	Setting range [mV]
PC39	Used to set the offset voltage for the analog monitor 1 (MO1).	−999 to 999
PC40	Used to set the offset voltage for the analog monitor 2 (MO2).	

(2) Set content

The driver is factory-set to output the servo motor speed to analog monitor 1 (MO1) and the torque to analog monitor (MO2). The setting can be changed as listed below by changing the parameter No.PC14 and PC15 value.

Refer to (3) for the measurement point.

Setting	Output item	Description	Setting	Output item	Description
0	Servo motor speed		1	Torque (Note 3)	
2	Servo motor speed		3	Torque (Note 3)	
4	Current command		5	Command pulse frequency	

Setting	Output item	Description	Setting	Output item	Description
6	Droop pulses (Note) (±10V/100 pulses)		7	Droop pulses (Note) (±10V/1000 pulses)	
8	Droop pulses (Note 1) (±10V/10000 pulses)		9	Droop pulses (Note 1) (±10V/100000 pulses)	
A	Feedback position (Note 1,2) (±10V/1 Mpulses)		B	Feedback position (Note 1,2) (±10V/10 Mpulses)	
C	Feedback position (Note 1,2) (±10V/100 Mpulses)		D	Bus voltage (Note 4)	

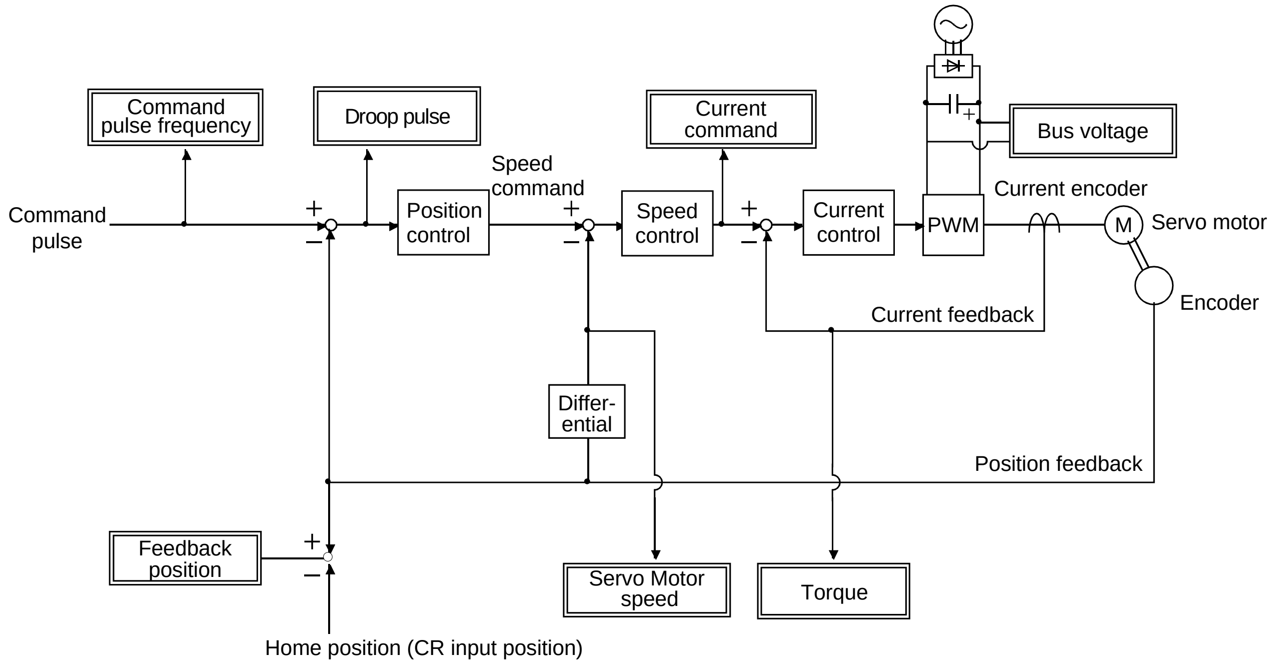
Note 1. Encoder pulse unit.

2. Available in position control mode

3. 8V is outputted at the maximum torque.
However, when parameter No.PA11・PA12 are set to limit torque, 8V is outputted at the torque highly limited.

4. For 400V class driver, the busvoltage becomes +8V/800V.

(3) Analog monitor block diagram

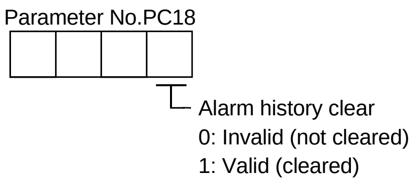


5.3.4 Alarm history clear

The driver stores past six alarms since the power is switched on for the first time. To control alarms which will occur during the operation, clear the alarm history using parameter No.PC18 before starting the operation. Turn off the power and then on again after setting the parameter to validate the parameter value.

Clearing the alarm history automatically returns to "□□□0".

After setting, this parameter is made valid by switch power from OFF to ON.



5.4 I/O setting parameters (No.PD□□)

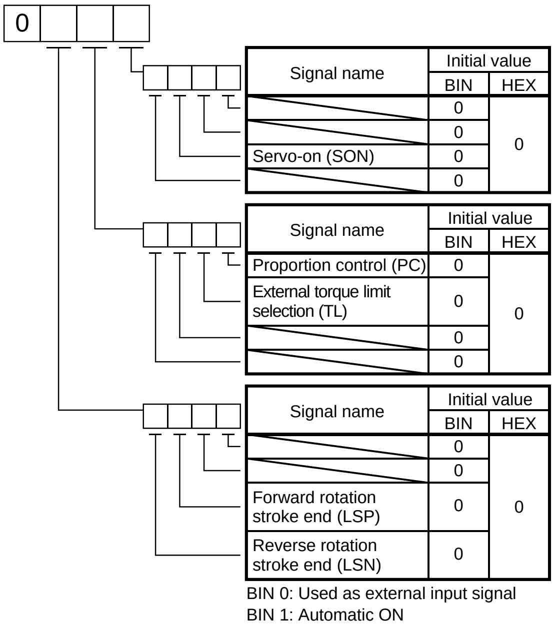
POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

5.4.1 Parameter list

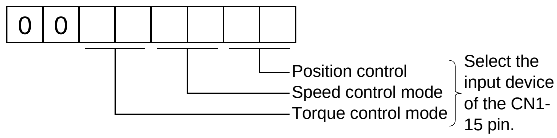
No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Speed	Torque
PD01	*DIA1	Input signal automatic ON selection 1	0000h		○	○	○
PD02		For manufacturer setting	0000h				
PD03	*DI1	Input signal device selection 1 (CN1-15)	00020202h		○	○	○
PD04	*DI2	Input signal device selection 2 (CN1-16)	00212100h		○	○	○
PD05	*DI3	Input signal device selection 3 (CN1-17)	00070704h		○	○	○
PD06	*DI4	Input signal device selection 4 (CN1-18)	00080805h		○	○	○
PD07	*DI5	Input signal device selection 5 (CN1-19)	00030303h		○	○	○
PD08	*DI6	Input signal device selection 6 (CN1-41)	00202006h		○	○	○
PD09		For manufacturer setting	00000000h				
PD10	*DI8	Input signal device selection 8 (CN1-43)	00000A0Ah		○	○	○
PD11	*DI9	Input signal device selection 9 (CN1-44)	00000B0Bh		○	○	○
PD12	*DI10	Input signal device selection 10 (CN1-45)	00232323h		○	○	○
PD13	*DO1	Output signal device selection 1 (CN1-22)	0004h		○	○	○
PD14	*DO2	Output signal device selection 2 (CN1-23)	000Ch		○	○	○
PD15	*DO3	Output signal device selection 3 (CN1-24)	0004h		○	○	○
PD16	*DO4	Output signal device selection 4 (CN1-25)	0007h		○	○	○
PD17		For manufacturer setting	0003h				
PD18	*DO6	Output signal device selection 6 (CN1-49)	0002h		○	○	○
PD19	*DIF	Input filter setting	0002h		○	○	○
PD20	*DOP1	Function selection D-1	0000h		○	○	○
PD21		For manufacturer setting	0000h				
PD22	*DOP3	Function selection D-3	0000h		○		
PD23		For manufacturer setting	0000h				
PD24	*DOP5	Function selection D-5	0000h		○	○	○
PD25		For manufacturer setting	0000h				
PD26			0000h				
PD27			0000h				
PD28			0000h				
PD29			0000h				
PD30			0000h				

5.4.2 List of details

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PD01	*DIA1	Input signal automatic ON selection 1 Select the input devices to be automatically turned ON.  For example, to turn ON SON, the setting is "□□□4".	0000h		Refer to name and function column.	○	○	○
PD02		For manufacturer setting Do not change this value by any means.	0000h		Refer to name and function column.			

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode: Position	Control mode: Speed	Control mode: Torque
PD03	*DI1	Input signal device selection 1 (CN1-15)	0002 0202h		Refer to name and function column.	○	○	○

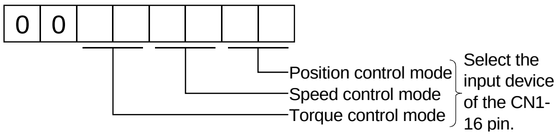
Any input signal can be assigned to the CN1-15 pin.
Note that the setting digits and the signal that can be assigned change depending on the control mode.



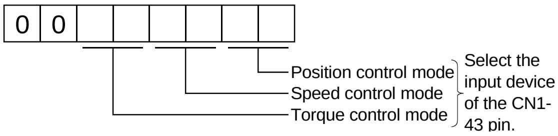
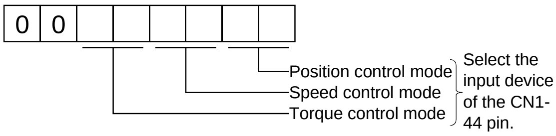
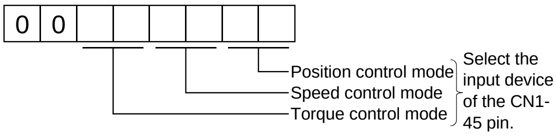
The devices that can be assigned in each control mode are those that have the symbols indicated in the following table. If any other device is set, it is invalid.

Setting	Control modes (Note 1) P	S	T
00			
01	For manufacturer setting (Note 2)		
02	SON	SON	SON
03	RES	RES	RES
04	PC	PC	
05	TL	TL	
06	CR		
07		ST1	RS2
08		ST2	RS1
09	TL1	TL1	
0A	LSP	LSP	
0B	LSN	LSN	
0C	For manufacturer setting (Note 2)		
0D	CDP	CDP	
0E to 1F	For manufacturer setting (Note 2)		
20		SP1	SP1
21		SP2	SP2
22		SP3	SP3
23	LOP	LOP	LOP
24	CM1		
25	CM2		
26		STAB2	STAB2
27 to 3F	For manufacturer setting (Note 2)		

Note 1. P: Position control mode
S: Speed control mode
T: Torque control mode
2. For manufacturer setting. Never set this value.

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PD04	*DI2	Input signal device selection 2 (CN1-16) Any input signal can be assigned to the CN1-16 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 	0021 2100h		Refer to name and function column.	○	○	○

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PD05	*DI3	Input signal device selection 3 (CN1-17) Any input signal can be assigned to the CN1-17 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-17 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No.PA03, the CN1-17 pin is set to the ABS transfer mode (ABSM). (Refer to section 14.7.)	0007 0704h		Refer to name and function column.	○	○	○
PD06	*DI4	Input signal device selection 4 (CN1-18) Any input signal can be assigned to the CN1-18 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 0 0 Position control Speed control mode Torque control mode Select the input device of the CN1-18 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No.PA03, the CN1-18 pin is set to the ABS transfer request (ABSR). (Refer to section 14.7.)	0008 0805h		Refer to name and function column.	○	○	○
PD07	*DI5	Input signal device selection 5 (CN1-19) Any input signal can be assigned to the CN1-19 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-19 pin.	0003 0303h		Refer to name and function column.	○	○	○
PD08	*DI6	Input signal device selection 6 (CN1-41) Any input signal can be assigned to the CN1-41 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-41 pin.	0020 2006h		Refer to name and function column.	○	○	○
PD09		For manufacturer setting Do not change this value by any means.	0000 0000h					

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Speed	Torque
PD10	*DI8	Input signal device selection 8 (CN1-43) Any input signal can be assigned to the CN1-43 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 	0000 0A0Ah		Refer to name and function column.	○	○	○
PD11	*DI9	Input signal device selection 9 (CN1-44) Any input signal can be assigned to the CN1-44 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 	0000 0B0Bh		Refer to name and function column.	○	○	○
PD12	*DI10	Input signal device selection 10 (CN1-45) Any input signal can be assigned to the CN1-45 pin. The devices that can be assigned and the setting method are the same as in parameter No.PD03. 	0023 2323h		Refer to name and function column.	○	○	○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Unit</th><th rowspan="2">Setting range</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PD13</td><td>*DO1</td><td>Output signal device selection 1 (CN1-22)
Any output signal can be assigned to the CN1-22 pin.
In the initial setting, INP is assigned in the position control mode, and SA is assigned in the speed control mode.
Note that the device that can be assigned changes depending on the control mode.

0 0 □ □
Select the output device of the CN1-22 pin.

The devices that can be assigned in each control mode are those that have the symbols indicated in the following table.
If any other device is set, it is invalid.
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Control modes (Note 1)</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>00</td><td>Always OFF</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>01</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>02</td><td>RD</td><td>RD</td><td>RD</td></tr>
<tr><td>03</td><td>ALM</td><td>ALM</td><td>ALM</td></tr>
<tr><td>04</td><td>INP</td><td>SA</td><td>Always OFF</td></tr>
<tr><td>05</td><td>MBR</td><td>MBR</td><td>MBR</td></tr>
<tr><td>06</td><td>DB</td><td>DB</td><td>DB</td></tr>
<tr><td>07</td><td>TLC</td><td>TLC</td><td>VLC</td></tr>
<tr><td>08</td><td>WNG</td><td>WNG</td><td>WNG</td></tr>
<tr><td>09</td><td>BWNG</td><td>BWNG</td><td>BWNG</td></tr>
<tr><td>0A</td><td>Always OFF</td><td>SA</td><td>SA</td></tr>
<tr><td>0B</td><td>Always OFF</td><td>Always OFF</td><td>VLC</td></tr>
<tr><td>0C</td><td>ZSP</td><td>ZSP</td><td>ZSP</td></tr>
<tr><td>0D</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0E</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0F</td><td>CDPS</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>10</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>11</td><td>ABSV</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>12 to 3F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
</table>
Note 1. P: Position control mode
S: Speed control mode
T: Torque control mode
2. For manufacturer setting. Never set this value.

When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No.PA03, the CN1-22 pin is set to the ABS transmission data bit 0 (ABSB0) in the ABS transfer mode only. (Refer to section 14.7.)</td><td>0004h</td><td></td><td>Refer to name and function column.</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PD14	*DO2	Output signal device selection 2 (CN1-23) Any output signal can be assigned to the CN1-23 pin. In the initial setting, ZSP is assigned to the pin. The devices that can be assigned and the setting method are the same as in parameter No.PD13. 0 0 □ □ Select the output device of the CN1-23 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No.PA03, the CN1-23 pin is set to the ABS transmission data bit 1 (ABSB1) in the ABS transfer mode only. (Refer to section 14.7.)	000Ch		Refer to name and function column.	○	○	○
PD15	*DO3	Output signal device selection 3 (CN1-24) Any output signal can be assigned to the CN1-24 pin. In the initial setting, INP is assigned in the position control mode, and SA is assigned in the speed control mode. The devices that can be assigned and the setting method are the same as in parameter No.PD13. 0 0 □ □ Select the output device of the CN1-24 pin.	0004h		Refer to name and function column.	○	○	○
PD16	*DO4	Output signal device selection 4 (CN1-25) Any output signal can be assigned to the CN1-25 pin. In the initial setting, TLC is assigned in the position control and speed control modes, and VLC is assigned in the torque control mode. The devices that can be assigned and the setting method are the same as in parameter No.PD13. 0 0 □ □ Select the output device of the CN1-25 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No.PA03, the CN1-25 pin is set to the ABS transmission data ready (ABST) in the ABS transfer mode only. (Refer to section 14.7.)	0007h		Refer to name and function column.	○	○	○
PD17		For manufacturer setting Do not change this value by any means.	0003h					
PD18	*DO6	Output signal device selection 6 (CN1-49) Any output signal can be assigned to the CN1-49 pin. In the initial setting, RD is assigned to the pin. The devices that can be assigned and the setting method are the same as in parameter No.PD13. 0 0 □ □ Select the output device of the CN1-49 pin.	0002h		Refer to name and function column.	○	○	○

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PD19	*DIF	Input filter setting Select the input filter. 0 0 0 □ Input signal filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 1.777[ms] 2: 3.555[ms] 3: 5.333[ms]	0002h		Refer to name and function column.	○	○	○
PD20	*DOP1	Function selection D-1 Select the stop processing at forward rotation stroke end (LSP)/reverse rotation stroke end (LSN) OFF and the base circuit status at reset (RES) ON. 0 0 □ □ How to make a stop when forward rotation stroke end (LSP) • reverse rotation stroke end (LSN) is valid. (Refer to Section 5.4.3.) 0: Sudden stop 1: Slow stop Selection of base circuit status at reset (RES) ON 0: Base circuit switched off 1: Base circuit not switched off	0000h		Refer to name and function column.	 ○ ○	 ○ ○	 ○
PD21		For manufacturer setting Do not change this value by any means.	0000h					
PD22	*DOP3	Function selection D-3 Set the clear (CR). 0 0 0 □ Clear (CR) selection 0: Droop pulses are cleared on the leading edge. 1: While on, droop pulses are always cleared.	0000h		Refer to name and function column.	○		
PD23		For manufacturer setting Do not change this value by any means.	0000h					

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode Position	Control mode Speed	Control mode Torque
PD24	*DOP5	Function selection D-5 Select the alarm code and warning (WNG) outputs.	0000h		Refer to name and function column.	○	○	○

0 0 □ □

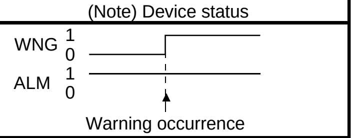
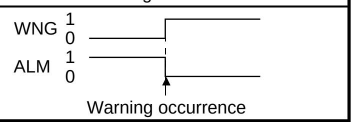
Setting of alarm code output

Set value	Connector pins of CN1 22	23	24
0	Alarm code is not output.		
1	Alarm code is output at alarm occurrence.		

(Note) Alarm code CN1 pin 22	CN1 pin 23	CN1 pin 24	Alarm display	Name
0	0	0	88888	Watchdog
			AL.12	Memory error 1
			AL.13	Clock error
			AL.15	Memory error 2
			AL.17	Board error 2
			AL.19	Memory error 3
			AL.37	Parameter error
			AL.8A	Serial communication time-out error
			AL.8E	Serial communication error
0	0	1	AL.30	Regenerative error
			AL.33	Overvoltage
0	1	0	AL.10	Undervoltage
0	1	1	AL.45	Main circuit device overheat
			AL.46	Servo motor overheat
			AL.47	Cooling fan alarm
			AL.50	Overload 1
			AL.51	Overload 2
1	0	0	AL.24	Main circuit
			AL.32	Overcurrent
1	0	1	AL.31	Overspeed
			AL.35	Command pulse frequency error
			AL.52	Error excessive
1	1	0	AL.16	Encoder error 1
			AL.1A	Motor combination error
			AL.20	Encoder error 2
			AL.25	Absolute position erase

Note. 0: off
1: on
A parameter alarm (AL. 37) occurs if the alarm code output is selected with parameter No. PA03 set to "□□□1" and the DI0-based absolute position detection system selected.

Selection of output device at warning occurrence
Select the warning (WNG) and trouble (ALM) output status at warning occurrence.

Setting	(Note) Device status
0	
1	

Note. 0: off
1: on

No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode		
						Position	Speed	Torque
PD25		For manufacturer setting Do not change this value by any means.	0000h					
PD26			0000h					
PD27			0000h					
PD28			0000h					
PD29			0000h					
PD30			0000h					

5.4.3 Using forward/reverse rotation stroke end to change the stopping pattern

The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing the parameter No.PD20 value.

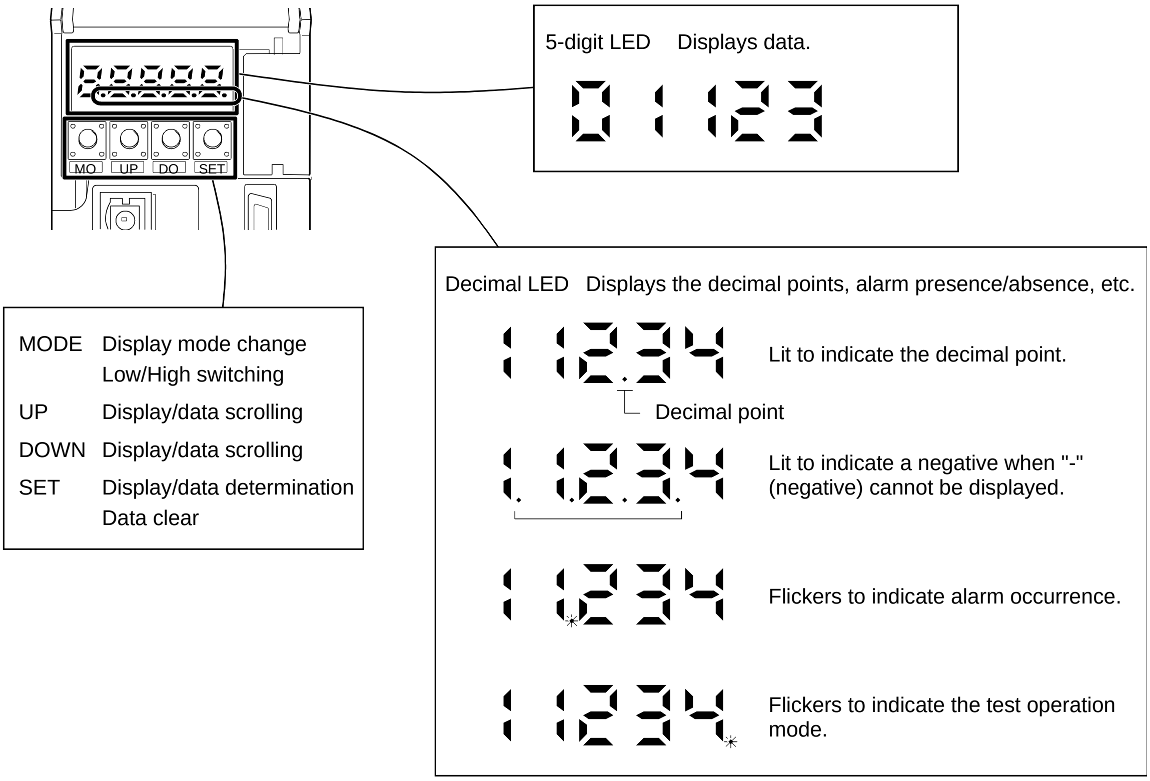
Parameter No.PD20 setting	Stopping method
□□□0 (initial value)	Sudden stop Position control mode : Motor stops with droop pulses cleared. Speed control mode : Motor stops at deceleration time constant of zero.
□□□1	Slow stop Position control mode : The motor is decelerated to a stop in accordance with the parameter No.PB03 value. Speed control mode : The motor is decelerated to a stop in accordance with the parameter No.PC02 value.

6. DISPLAY AND OPERATION SECTIONS

6. DISPLAY AND OPERATION SECTIONS

6.1 Overview

The LECSB□-□driver has the display section (5-digit, 7-segment LED) and operation section (4 pushbuttons) for driver status display, alarm display, parameter setting, etc.
The operation section and display data are described below.



6.2 Display sequence

Press the "MODE" button once to shift to the next display mode. Refer to section 6.3 and later for the description of the corresponding display mode.

To refer to or set the gain filter parameters, extension setting parameters and I/O setting parameters, make them valid with parameter No.PA19 (parameter write disable).

Display mode transition	Initial screen	Function	Reference
Status display	C	Servo status display. C appears at power-on. (Note)	Section 6.3
Diagnosis	rd-oF	Sequence display, external signal display, forced output signal (DO), test operation, software version display, VC automatic offset, servo motor series ID display, servo motor type ID display, servo motor encoder ID display, parameter write inhibit, next deactivation display.	Section 6.4
Alarm	AL --	Current alarm display, alarm history display, parameter error No. display, point table error No. display.	Section 6.5
button MODE Basic setting parameters	P A01	Display and setting of basic setting parameters.	Section 6.6
Gain/filter parameters	P b01	Display and setting of gain filter parameters.	
Extension setting parameters	P C01	Display and setting of extension setting parameters.	
I/O setting parameters	P d01	Display and setting of I/O setting parameters.	

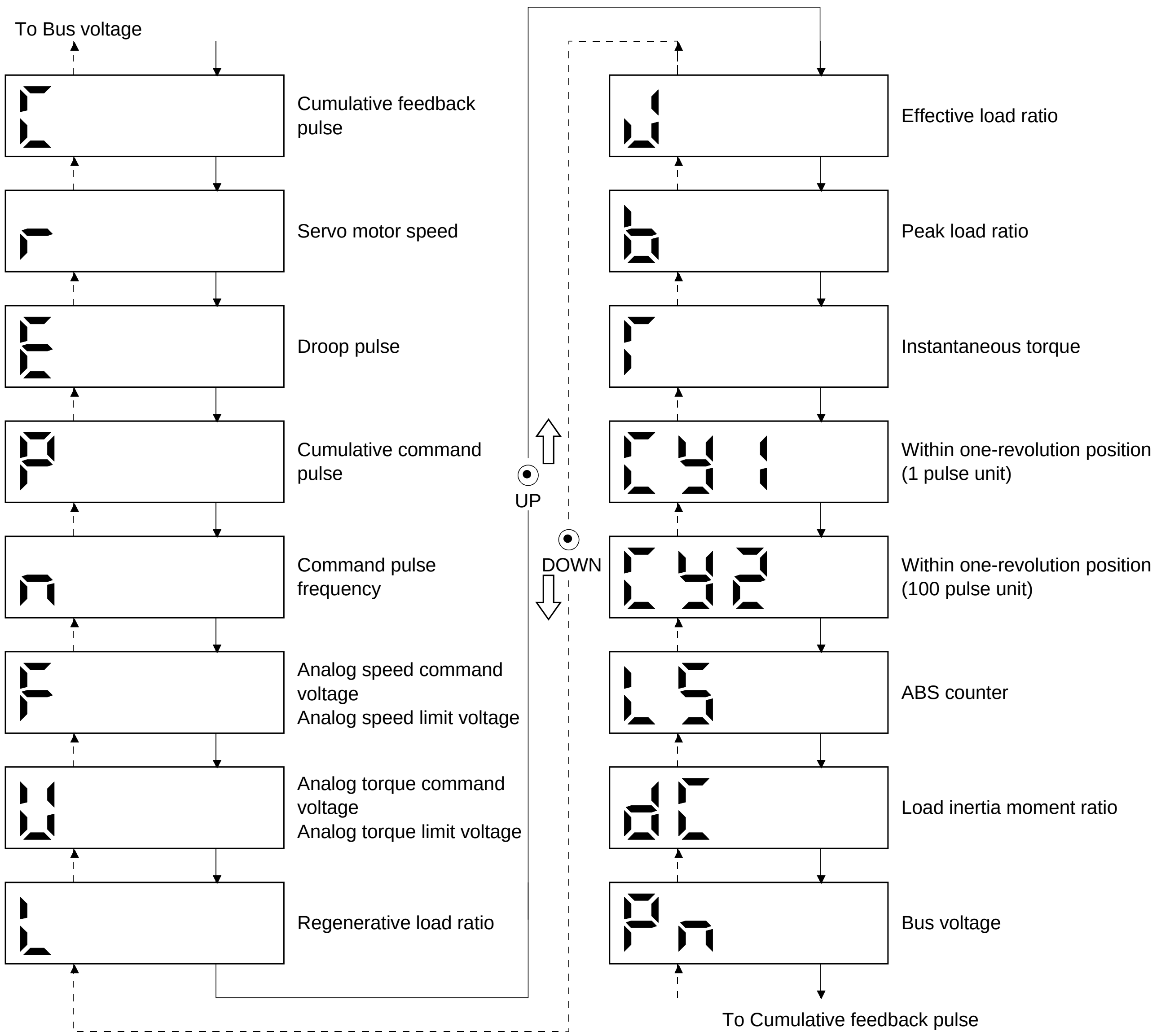
Note. When the axis name is set to the driver using software (MR Configurator2™), the axis name is displayed and the servo status is then displayed.

6.3 Status display

The servo status during operation is shown on the 5-digit, 7-segment LED display. Press the "UP" or "DOWN" button to change display data as desired. When the required data is selected, the corresponding symbol appears. Press the "SET" button to display its data. At only power-on, however, data appears after the symbol of the status display selected in parameter No.PC36 has been shown for 2[s].
The driver display shows the lower five digits of 16 data items such as the motor speed.

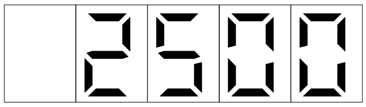
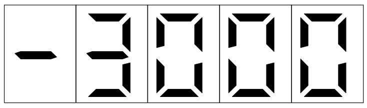
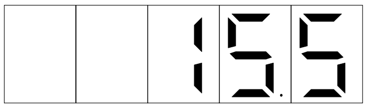
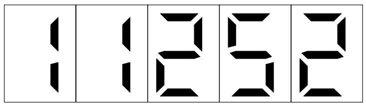
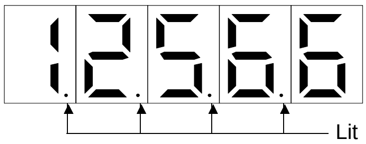
6.3.1 Display transition

After choosing the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



6.3.2 Display examples

The following table lists display examples.

Item	Status	Displayed data Driver display
Servo motor speed	Forward rotation at 2500r/min	
	Reverse rotation at 3000r/min	 Reverse rotation is indicated by "－".
Load inertia moment	15.5 Multiplier (×1)	
ABS counter	11252rev	
	－12566rev	 Negative value is indicated by the lit decimal points in the upper four digits.

6.3.3 Status display list

POINT
・Refer to appendix 3 for the measurement point.

The following table lists the servo statuses that may be shown.

Name	Symbol	Unit	Description	Display range
Cumulative feedback pulses	C	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the driver display is five digits. Press the "SET" button to reset the display value to zero. The value of minus is indicated by the lit decimal points in the upper four digits.	−99999 to 99999
Servo motor speed	r	r/min	The servo motor speed is displayed. The value rounded off is displayed in ×0.1r/min.	−7200 to 7200
Droop pulses	E	pulse	The number of droop pulses in the deviation counter is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the driver display is five digits. The number of pulses displayed is in the encoder pulse unit.	−99999 to 99999
Cumulative command pulses	P	pulse	The position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. The values in excess of ±99999 can be counted. However, the counter shows only the lower five digits of the actual value since the driver display is five digits. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit.	−99999 to 99999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).	−1500 to 1500
Analog speed command voltage Analog speed limit voltage	F	V	(1) Torque control mode Analog speed limit (VLA) voltage is displayed. (2) Speed control mode Analog speed command (VC) voltage is displayed.	−10.00 to 10.00
Analog torque command voltage Analog torque limit voltage	U	V	(1) Position control mode, speed control mode Analog torque limit (TLA) voltage is displayed.	0 to 10.00
			(2) Torque control mode Analog torque command (TLA) voltage is displayed.	−8.00 to +8.00
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15 seconds is displayed relative to the rated current of 100%.	0 to 300

Name	Symbol	Unit	Description	Display range
Peak load ratio	b	%	The maximum current is displayed. The highest value in the past 15 seconds is displayed relative to the rated current of 100%.	0 to 400
Instantaneous torque	T	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rate torque of 100%.	0 to 400
Within one-revolution position low	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses. However, the counter shows only the lower five digits of the actual value since the driver display is five digits. The value is incremented in the CCW direction of rotation.	0 to 99999
Within one-revolution position high	Cy2	100 pulse	The within one-revolution position is displayed in 100 pulse increments of the encoder. The value returns to 0 when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 2621
ABS counter	LS	rev	Travel value from the home position in the absolute position detection systems is displayed in terms of the absolute position detectors counter value.	−32768 to 32767
Load inertia moment ratio	dC	Multiplier ($\times 10^{-1}$)	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	0.0 to 300.0
Bus voltage	Pn	V	The voltage (across P+-N−) of the main circuit converter is displayed.	0 to 900

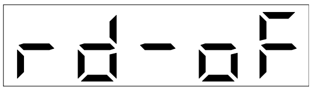
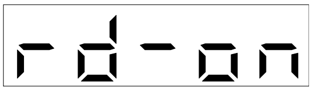
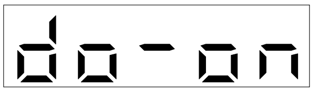
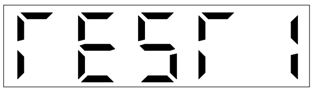
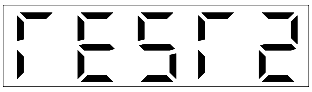
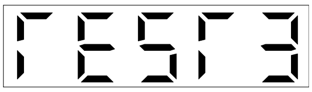
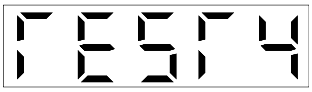
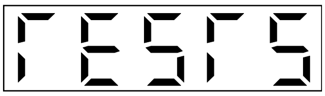
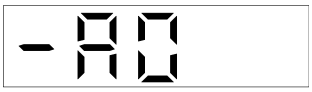
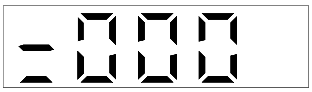
6.3.4 Changing the status display screen

The status display item of the driver display shown at power-on can be changed by changing the parameter No.PC36 settings.

The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display at power-on
Position	Cumulative feedback pulses
Position/speed	Cumulative feedback pulses/servo motor speed
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage
Torque/position	Analog torque command voltage/cumulative feedback pulses

6.4 Diagnostic mode

Name		Display	Description
Sequence			Not ready. Indicates that the driver is being initialized or an alarm has occurred.
			Ready. Indicates that the servo was switched on after completion of initialization and the driver is ready to operate.
External I/O signal display		Refer to section 6.7.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF
Output signal (DO) forced output			The digital output signal can be forced on/off. For more information, refer to section 6.8.
Test operation mode	JOG operation		JOG operation can be performed when there is no command from the external command device. For details, refer to section 6.9.2.
	Positioning operation		Positioning operation can be performed when there is no command from the external command device. The software (MR Configurator2 TM) is required for positioning operation. For details, refer to section 6.9.3.
	Motorless operation		Without connection of the servo motor, the driver provides output signals and displays the status as if the servo motor is running actually in response to the input device. For details, refer to section 6.9.4.
	Machine analyzer operation		Merely connecting the driver allows the resonance point of the mechanical system to be measured. The software (MR Configurator2 TM) is required for machine analyzer operation. For details, refer to section 12.8.
	Driver diagnosis		Simple diagnosis as to correct function of the input/output interface of the driver can be made. To diagnose the driver, the diagnosis cable (MR-J3ACHECK : Mitsubishi Electric Corporation) and software (MR Configurator2 TM) are necessary.
Software version low			Indicates the version of the software.
Software version high			Indicates the system number of the software.

Name	Display	Description
Automatic VC offset	H1 0	If offset voltages in the analog circuits inside and outside the driver cause the servo motor to rotate slowly at the analog speed command (VC) or analog speed limit (VLA) of 0V, this function automatically makes zero-adjustment of offset voltages. When using this function, make it valid in the following procedure. Making it valid causes the parameter No.PC37 value to be the automatically adjusted offset voltage. 1) Press "SET" once. 2) Set the number in the first digit to 1 with "UP"/"DOWN". 3) Press "SET". This function cannot be used if the input voltage of VC or VLA is −0.4V or less, or +0.4V or more.
Servo motor series ID	H2 0	Press the "SET" button to show the series ID of the servo motor currently connected.
Servo motor type ID	H3 0	Press the "SET" button to show the type ID of the servo motor currently connected.
Servo motor encoder ID	H4 0	Press the "SET" button to show the encoder ID of the servo motor currently connected.
For manufacturer setting	H5 0	For manufacturer setting
For manufacturer setting	H6 0	For manufacturer setting

6.5 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error. Display examples are shown below.

Name	Display	Description
Current alarm	AL --	Indicates no occurrence of an alarm.
	AL 33	Indicates the occurrence of overvoltage (AL.33). Flickers at occurrence of the alarm.
Alarm history	A0 50	Indicates that the last alarm is overload 1 (AL.50).
	A1 33	Indicates that the second alarm in the past is overvoltage (AL.33).
	A2 10	Indicates that the third alarm in the past is undervoltage (AL.10).
	A3 31	Indicates that the fourth alarm in the past is overspeed (AL.31).
	A4 --	Indicates that there is no fifth alarm in the past.
	A5 --	Indicates that there is no sixth alarm in the past.

Name	Display	Description
Parameter error No.	E --	Indicates no occurrence of parameter error (AL.37).
	E 01	Indicates that the data of parameter No.PA12 is faulty.

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

(2) Even during alarm occurrence, the other screen can be viewed by pressing the button in the operation area. At this time, the decimal point in the fourth digit remains flickering.

(3) For any alarm, remove its cause and clear it in any of the following methods (for clearable alarms, refer to section 9.1).

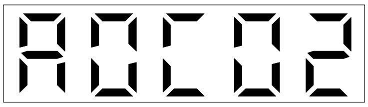
(a) Switch power OFF, then ON.

(b) Press the "SET" button on the current alarm screen.

(c) Turn on the alarm reset (RES).

(4) Use parameter No.PC18 to clear the alarm history.

(5) Pressing "SET" on the alarm history display screen for 2s or longer shows the following detailed information display screen. Note that this is provided for maintenance by the manufacturer.



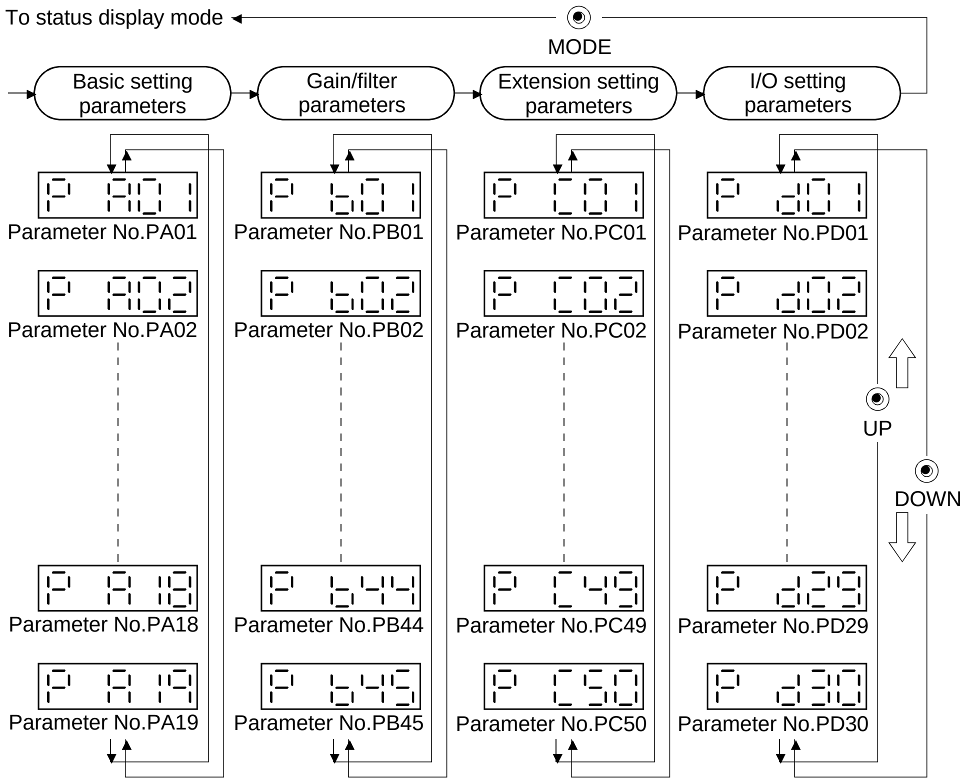
(6) Press "UP" or "DOWN" to move to the next history.

6.6 Parameter mode

POINT
· To use the I/O setting parameters, change the parameter No.PA19 (parameter write inhibit value. (Refer to section 5.1.1) · The I/O signal settings can be changed using the I/O setting parameter No.PD03 to PD08, PD10 to PD16, PD18.

6.6.1 Parameter mode transition

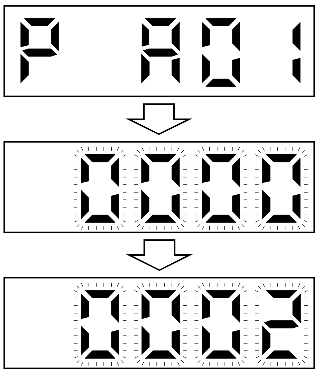
After choosing the corresponding parameter mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



6.6.2 Operation example

(1) Parameters of 5 or less digits

The following example shows the operation procedure performed after power-on to change the control mode (Parameter No.PA01) into the speed control mode. Press "MODE" to switch to the basic setting parameter screen.



Press MODE four times. Select parameter No.8 with UP or DOWN.

· · · · · · The parameter number is displayed.

Press UP or DOWN to change the number.

Press SET twice.

· · · · · · The set value of the specified parameter number flickers.

Press UP twice.

· · · · · · During flickering, the set value can be changed.

Use UP or DOWN .

(□□□2: Speed control mode)

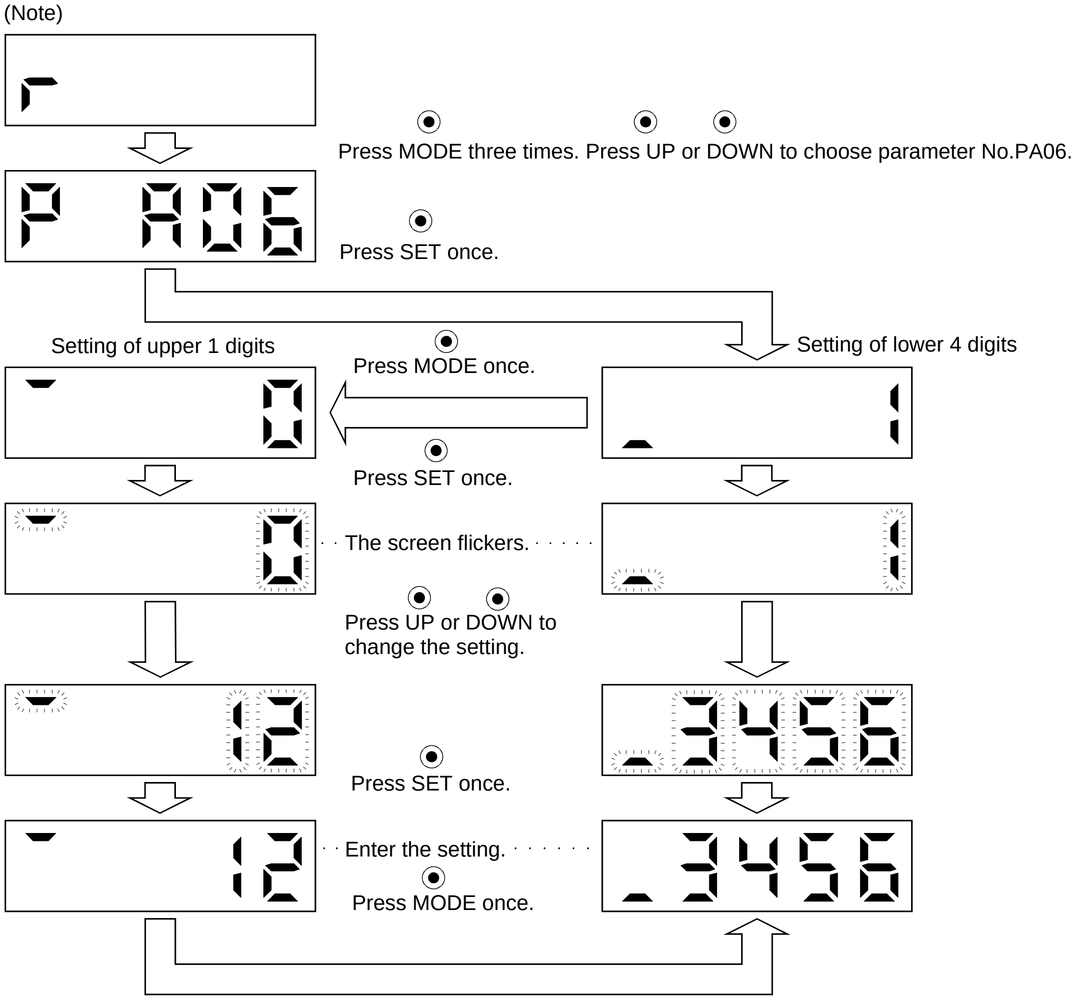
Press SET to enter.

To shift to the next parameter, press the "UP" or "DOWN" button.

When changing the parameter No.PA01 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

(2) Parameters of 6 or more digits

The following example gives the operation procedure to change the electronic gear numerator (parameter No.PA06) to "123456".



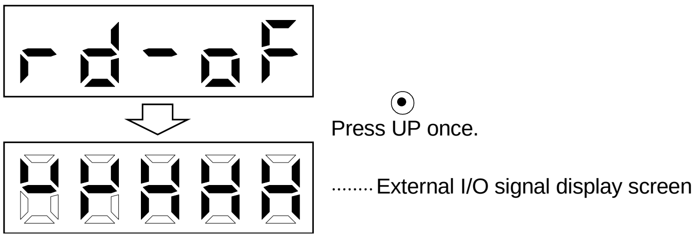
Note. The example assumes that the status display screen that appears at power-on has been set to the servo motor speed in parameter No.PC36.

6.7 External I/O signal display

The ON/OFF states of the digital I/O signals connected to the driver can be confirmed.

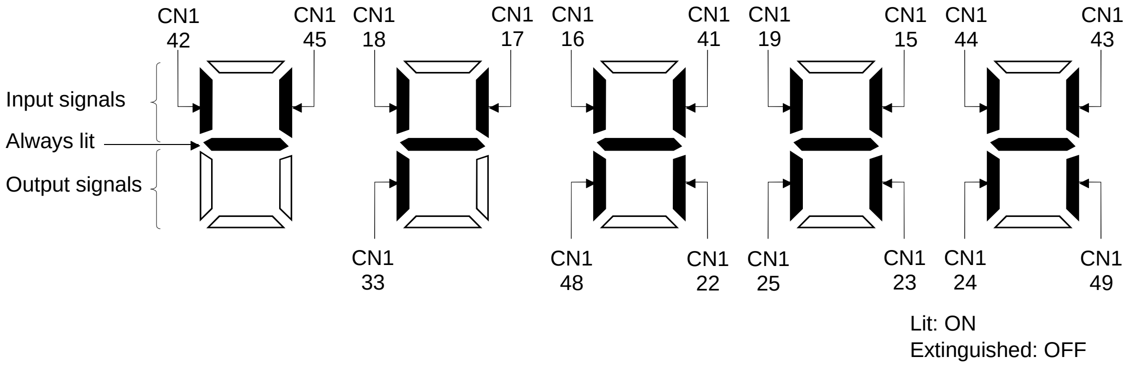
(1) Operation

After power-on, change the display mode to the diagnostic mode using the "MODE" button.



(2) Display definition

The 7-segment LED segments and CN1 connector pins correspond as shown below.



The LED segment corresponding to the pin is lit to indicate ON, and is extinguished to indicate OFF.

The signals corresponding to the pins in the respective control modes are indicated below.

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	15	I	SON	SON	SON	SON	SON	SON	No.PD03
	16	I		－/SP2	SP2	SP2/SP2	SP2	SP2/－	No.PD04
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	No.PD05
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	No.PD06
	19	I	RES	RES	RES	RES	RES	RES	No.PD07
	22	O	INP	INP/SA	SA	SA/－		－/INP	No.PD13
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	No.PD14
	24	O	INP	INP/SA	SA	SA/－		－/INP	No.PD15
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	No.PD16
	33	O	OP	OP	OP	OP	OP	OP	
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	No.PD08
	42	I	EMG	EMG	EMG	EMG	EMG	EMG	
	43	I	LSP	LSP	LSP	LSP/－		－/LSP	No.PD10
	44	I	LSN	LSN	LSN	LSN/－		－/LSN	No.PD11
	45	I	LOP	LOP	LOP	LOP	LOP	LOP	No.PD12
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	No.PD18

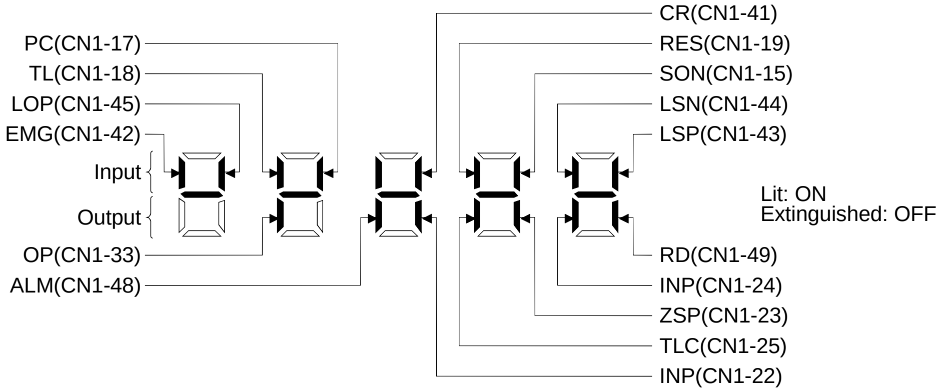
Note 1. I: Input signal, O: Output signal
2. P: Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

(b) Symbol and signal names

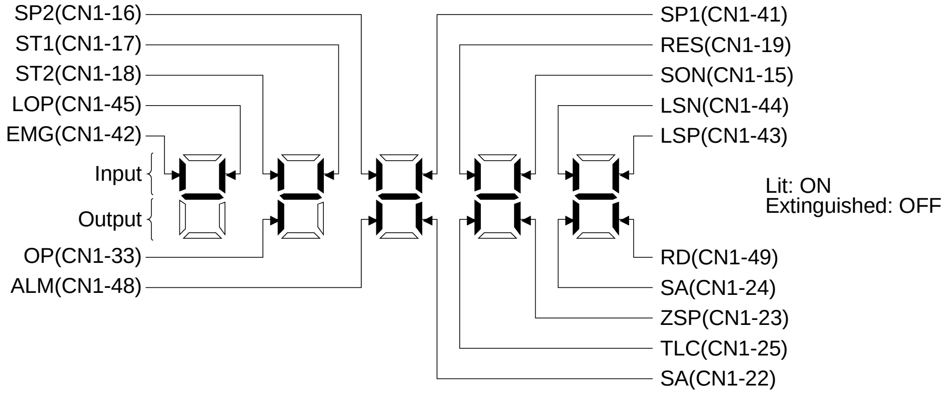
Symbol	Signal name	Symbol	Signal name
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EMG	Emergency stop
LSN	Reverse rotation stroke end	LOP	Control change
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportion control	ZSP	Zero speed detection
ST1	Forward rotation start	INP	In-position
ST2	Reverse rotation start	SA	Speed reached
RS1	Forward rotation selection	ALM	Trouble
RS2	Reverse rotation selection	OP	Encoder Z-phase pulse (open collector)
TL	External torque limit selection		

(3) Display data at initial values

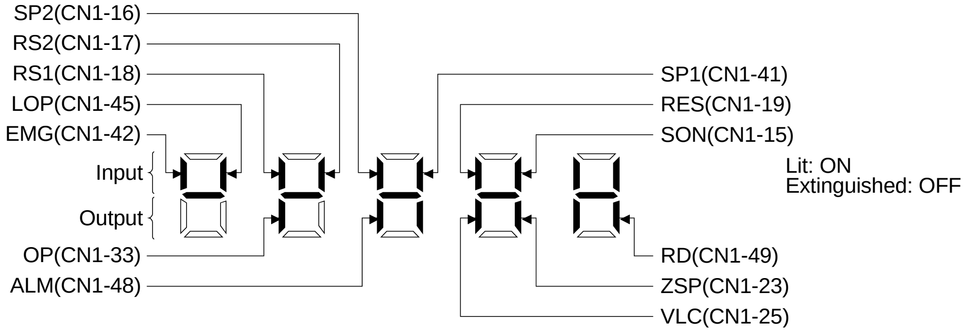
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



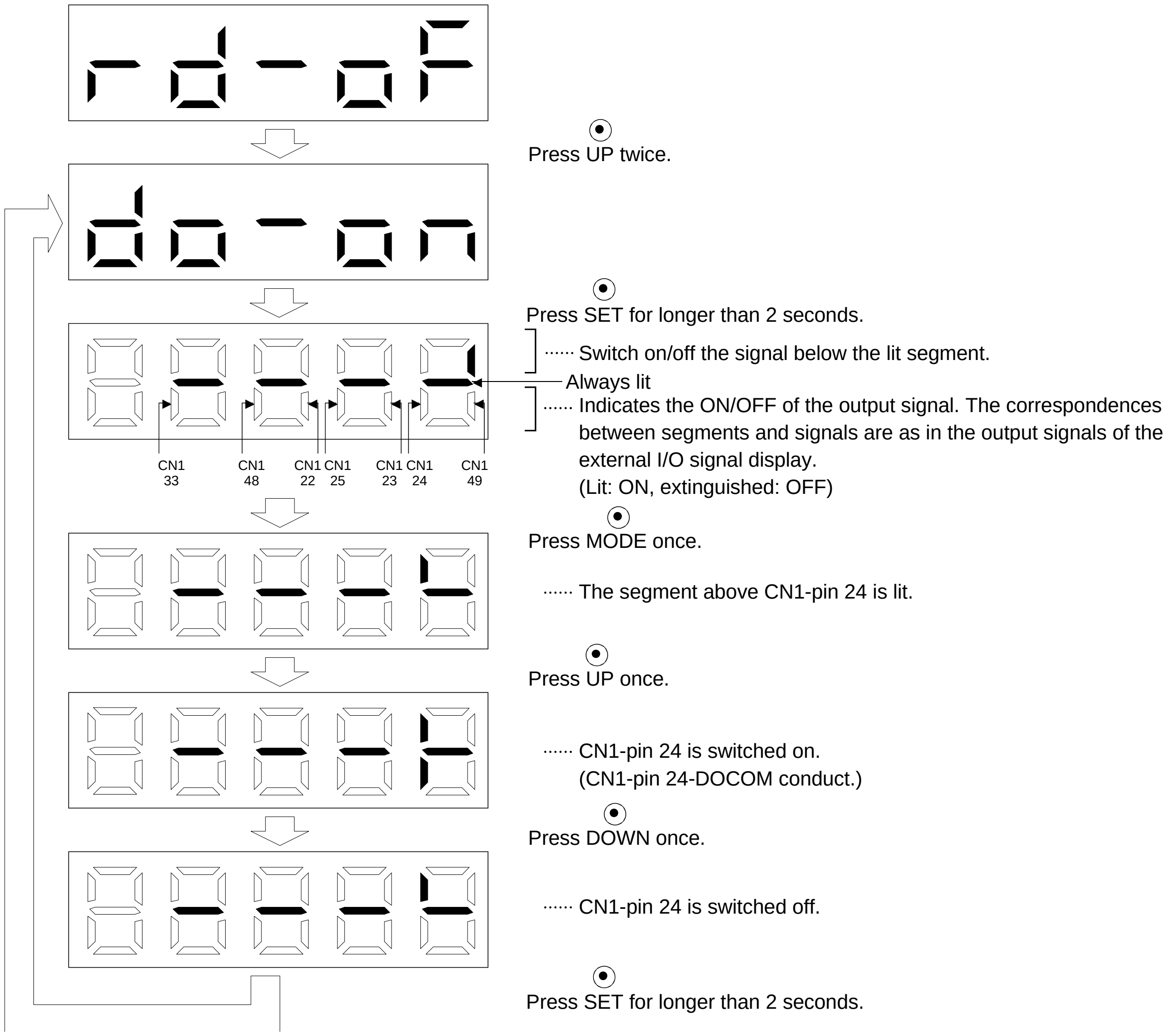
6.8 Output signal (DO) forced output

POINT
· When the servo system is used in a vertical lift application, turning on the electromagnetic brake interlock (MBR) by the DO forced output after assigning it to connector CN1 will release the lock, causing a drop. Take drop preventive measures on the machine side.

The output signal can be forced on/off independently of the servo status. This function is used for output signal wiring check, etc. This operation must be performed in the servo off state by turning off the servo-on (SON).

Operation

After power-on, change the display mode to the diagnostic mode using the "MODE" button.



6.9 Test operation mode

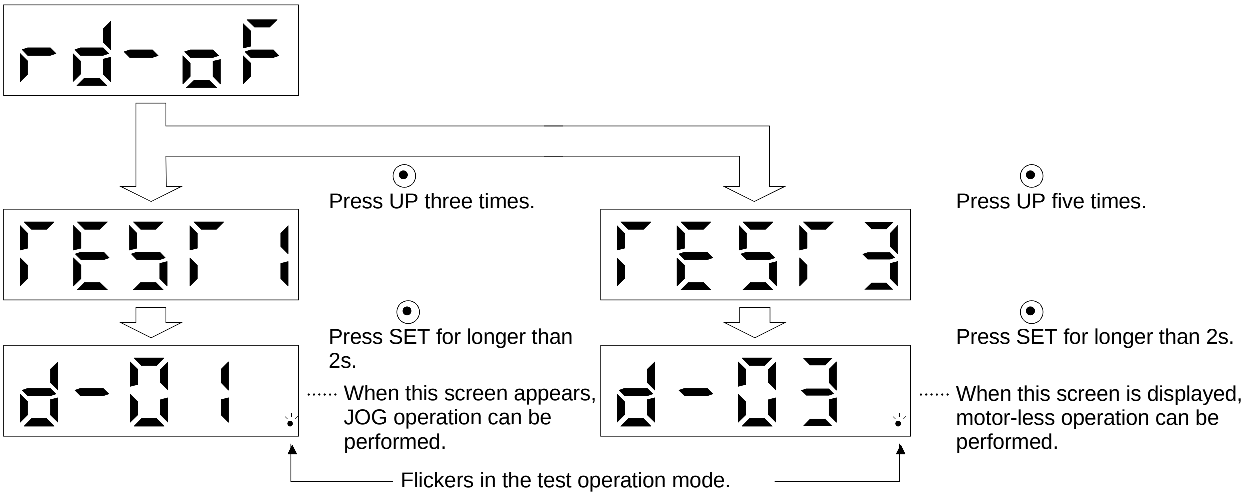
CAUTION	
⚠ CAUTION	・The test operation mode is designed to confirm servo operation. Do not use it for actual operation. ・If any operational fault has occurred, stop operation using the emergency stop (EMG) signal.

POINT

- The test operation mode cannot be used in the absolute position detection system by DIO (parameter No.PA03: □□□1).
- The software (MR Configurator2 ™) is required to perform positioning operation.
- Test operation cannot be performed if the servo-on (SON) is not turned OFF.

6.9.1 Mode change

After power-on, change the display mode to the diagnostic mode using the "MODE" button. Choose JOG operation/motor-less operation in the following procedure.



6.9.2 JOG operation

POINT
・When performing JOG operation, turn ON EMG, LSP and LSN. LSP and LSN can be set to automatic ON by setting parameter No.PD01 to "□C□□".

JOG operation can be performed when there is no command from the external command device.

(1) Operation

The servo motor rotates while holding down the "UP" or the "DOWN" button. The servo motor stops rotating by releasing the button. The operation condition can be changed using the software (MR Configurator2™). The initial conditions and setting ranges for operation are listed below.

Item	Initial setting	Setting range
Speed [r/min]	200	0 to instantaneous permissible speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the buttons is explained below.

Button	Description
"UP"	Press to start CCW rotation. Release to stop.
"DOWN"	Press to start CW rotation. Release to stop.

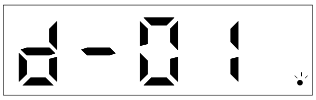
If the communication cable is disconnected during JOG operation using the software (MR Configurator2™), the servo motor decelerates to a stop.

(2) Status display

Call the status display screen by pressing the "MODE" button in the JOG operation stand-by status. When the JOG operation is performed using the “UP” or the “DOWN” button, the servo status appears on the display.
The status display screen shifts to the next screen every time the "MODE" button is pressed. For details of the status display, refer to section 5.3. The status display screen returns to the JOG operation stand-by screen after one screen cycle. Note that the status display screen cannot be changed by the "UP" or the "DOWN" button in the JOG operation mode.

(3) Termination of JOG operation

To end the JOG operation, turn the power off once or press the "MODE" button to switch to the next screen, and then hold down the "SET" button for 2[s] or longer.

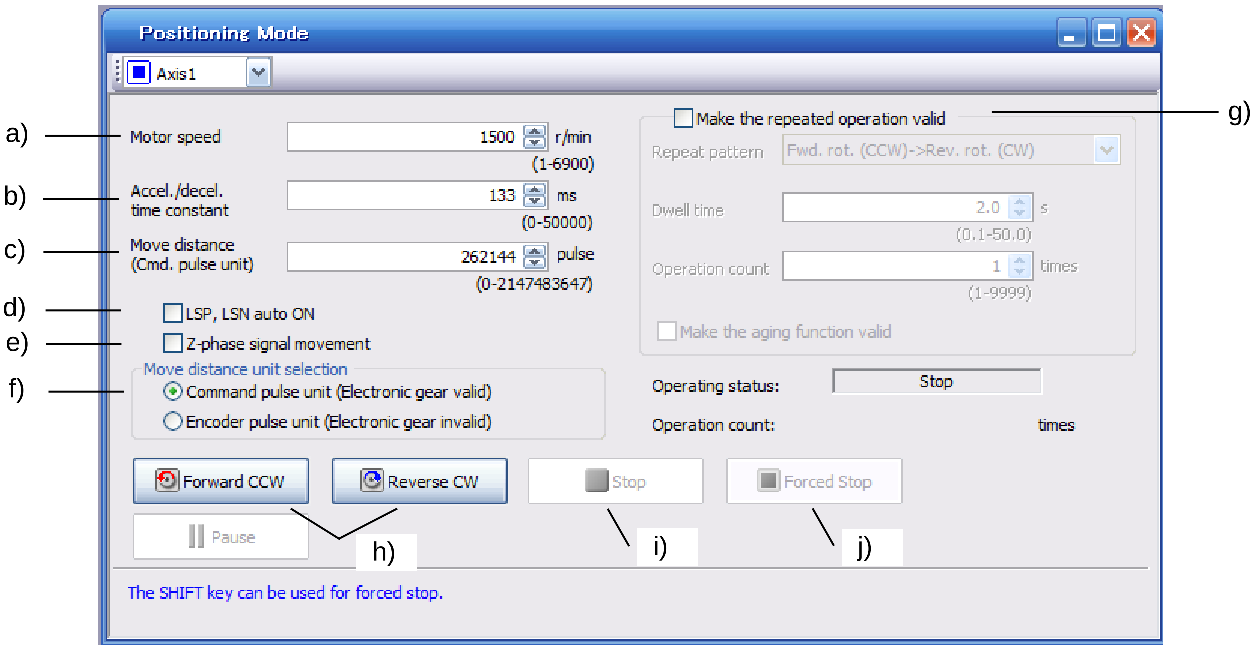


6.9.3 Positioning operation

POINT
・ Software (MR Configurator2 ™) is required to perform positioning operation. ・Turn ON EMG when performing positioning operation.

With no command given from the external command device, positioning operation can be executed.

(1) Operation



a) Motor speed [r/min]

Enter the servo motor speed into the "Motor speed" input field.

b) Accel/decel time [ms]

Enter the acceleration/deceleration time constant into the "Accel/decel time" input field.

c) Move distance [pulse]

Enter the moving distance into the "Move distance" input field.

d) LSP and LSN are automatically turned ON

When setting the external stroke signal to automatic ON, click the check box to make it valid. When it is not checked, turn ON LSP and LSN externally.

e) Move until the initial Z-phase signal of the move distance in the move direction is turned ON.

Movement is made until the moving distance is reached and the first Z-phase signal in the moving direction turns ON.

f) Pulse move distance unit selection

Select with the option buttons whether the moving distance set in c) is in the command pulse unit or in the encoder pulse unit.

When the command input pulse unit is selected, the value, which is the set moving distance multiplied by the electronic gear ($\frac{CMX}{CDV}$), will be the command value. When the encoder pulse unit is selected, the moving distance is not multiplied by the electronic gear.

g) Repeat operation

To perform the repeated operation, click the check box of "Make the repeated operation valid". The next table shows the initial setting and the setting range of the repeated operation.

Item	Initial setting	Setting range
Repeat pattern	Fwd. rot.(CCW)→Rev. rot. (CW)	Fwd. rot.(CCW)→Rev. rot. (CW) Fwd. rot.(CCW)→Fwd. rot.(CCW) Rev. rot. (CW)→Fwd. rot.(CCW) Rev. rot. (CW)→Rev. rot. (CW)
Dwell time [s]	2.0	0.1 to 50.0
Number of repeats [times]	1	1 to 9999

To perform continuous operation with the repeat pattern and dwell time settings, which are set by referring to the above table, click the check box of "Make the aging function valid".

h) Forward/Reverse

Click the "Forward" button to rotate the servo motor in the forward rotation direction.
Click the "Reverse" button to rotate the servo motor in the reverse rotation direction.

i) Stop

Click the "Stop" button erase the remaining distance after the motor has stopped.

j) Forced Stop

Click the "Forced Stop" button motor stops suddenly.

k) Pause

Click the "Pause" button during servo motor rotation to temporarily stop the servo motor.
This button is valid during servo motor rotation.

(2) Status display

The status display can be monitored during positioning operation.

6.9.4 Motor-less operation

Without connecting the servo motor, you can provide output signals or monitor the status display as if the servo motor is running in response to input device. This operation can be used to check the sequence of a PC or PLC…etc or the like.

(1) Operation

Turn SON off, and then select motor-less operation. After that, perform external operation as in ordinary operation.

(2) Status display

Change the display to the status display screen by pressing the "MODE" button. (Refer to section 6.2.)
The status screen can be changed by pressing the "UP" or the "DOWN" button. (Refer to section 6.3.)

(3) Termination of motor-less operation

To terminate the motor-less operation, switch power off.

7. GENERAL GAIN ADJUSTMENT

7. GENERAL GAIN ADJUSTMENT

POINT
· Consider individual machine differences, and do not adjust gain too strictly. It is recommended to keep the servo motor torque to 90% or less of the maximum torque of the servo motor during the operation. · For use in the torque control mode, you need not make gain adjustment.

7.1 Different adjustment methods

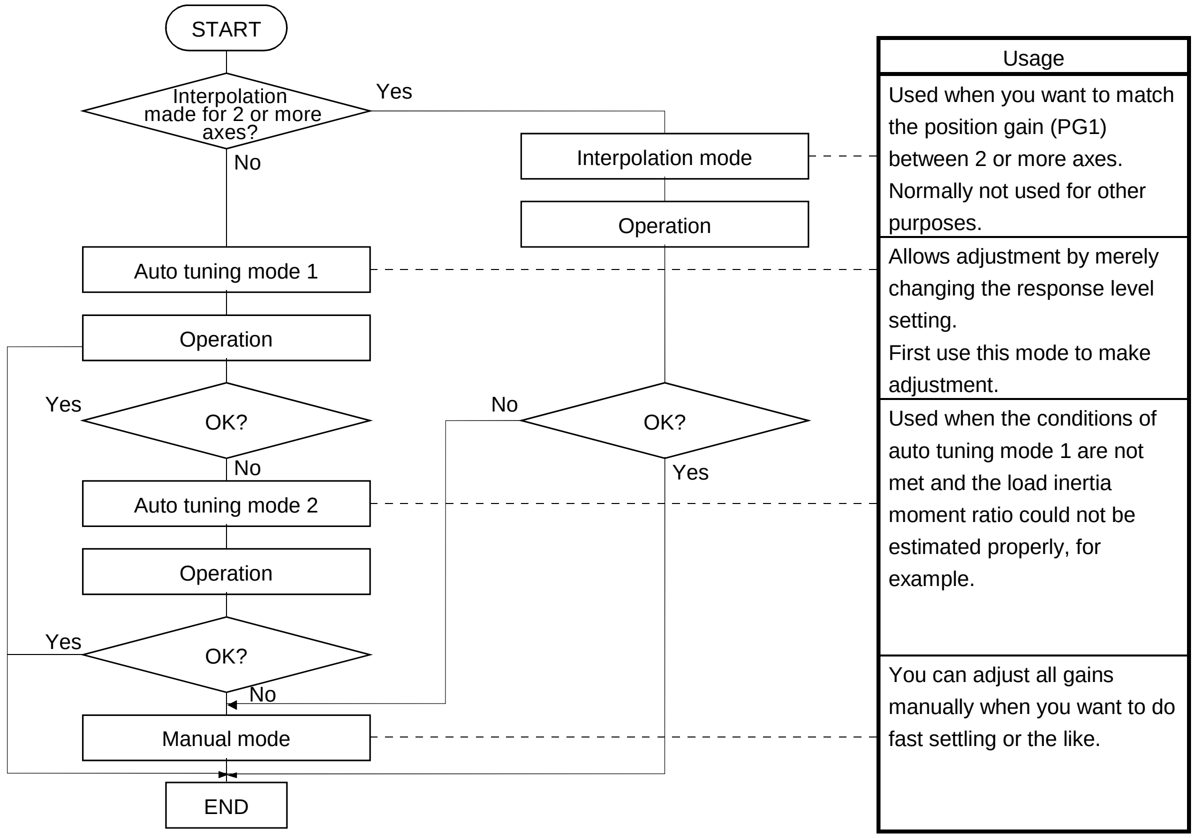
7.1.1 Adjustment on a single driver

The gain adjustment in this section can be made on a single driver. For gain adjustment, first execute auto tuning mode 1. If you are not satisfied with the results, execute auto tuning mode 2 and manual mode in this order.

(1) Gain adjustment mode explanation

Gain adjustment mode	Parameter No. PA08 setting	Estimation of load inertia moment ratio	Automatically set parameters	Manually set parameters
Auto tuning mode 1 (initial value)	0001	Always estimated	GD2 (parameter No.PB06) PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	RSP (parameter No.PA09)
Auto tuning mode 2	0002	Fixed to parameter No. PB06 value	PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	GD2 (parameter No.PB06) RSP (parameter No.PA09)
Manual mode	0003			GD2 (parameter No.PB06) PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)
Interpolation mode	0000	Always estimated	GD2 (parameter No.PB06) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	PG1 (parameter No.PB07) RSP (parameter No.PA09)

(2) Adjustment sequence and mode usage



7.1.2 Adjustment using software (MR Configurator2™)

This section gives the functions and adjustment that may be performed by using the driver with the software (MR Configurator2™) which operates on a personal computer.

Function	Description	Adjustment
Machine analyzer	With the machine and servo motor coupled, the characteristic of the mechanical system can be measured by giving a random vibration command from the personal computer to the servo and measuring the machine response.	· You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter. · You can automatically set the optimum gains in response to the machine characteristic. This simple adjustment is suitable for a machine which has large machine resonance and does not require much settling time.
Gain search	Executing gain search under to-and-fro positioning command measures settling characteristic while simultaneously changing gains, and automatically searches for gains which make settling time shortest.	· You can automatically set gains which make positioning settling time shortest.
Machine simulation	Response at positioning settling of a machine can be simulated from machine analyzer results on personal computer.	· You can optimize gain adjustment and command pattern on personal computer.

7.2 Auto tuning

7.2.1 Auto tuning mode

The driver has a real-time auto tuning function which estimates the machine characteristic (load inertia moment ratio) in real time and automatically sets the optimum gains according to that value. This function permits ease of gain adjustment of the driver.

(1) Auto tuning mode 1

The driver is factory-set to the auto tuning mode 1.

In this mode, the load inertia moment ratio of a machine is always estimated to set the optimum gains automatically.

The following parameters are automatically adjusted in the auto tuning mode 1.

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

POINT

- The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.
  - Time to reach 2000r/min is the acceleration/deceleration time constant of 5s or less.
  - Speed is 150r/min or higher.
  - The ratio of load inertia moment to servo motor inertia moment is 100 times or less.
- The acceleration/deceleration torque is 10% or more of the rated torque.
- Under operating conditions which will impose sudden disturbance torque during acceleration/deceleration or on a machine which is extremely loose, auto tuning may not function properly, either. In such cases, use the auto tuning mode 2 or manual mode to make gain adjustment.

(2) Auto tuning mode 2

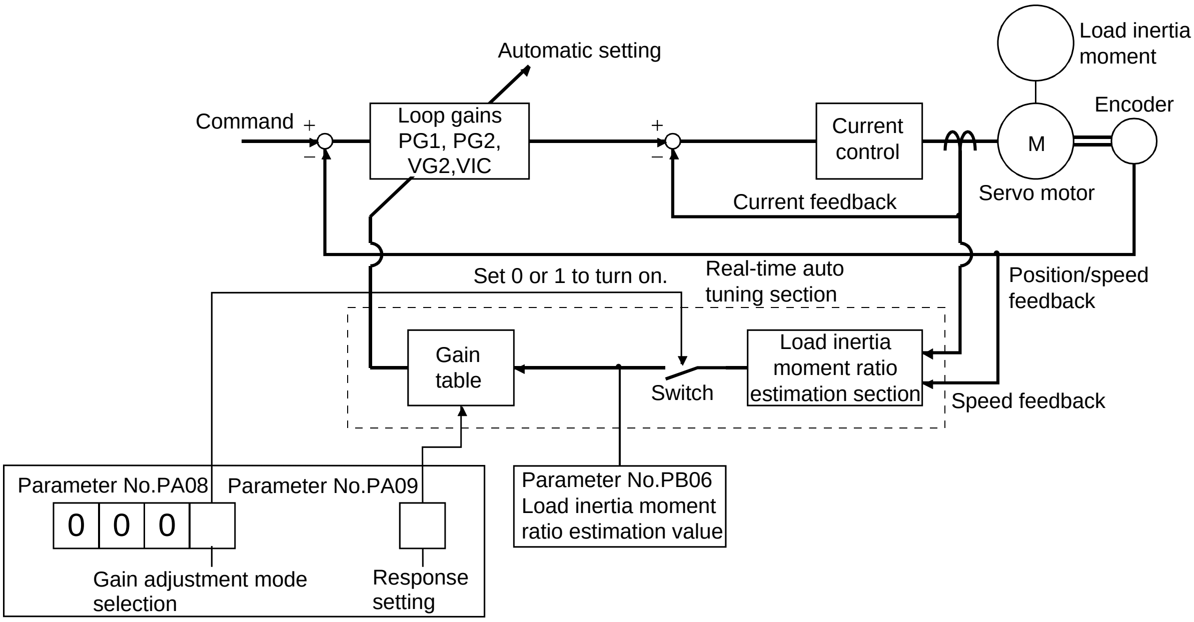
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load inertia moment ratio is not estimated in this mode, set the value of a correct load inertia moment ratio (parameter No.PB06).

The following parameters are automatically adjusted in the auto tuning mode 2.

Parameter No.	Abbreviation	Name
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

7.2.2 Auto tuning mode basis

The block diagram of real-time auto tuning is shown below.

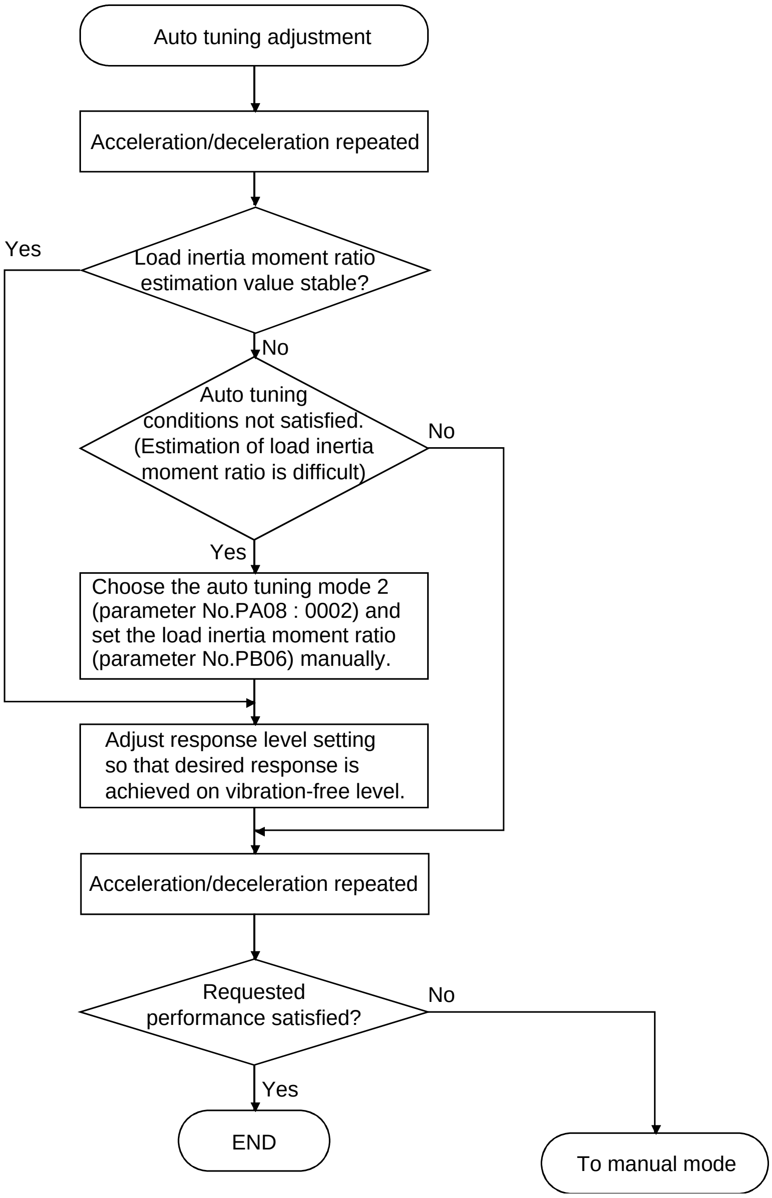


When a servo motor is accelerated/decelerated, the load inertia moment ratio estimation section always estimates the load inertia moment ratio from the current and speed of the servo motor. The results of estimation are written to parameter No.PB06 (the ratio of load inertia moment to servo motor). These results can be confirmed on the status display screen of the software (MR Configurator2 ™) section.
If the value of the load inertia moment ratio is already known or if estimation cannot be made properly, chose the "auto tuning mode 2" (parameter No.PA08: 0002) to stop the estimation of the load inertia moment ratio (Switch in above diagram turned off), and set the load inertia moment ratio (parameter No.PB06) manually.
From the preset load inertia moment ratio (parameter No.PB06) value and response level (parameter No. PA09), the optimum loop gains are automatically set on the basis of the internal gain tale.
The auto tuning results are saved in the EEP-ROM of the driver every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

POINT
･If sudden disturbance torque is imposed during operation, the estimation of the inertia moment ratio may malfunction temporarily. In such a case, choose the "auto tuning mode 2" (parameter No.PA08: 0002) and set the correct load inertia moment ratio in parameter No.PB06. ･When any of the auto tuning mode 1 and auto tuning mode settings is changed to the manual mode 2 setting, the current loop gains and load inertia moment ratio estimation value are saved in the EEP-ROM.

7.2.3 Adjustment procedure by auto tuning

Since auto tuning is made valid before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.

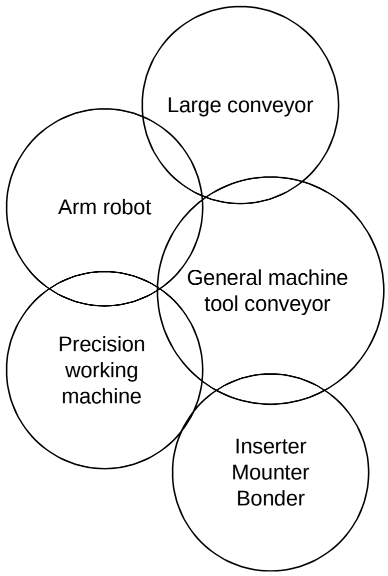


7.2.4 Response level setting in auto tuning mode

Set the response (The first digit of parameter No.PA09) of the whole servo system. As the response level setting is increased, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range.
If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100Hz, adaptive tuning mode (parameter No.PB01) or machine resonance suppression filter (parameter No.PB13 to PB16) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to section 8.2, 8.3 for adaptive tuning mode and machine resonance suppression filter.

Setting of parameter No.PA09

Response level setting	Machine characteristic		
	Machine rigidity	Machine resonance frequency guideline	Guideline of corresponding machine
1	Low	10.0	
2		11.3	
3		12.7	
4		14.3	
5		16.1	
6		18.1	
7		20.4	
8		23.0	
9		25.9	
10		29.2	
11		32.9	
12		37.0	
13		41.7	
14		47.0	
15		52.9	
16	Middle	59.6	
17		67.1	
18		75.6	
19		85.2	
20		95.9	
21		108.0	
22		121.7	
23		137.1	
24		154.4	
25		173.9	
26		195.9	
27		220.6	
28		248.5	
29		279.9	
30		315.3	
31		355.1	
32	High	400.0	



7.3 Manual mode 1 (simple manual adjustment)

If you are not satisfied with the adjustment of auto tuning, you can make simple manual adjustment with three parameters.

> **POINT**
>
> - If machine resonance occurs, adaptive tuning mode (parameter No.PB01) or machine resonance suppression filter (parameter No.PB13 to PB16) may be used to suppress machine resonance. (Refer to section 8.3.)

(1) For speed control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
PB07	PG1	Model loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 7.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the model loop gain.
8	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 7.	Suppression of machine resonance. Refer to section 8.2, 8.3.
9	While checking the rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Speed loop gain (parameter No.PB09)

This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency(Hz)} = \frac{\text{Speed loop gain setting}}{(1+\text{ratio of load inertia moment to servo motor inertia moment})\times 2\pi}$$

2) Speed integral compensation (VIC: parameter No.PB10)
To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting(ms)} \geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain setting/ (1+ratio of load inertia moment to servo motor inertia moment setting)}}$$

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 7.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain and the position loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the position loop gain, and return slightly if vibration takes place.	Increase the position loop gain.
8	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the position loop gain.
9	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 8.	Suppression of machine resonance. Refer to section 8.2・8.3.
10	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Model loop gain (parameter No.PB07)

This parameter determines the response level of the model loop. Increasing position loop gain 1 improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling.

$$\text{Model loop gain guideline} \leq \frac{\text{Speed loop gain setting}}{(1+\text{ratio of load inertia moment to servo motor inertia moment})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

2) Speed loop gain (VG2: parameter No.PB09)

This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency (Hz)} = \frac{\text{Speed loop gain setting}}{(1+\text{ratio of load inertia moment to servo motor inertia moment}) \times 2\pi}$$

3) Speed integral compensation (parameter No.PB10)

To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting (ms)} \geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain setting}/(1+\text{ratio of load inertia moment to servo motor inertia moment 2 setting})}$$

7.4 Interpolation mode

The interpolation mode is used to match the position loop gains of the axes when performing the interpolation operation of servo motors of two or more axes for an X-Y table or the like. In this mode, manually set the model loop gain that determines command track ability. Other parameters for gain adjustment are set automatically.

(1) Parameter

(a) Automatically adjusted parameters

The following parameters are automatically adjusted by auto tuning.

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameters

The following parameters are adjustable manually.

Parameter No.	Abbreviation	Name
PB07	PG1	Model loop gain

(2) Adjustment procedure

Step	Operation	Description
1	Set to the auto tuning mode.	Select the auto tuning mode 1.
2	During operation, increase the response level setting (parameter No.PA09), and return the setting if vibration occurs.	Adjustment in auto tuning mode 1.
3	Check the values of model loop gain.	Check the upper setting limits.
4	Set the interpolation mode (parameter No.PA08: 0000).	Select the interpolation mode.
5	Set the model loop gain of all the axes to be interpolated to the same value. At that time, adjust to the setting value of the axis, which has the smallest model loop gain.	Set model loop gain.
6	Looking at the interpolation characteristic and rotation status, fine-adjust the gains and response level setting.	Fine adjustment.

(3) Adjustment description

(a) Model loop gain (parameter No.PB07)

This parameter determines the response level of the position control loop. Increasing model loop gain improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling. The droop pulses are determined by the following expression.

$$\text{Droop pulses (pulse)} = \frac{\dfrac{\text{Rotation speed (r/min)}}{60} \times 262144\text{(pulse)}}{\text{Model loop gain setting}}$$

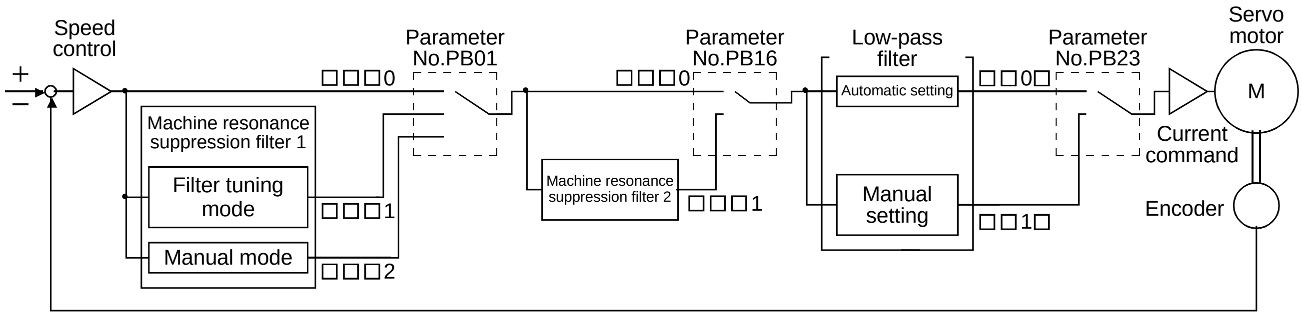
8. SPECIAL ADJUSTMENT FUNCTIONS

8. SPECIAL ADJUSTMENT FUNCTIONS

POINT
・The functions given in this chapter need not be used generally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 7.

If a mechanical system has a natural resonance point, increasing the servo system response level may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency.
Using the machine resonance suppression filter and adaptive tuning can suppress the resonance of the mechanical system.

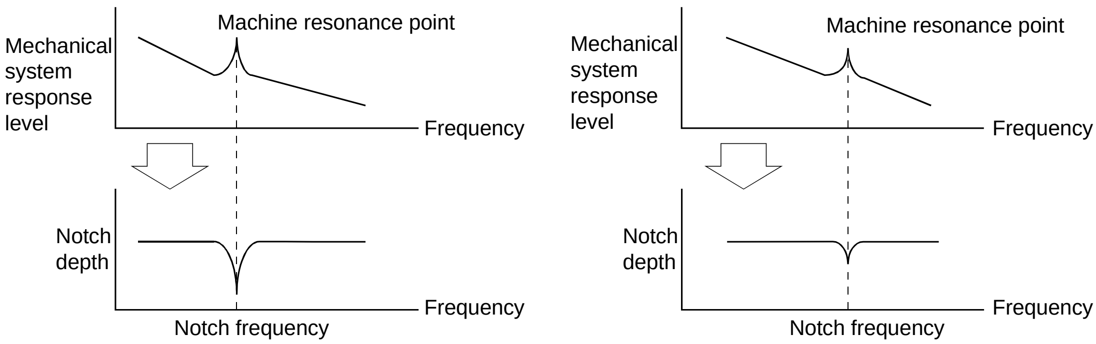
8.1 Function block diagram



8.2 Adaptive filter Ⅱ

(1) Function

Adaptive filter Ⅱ (adaptive tuning) is a function in which the driver detects machine vibration for a predetermined period of time and sets the filter characteristics automatically to suppress mechanical system vibration. Since the filter characteristics (frequency, depth) are set automatically, you need not be conscious of the resonance frequency of a mechanical system.



When machine resonance is large and frequency is low

When machine resonance is small and frequency is high

POINT
· The machine resonance frequency which adaptive filter Ⅱ (adaptive tuning) can respond to is about 100 to 2.25kHz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range. · Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics.

(2) Parameters

The adjustment mode of adaptive tuning mode (parameter No.PB01).

Parameter No.PB01

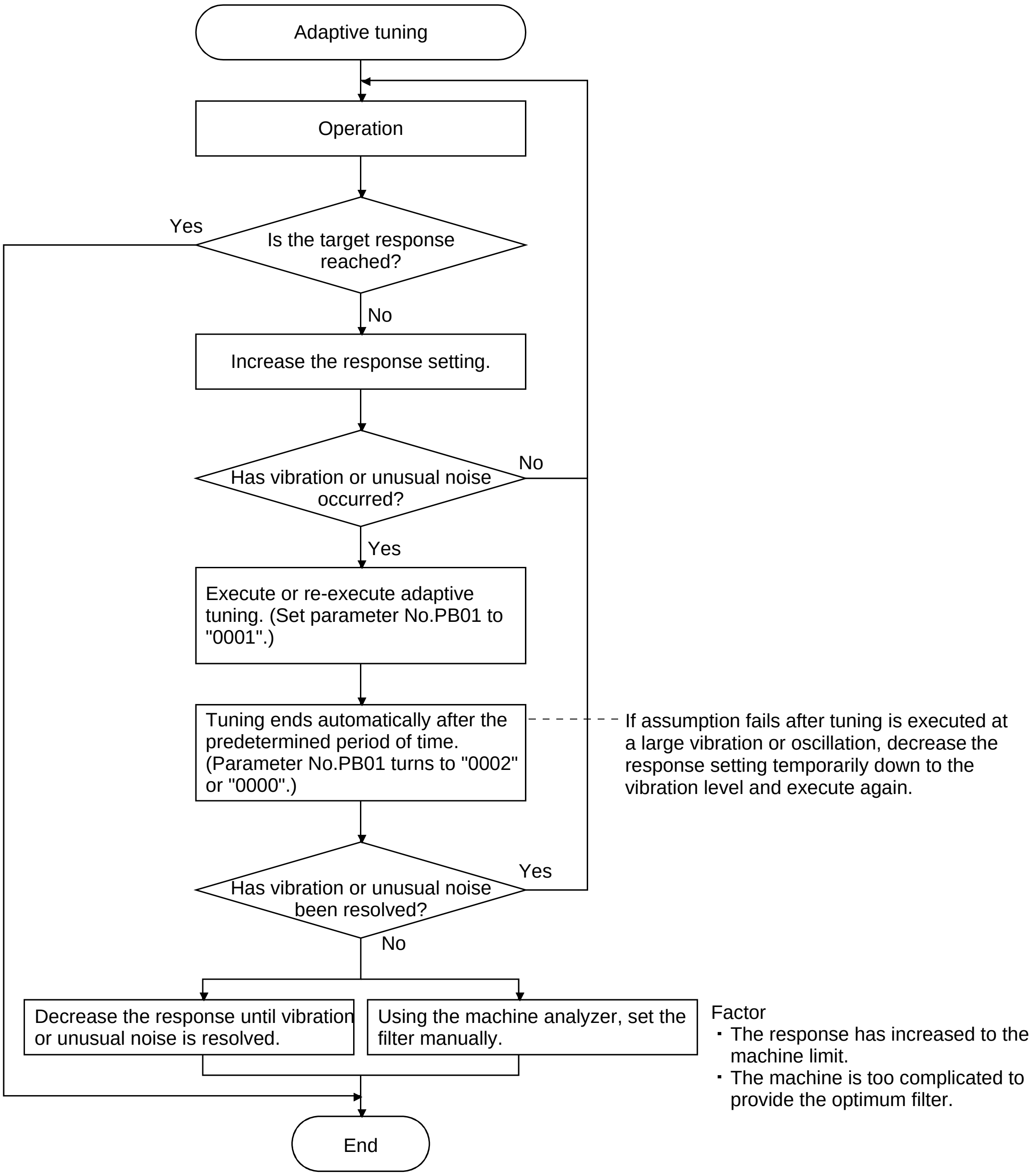
0	0	0	

Adaptive tuning mode selection

Setting	Adaptive tuning mode	Automatically set parameter
0	Filter OFF	(Note)
1	Filter tuning mode	Parameter No.PB13 Parameter No.PB14
2	Manual mode	

Note. Parameter No.PB13 and PB14 are fixed to the initial values.

(3) Adaptive tuning procedure



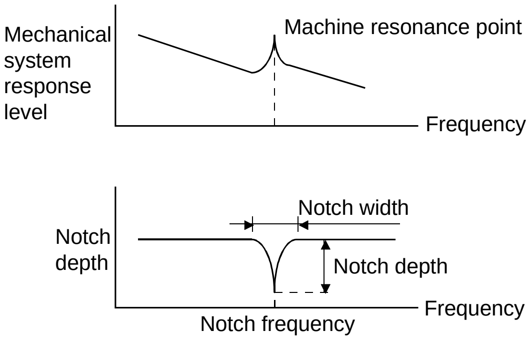
POINT

- "Filter OFF" enables a return to the initial value.
- When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds.
- When adaptive tuning is executed, machine resonance is detected for a maximum of 10 seconds and a filter is generated. After filter generation, the adaptive tuning mode automatically shifts to the manual mode.
- Adaptive tuning generates the optimum filter with the currently set control gains. If vibration occurs when the response setting is increased, execute adaptive tuning again.
- During adaptive tuning, a filter having the best notch depth at the set control gain is generated. To allow a filter margin against machine resonance, increase the notch depth in the manual mode.

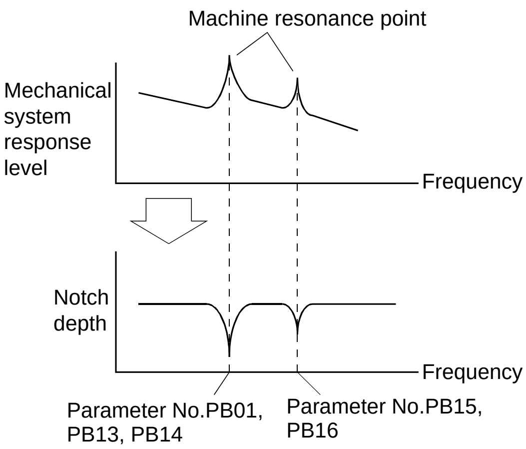
8.3 Machine resonance suppression filter

(1) Function

The machine resonance suppression filter is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system. You can set the gain decreasing frequency (notch frequency), gain decreasing depth and width.



You can use the machine resonance suppression filter 1 (parameter No.PB13, PB14) and machine resonance suppression filter 2 (parameter No.PB15, PB16) to suppress the vibration of two resonance frequencies. Execution of adaptive tuning in the filter tuning mode automatically adjusts the machine resonance suppression filter. When filter tuning mode is ON, the filter tuning mode shifts to the manual mode after the predetermined period of time. The manual mode enables manual setting using the machine resonance suppression filter 1.



(2) Parameters

(a) Machine resonance suppression filter 1 (parameter No.PB13, PB14)

Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 (parameter No.PB13, PB14)

When the "manual mode" is selected in the adaptive tuning mode (parameter No.PB01), the settings of the machine resonance suppression filter 1 are valid.

(b) Machine resonance suppression filter 2 (parameter No.PB15, PB16)

Setting method for the machine resonance suppression filter 2 (parameter No.PB15, PB16) is same as for the machine resonance suppression filter 1 (parameter No.PB13, PB14). However, the machine resonance suppression filter 2 can be set whether the filter tuning mode is valid or not.

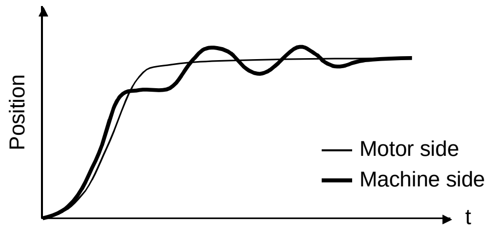
POINT

- The machine resonance suppression filter is a delay factor for the servo system. Hence, vibration may increase if you set a wrong resonance frequency or a too deep notch.
- If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- A wider notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- The machine characteristic can be grasped beforehand by the machine analyzer on the software (MR Configurator2™). This allows the required notch frequency and depth to be determined.

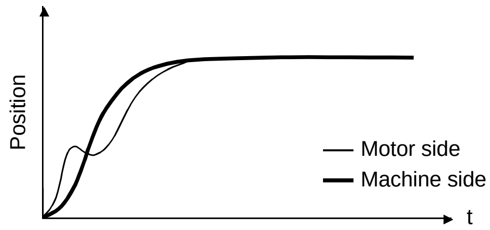
8.4 Advanced vibration suppression control

(1) Operation

Vibration suppression control is used to further suppress machine side vibration, such as workpiece end vibration and base shake. The motor side operation is adjusted for positioning so that the machine does not shake.



Vibration suppression control OFF
(Nomal control)



Vibration suppression control ON

When the advanced vibration suppression control (vibration suppression control tuning mode (parameter No.PB02)) is executed, the vibration frequency at machine side can automatically be estimated to suppress machine side vibration.

In the vibration suppression control tuning mode, this mode shifts to the manual mode after positioning operation is performed the predetermined number of times. The manual mode enables manual setting using the vibration suppression control vibration frequency setting (parameter No.PB19) and vibration suppression control resonance frequency setting (parameter No.PB20).

(2) Parameter

Select the adjustment mode of the vibration suppression control tuning mode (parameter No.PB02).

Parameter No.PB02

0	0	0	

Vibration suppression control tuning mode

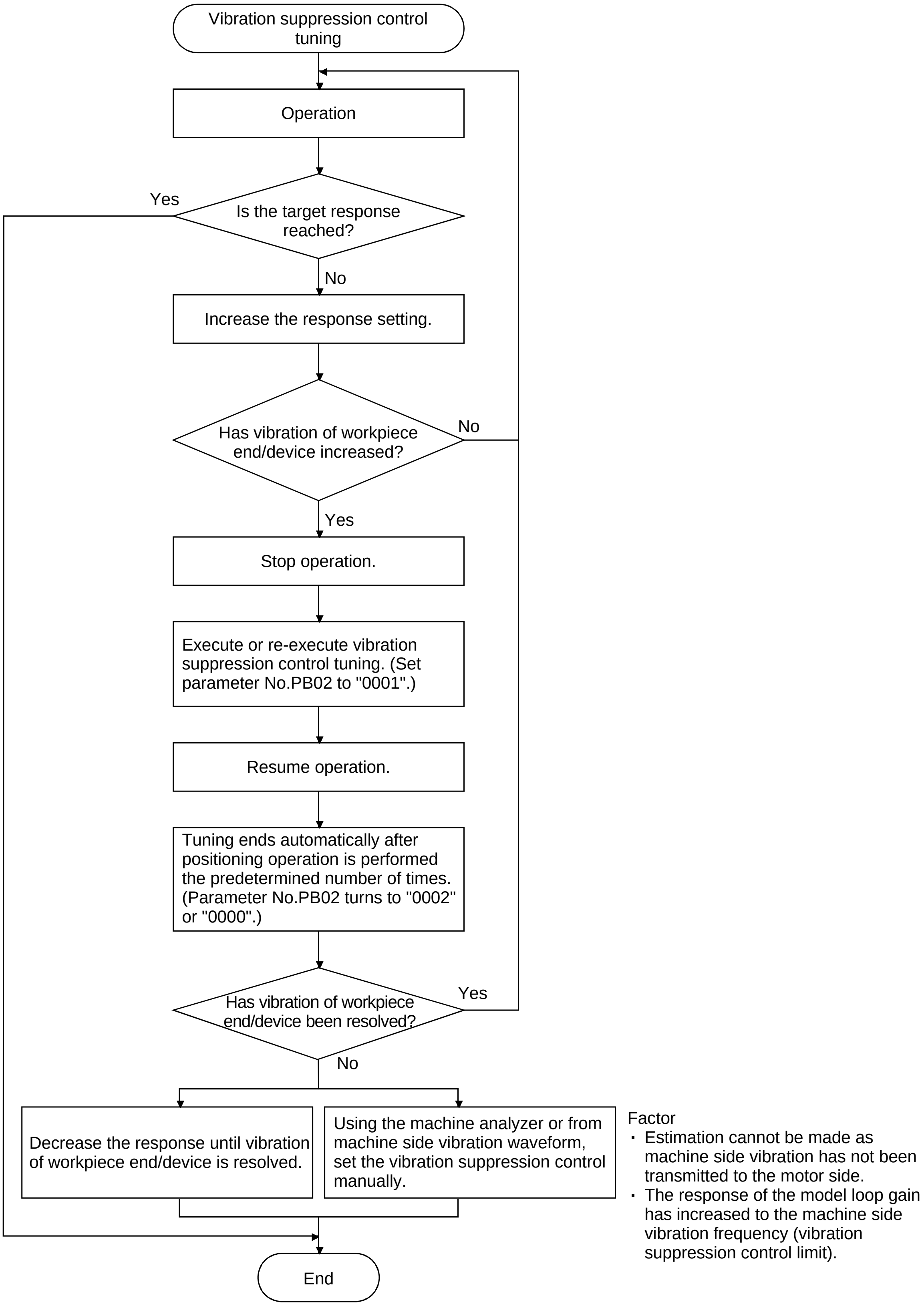
Setting	Vibration suppression control tuning mode	Automatically set parameter
0	Vibration suppression control OFF	(Note)
1	Vibration suppression control tuning mode (Advanced vibration suppression control)	Parameter No.PB19 Parameter No.PB20
2	Manual mode	

Note. Parameter No.PB19 and PB20 are fixed to the initial values.

POINT

- The function is made valid when the auto tuning mode (parameter No.PA08) is the auto tuning mode 2 ("0002") or manual mode ("0003").
- The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 to 100.0Hz. The function is not effective for vibration outside this range.
- Stop the motor before changing the vibration suppression control-related parameters (parameter No.PB02, PB19, PB20, PB33, PB34). A failure to do so will cause a shock.
- For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after full vibration damping.
- Vibration suppression control tuning may not make normal estimation if the residual vibration at the motor side is small.
- Vibration suppression control tuning sets the optimum parameter with the currently set control gains. When the response setting is increased, set vibration suppression control tuning again.

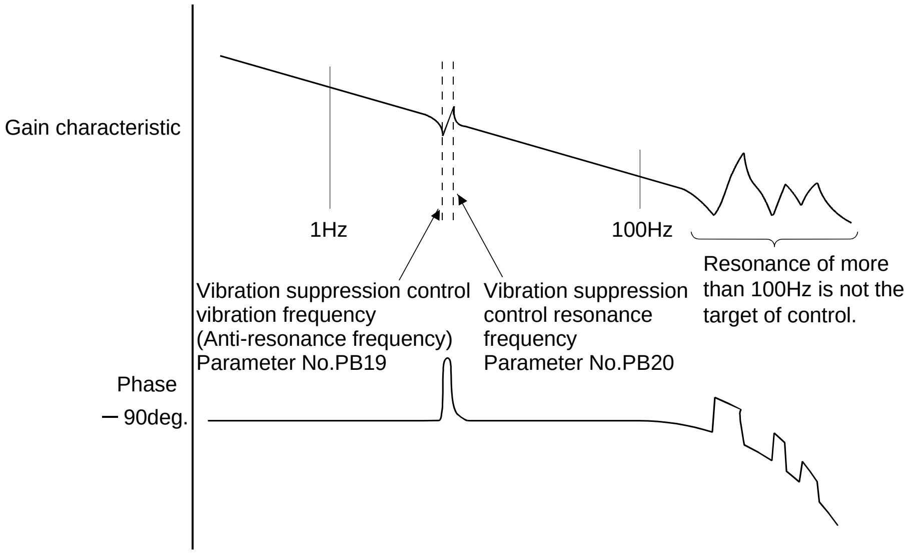
(3) Vibration suppression control tuning procedure



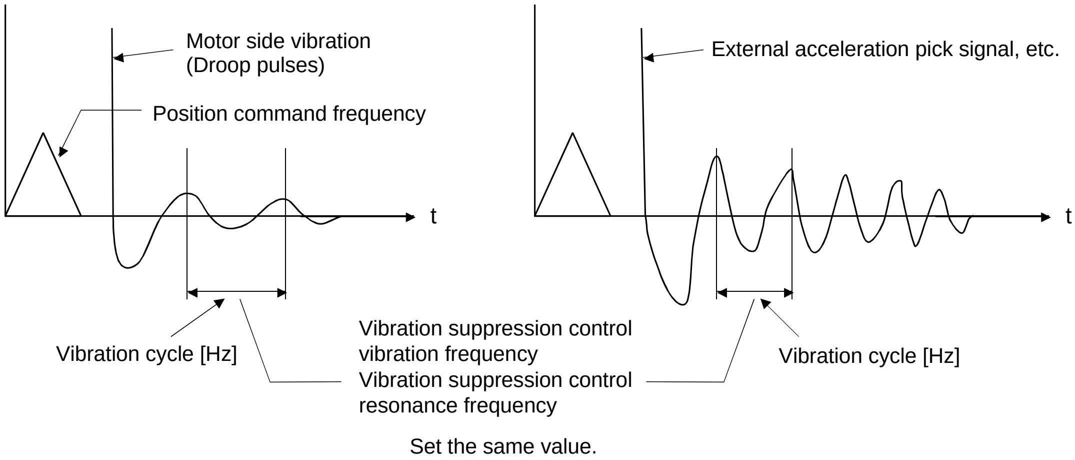
(4) Vibration suppression control manual mode

Measure work side vibration and device shake with the machine analyzer or external measuring instrument, and set the vibration suppression control vibration frequency (parameter No.PB19) and vibration suppression control resonance frequency (parameter No.PB20) to set vibration suppression control manually.

(a) When a vibration peak can be confirmed using machine analyzer by software (MR Configurator2™) or external measuring instrument



(b) When vibration can be confirmed using monitor signal or external sensor



POINT

- When machine side vibration does not show up in motor side vibration, the setting of the motor side vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external measuring instrument, do not set the same value but set different values to improve the vibration suppression performance.
- A vibration suppression control effect is not produced if the relationship between the model loop gain (parameter No.PB07) value and vibration frequency is as indicated below. Make setting after decreasing model loop gain (PG1), e.g. reduce the response setting.

$$\frac{1}{2\pi}(1.5 \times \mathrm{PG1}) > \text{vibration frequency}$$

8.5 Low-pass filter

(1) Function

When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is initial setting to be valid for a torque command. The filter frequency of this low-pass filter is automatically adjusted to the value in the following expression.

$$\text{Filter frequency(rad/s)} = \frac{\mathrm{VG2}}{1 + \mathrm{GD2}} \times 10$$

When parameter No.PB23 is set to "□□1□", manual setting can be made with parameter No.PB18.

(2) Parameter

Set the low-pass filter selection (parameter No.PB23.)

Parameter No.PB23

0	0		0

Low-pass filter selection
0: Automatic setting (initial value)
1: Manual setting (parameter No.PB18 setting)

8.6 Gain changing function

This function can change the gains. You can change between gains during rotation and gains during stop or can use an input device to change gains during operation.

8.6.1 Applications

This function is used when.

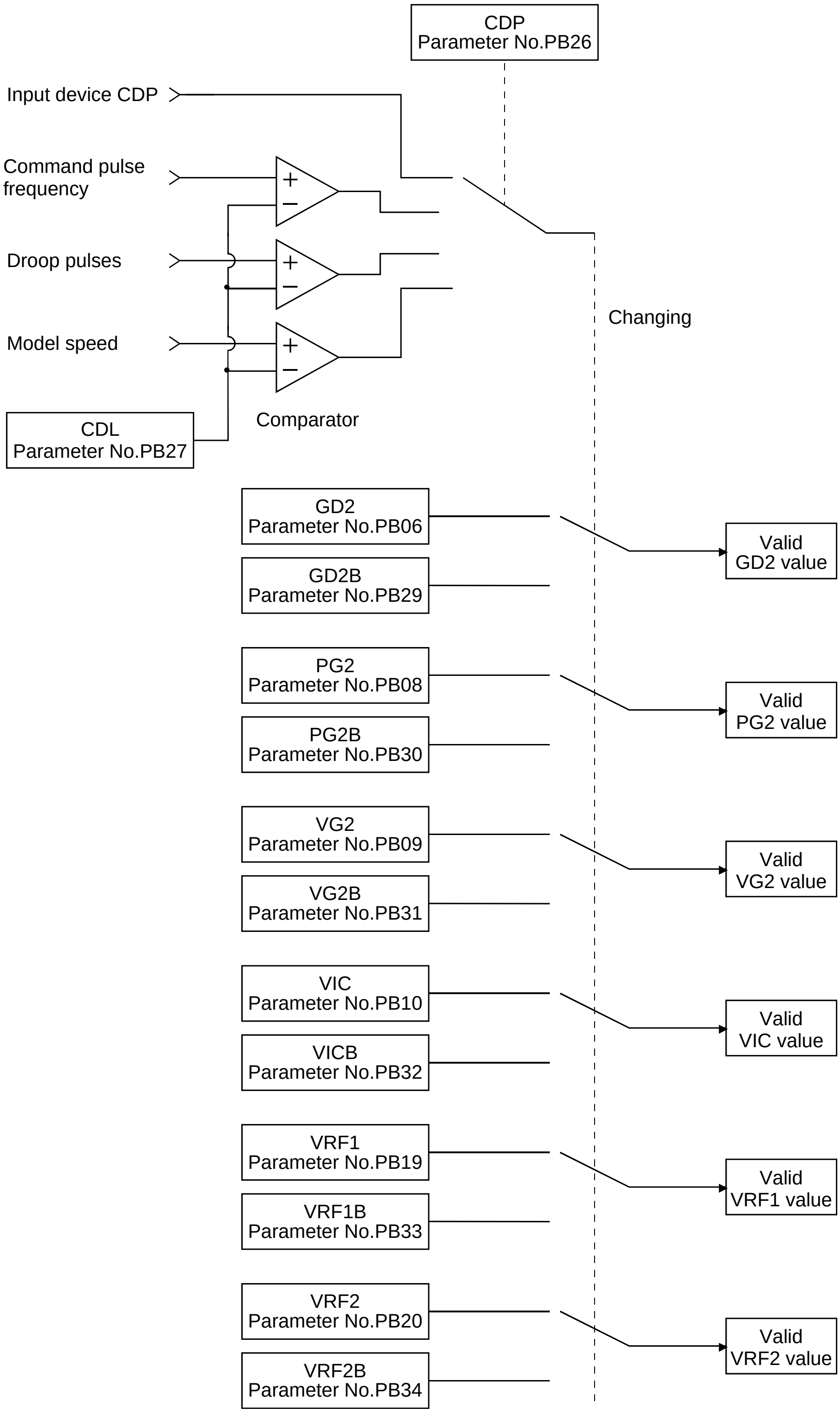
(1) You want to increase the gains during servo lock but decrease the gains to reduce noise during rotation.

(2) You want to increase the gains during settling to shorten the stop settling time.

(3) You want to change the gains using an input device to ensure stability of the servo system since the load inertia moment ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

8.6.2 Function block diagram

The valid loop gains PG2, VG2, VIC, GD2, VRF1 and VRF2 of the actual loop are changed according to the conditions selected by gain changing selection CDP (parameter No.PB26) and gain changing condition CDL (parameter No.PB27).



8.6.3 Parameters

When using the gain changing function, always set parameter No.PA08 to "□□□3" (auto tuning mode) to select the manual mode in the auto tuning modes. The gain changing function cannot be used in the auto tuning mode.

Parameter No.	Abbreviation	Name	Unit	Description
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	Multiplier (×1)	Control parameters before changing
PB07	PG1	Model loop gain	rad/s	Position and speed gains of a model used to set the response level to a command. Always valid.
PB08	PG2	Position loop gain	rad/s	
PB09	VG2	Speed loop gain	rad/s	
PB10	VIC	Speed integral compensation	ms	
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	Multiplier (×1)	Used to set the ratio of load inertia moment to servo motor inertia moment after changing.
PB30	PG2B	Gain changing position loop gain	rad/s	Used to set the value of the after-changing position loop gain.
PB31	VG2B	Gain changing speed loop gain	rad/s	Used to set the value of the after-changing speed loop gain.
PB32	VICB	Gain changing speed integral compensation	ms	Used to set the value of the after-changing speed integral compensation.
PB26	CDP	Gain changing selection		Used to select the changing condition.
PB27	CDL	Gain changing condition	kpps pulse r/min	Used to set the changing condition values.
PB28	CDT	Gain changing time constant	ms	You can set the filter time constant for a gain change at changing.
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	Hz	Used to set the value of the after-changing vibration suppression control vibration frequency setting.
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	Hz	Used to set the value of the after-changing vibration suppression control resonance frequency setting.

(1) Parameters No.PB06 to PB10

These parameters are the same as in ordinary manual adjustment. Gain changing allows the values of ratio of load to motor inertia moment ratio, the position loop gain, the speed loop gain and the speed integral compensation to be changed.

(2) Gain changing ratio of load inertia moment to servo motor inertia moment (GD2B: parameter No.PB29)

Set the load to servo motor inertia moment ratio after changing the gain. If the load to servo inertia moment ratio does not change, set the parameter to the same value as the load to servo motor inertia moment ratio (parameter No.PB06).

(3) Gain changing position loop gain (parameter No.PB30), Gain changing speed loop gain (parameter No. PB31), Gain changing speed integral compensation (parameter No.PB32)

Set the values of after-changing position loop gain, speed loop gain and speed integral compensation.

(4) Gain changing selection (parameter No.PB26)

Used to set the gain changing condition. Choose the changing condition in the first digit and second digit. If "1" is set in the first digit, the gain can be changed by the gain changing (CDP) input device. The gain changing (CDP) can be assigned to the pins using parameters No.PD03 to PD08 and PD10 to PD12.

Parameter No.PB26

0	0		

Gain changing selection
Under any of the following conditions, the gains change on the basis of the parameter No.PB29 to PB34 settings.
0: Invalid
1: Input device (Gain changing (CDP))
2: Command frequency (Parameter No.PB27 setting)
3: Droop pulse (Parameter No.PB27 setting)
4: Servo motor speed (Parameter No.PB27 setting)

Gain changing condition
0: Valid when the input device (gain changing (CDP)) is ON, or valid when the value is equal to or larger than the value set in parameter No.PB27
1: Valid when the input device (gain changing (CDP)) is OFF, or valid when the value is equal to or smaller than the value set in parameter No.PB27

(5) Gain changing condition (parameter No.PB27)

Used to set the gain changing level when "command frequency", "droop pulse" or "servo motor speed" is set in the gain changing selection (parameter No.PB26).

The setting unit is as follows:

Gain changing condition	Unit
Command frequency	kpps
Droop pulses	pulse
Servo motor speed	r/min

(6) Gain changing time constant (parameter No.PB28)

You can set the primary delay filter to each gain at gain changing. This parameter is used to suppress shock given to the machine if the gain difference is large at gain changing, for example.

(7) Gain changing vibration suppression control

Gain changing vibration suppression control is only available when changing the valid parameters with ON/OFF of the input device.

8.6.4 Gain changing procedure

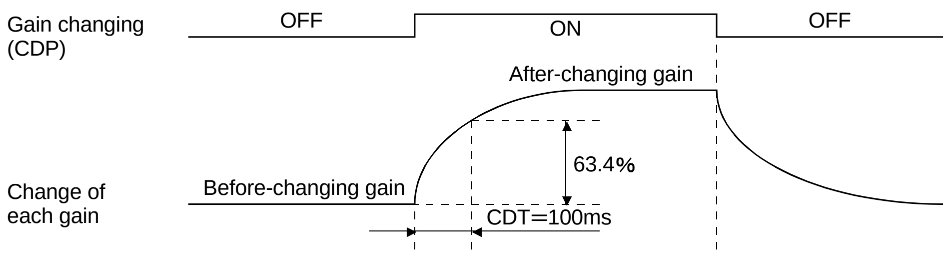
This operation will be described by way of setting examples.

(1) When you choose changing by input device (CDP)

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	4.0	Multiplier (×1)
PB07	PG1	Model loop gain	100	rad/s
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB19	VRF1	Vibration suppression control vibration frequency setting	50	Hz
PB20	VRF2	Vibration suppression control resonance frequency setting	50	Hz
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	0001 (Changed by ON/OFF of Input device (CDP))	
PB28	CDT	Gain changing time constant	100	ms
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	60	Hz
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	60	Hz

(b) Changing timing chart



Model loop gain	100				
Ratio of load inertia moment to servo motor inertia moment	4.0	→	10.0	→	4.0
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control vibration frequency setting	50	→	60	→	50
Vibration suppression control resonance frequency setting	50	→	60	→	50

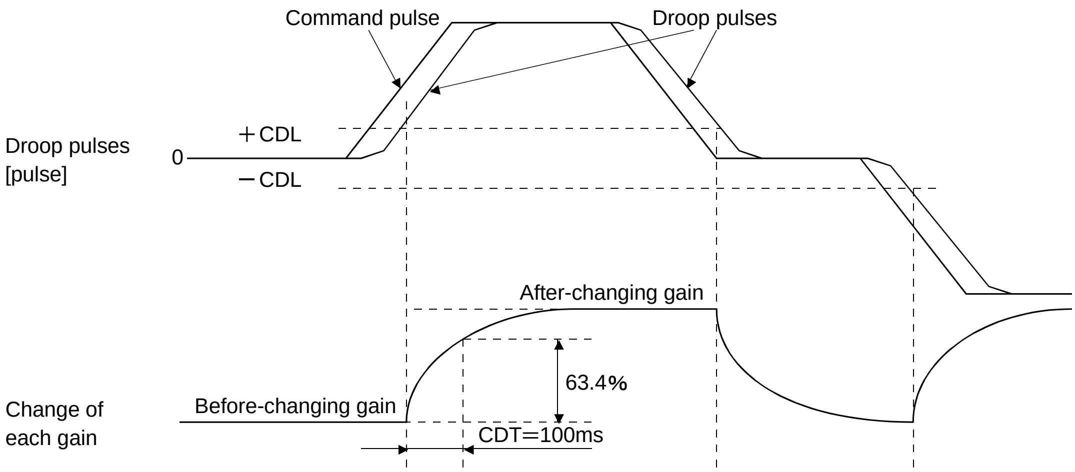
(2) When you choose changing by droop pulses

In this case, gain changing vibration suppression control cannot be used.

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	4.0	Multiplier (×1)
PB07	PG1	Model loop gain	100	rad/s
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	0003 (Changed by droop pulses)	
PB27	CDS	Gain changing condition	50	pulse
PB28	CDT	Gain changing time constant	100	ms

(b) Changing timing chart



Model loop gain	100						
Ratio of load inertia moment to servo motor inertia moment	4.0	→	10.0	→	4.0	→	10.0
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

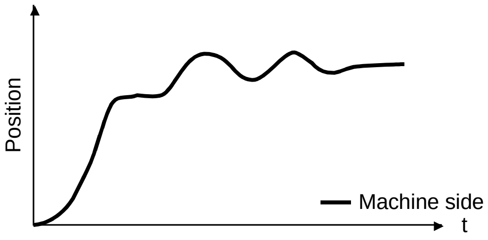
8.7 Vibration suppression control filter 2

POINT
▪ By using the advanced vibration suppression control and the vibration suppression control filter 2, the machine side vibration of two frequencies can be suppressed. ▪ The frequency range of machine vibration, which can be supported by the vibration suppression control filter 2, is between 4.5Hz and 2250Hz. Set a frequency close to the machine vibration frequency and within the range. ▪ When the parameter of the vibration suppression control filter 2 (parameter No.PB45) is changed during the positioning operation, the changed setting is not reflected. The setting is reflected approximately 150ms after the servo motor stops (after servo lock).

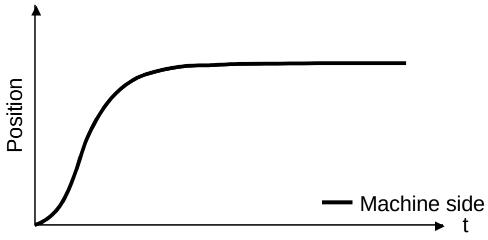
(1) Operation

Vibration suppression control filter 2 has a filter function (notch filter) that lowers the gain of the specified frequency contained in a positioning command. By lowering the gain, machine side vibration, such as workpiece end vibration and base shake, can be suppressed.

Which frequency to lower the gain and how deep to lower the gain can be set.



Vibration suppression control filter 2 invalid



Vibration suppression control filter 2 valid

(2) Parameter

Set parameter No.PB45 (vibration suppression control filter 2) as shown below. For the vibration suppression control filter 2, set a frequency close to the vibration frequency [Hz] at the machine side.

Parameter No.PB45

0			

Notch depth

Setting	Depth
0	−40.0dB
1	−24.1dB
2	−18.1dB
3	−14.5dB
4	−12.0dB
5	−10.1dB
6	−8.5dB
7	−7.2dB
8	−6.0dB
9	−5.0dB
A	−4.1dB
B	−3.3dB
C	−2.5dB
D	−1.8dB
E	−1.2dB
F	−0.6dB

Vibration suppression filter 2 setting frequency selection

Setting	Frequency [Hz]	Setting	Frequency [Hz]	Setting	Frequency [Hz]
00	Invalid	20	70	40	17.6
01	2250	21	66	41	16.5
02	1125	22	62	42	15.6
03	750	23	59	43	14.8
04	562	24	56	44	14.1
05	450	25	53	45	13.4
06	375	26	51	46	12.8
07	321	27	48	47	12.2
08	281	28	46	48	11.7
09	250	29	45	49	11.3
0A	225	2A	43	4A	10.8
0B	204	2B	41	4B	10.4
0C	187	2C	40	4C	10.0
0D	173	2D	38	4D	9.7
0E	160	2E	37	4E	9.4
0F	150	2F	36	4F	9.1
10	140	30	35.2	50	8.8
11	132	31	33.1	51	8.3
12	125	32	31.3	52	7.8
13	118	33	29.6	53	7.4
14	112	34	28.1	54	7.0
15	107	35	26.8	55	6.7
16	102	36	25.6	56	6.4
17	97	37	24.5	57	6.1
18	93	38	23.4	58	5.9
19	90	39	22.5	59	5.6
1A	86	3A	21.6	5A	5.4
1B	83	3B	20.8	5B	5.2
1C	80	3C	20.1	5C	5.0
1D	77	3D	19.4	5D	4.9
1E	75	3E	18.8	5E	4.7
1F	72	3F	18.2	5F	4.5

9. TROUBLESHOOTING

9. TROUBLESHOOTING

POINT
· As soon as an alarm occurs, turn off Servo-on (SON) and power off.

If an alarm/warning has occurred, refer to section 9.1 to 9.3 and remove its cause. In case of a trouble without an alarm/warning, refer to section 9.4 and remove its cause.

9.1 Alarms and warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 9.2 or 9.3 and take the appropriate action. When an alarm occurs, ALM turns off. Set "□□□1" in parameter No.PD24 to output the alarm code is outputted by ON/OFF of bit0 to bit2. Warnings (AL.92 to AL.EA) have no alarm codes. Any alarm code is output at occurrence of the corresponding alarm. In the normal status, the alarm code is not output.
After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column.

	Display	(Note 2) Alarm code			Name	Alarm deactivation		
		CN1 22 (bit2)	CN1 23 (bit1)	CN1 24 (bit0)		Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES)
Alarms	AL.10	0	1	0	Undervoltage	○	○	○
	AL.12	0	0	0	Memory error 1 (RAM)	○		
	AL.13	0	0	0	Clock error	○		
	AL.15	0	0	0	Memory error 2 (EEP-ROM)	○		
	AL.16	1	1	0	Encoder error 1 (At power on)	○		
	AL.17	0	0	0	Board error	○		
	AL.19	0	0	0	Memory error 3 (Flash-ROM)	○		
	AL.1A	1	1	0	Motor combination error	○		
	AL.20	1	1	0	Encoder error 2 (during runtime)	○		
	AL.21	1	1	0	Encoder error 3 (during runtime)	○		
	AL.24	1	0	0	Main circuit error	○	○	○
	AL.25	1	1	0	Absolute position erase	○		
	AL.30	0	0	1	Regenerative error	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.31	1	0	1	Overspeed	○	○	○
	AL.32	1	0	0	Overcurrent	○		
	AL.33	0	0	1	Overvoltage	○	○	○
	AL.35	1	0	1	Command pulse frequency alarm	○	○	○
	AL.37	0	0	0	Parameter error	○		
	AL.45	0	1	1	Main circuit device overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.46	0	1	1	Servo motor overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.47	0	1	1	Cooling fan alarm	○		
	AL.50	0	1	1	Overload 1	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.51	0	1	1	Overload 2	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.52	1	0	1	Error excessive	○	○	○
	AL.8A	0	0	0	Serial communication time-out	○	○	○
	AL.8E	0	0	0	Serial communication error	○	○	○
	88888				Watchdog	○		

	Display	Name
Warnings	AL.92	Battery cable disconnection warning
	AL.96	Home position setting error
	AL.99	Stroke limit warning
	AL.9F	Battery warning
	AL.E0	Excessive regeneration warning
	AL.E1	Overload warning 1
	AL.E3	Absolute position counter warning
	AL.E5	ABS time-out warning
	AL.E6	Servo emergency stop warning
	AL.E8	Cooling fan speed reduction warning
	AL.E9	Main circuit off warning
	AL.EA	ABS servo on warning
	AL.EC	Overload warning 2
	AL.ED	Output watt excess warning

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.
2. 0: off
1: on

9.2 Remedies for alarms

⚠CAUTION	・When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur. ・If an absolute position erase (AL.25) occurred, always to make home position setting again. Not doing so may cause unexpected operation. ・As soon as an alarm occurs, turn off Servo-on (SON) and power off.

POINT

- When any of the following alarms has occurred, do not deactivate the alarm and resume operation repeatedly. To do so will cause the driver/servo motor to fail. Remove the cause of occurrence, and leave a cooling time of more than 30 minutes before resuming operation.
  - Regenerative error (AL.30)
  - Main circuit device overheat (AL.45)
  - Servo motor overheat (AL.46)
  - Overload 1 (AL.50)
  - Overload 2 (AL.51)
- The alarm can be deactivated by switching power off, then on press the "SET" button on the current alarm screen or by turning on the reset (RES). For details, refer to section 9.1.

When an alarm occurs, the trouble (ALM) switches off and the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No.
The servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. Use the software (MR Configurator2TM) to refer to a factor of alarm occurrence. The alarm details can be confirmed by the alarm history of software (MR Configurator2TM).

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.10	Undervoltage	Power supply voltage dropped.	1. Power supply voltage is low. <Checking method> Check that the power supply voltage is the following voltage or more. LECSB2-□: 160VAC LECSB1-□: 83VAC	Check the power supply.	2
			2. Shortage of power supply capacity caused the power supply voltage to drop at start, etc. <Checking method> Check that the bus voltage is the following voltage or more. LECSB2-□: 200VDC LECSB1-□: 158VDC		
			3. The bus voltage dropped to the following value or less. LECSB2-□: 200VDC LECSB1-□: 158VDC		
			4. There was an instantaneous control power failure of 60ms or longer.		1
			5. Faulty parts in the driver. <Checking method> 1. Alarm (AL.10) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables. 2. Check that the bus voltage is the following voltage or more. LECSB2-□: 200VDC LECSB1-□: 158VDC	Change the driver.	
			6. Waveform of power supply voltage is distorted. When power supply impedance is high, waveform of power voltage is distorted, and it may recognized as undervoltage.	Set the parameter No.PC27 to "0001".	
AL.12	Memory error 1 (RAM)	RAM, memory fault	Faulty parts in the driver <Checking method> Alarm (any of AL.12 and AL.13) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the driver.	
AL.13	Clock error	Printed board fault		Change the driver.	
AL.15	Memory error 2 (EEP-ROM)	EEP-ROM fault	1. Faulty parts in the driver <Checking method> Alarm (AL.15) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the driver.	
			2. The number of write times to EEP-ROM exceeded 100,000.		

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.16	Encoder error 1 (At power on)	Communication error occurred between encoder and driver.	1. Encoder connector (CN2) disconnected.	Connect correctly.	44
			2. Encoder cable type (2-wire, 4-wire) selection was incorrect in parameter setting.	Correct the setting in the fourth digit of parameter No. PC22.	
			3. Encoder cable faulty (Wire breakage or shorted)	Repair or change the cable.	
			4. Encoder fault	Change the servo motor.	
			5. A servo motor other than that of LECSB□-□ series is connected.	Check the combination of the driver and the servo motor.	63
			6. A communication error occurred due to external noise. <Checking method> 1. Check that the encoder cable and the power cables are wired side by side. 2. Check that the driver is not influenced by noise of magnetic valves, magnetic contactors or relays. 3. Check the grounding of the driver and the servo motor. 4. Check that there is no cause of static electricity around. 5. Check that the shield of the encoder cable is made correctly.	Ground correctly or take noise reduction measures.	
AL.17	Board error	CPU/parts fault	Faulty parts in the driver <Checking method> Alarm (AL.17 or AL.19) occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change the driver.	
AL.19	Memory error 3 (Flash ROM)	ROM memory fault			
AL.1A	Motor combination error	Incorrect combination of driver and servo motor.	Incorrect combination of driver and servo motor connected.	Check the combination of the driver and the servo motor.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.20	Encoder error 2 (during runtime)	Communication error occurred between encoder and driver.	1. Encoder cable disconnected. <Checking method> Check the connection of the encoder cable.	Connect the servo motor encoder connector to the driver connector (CN2) correctly.	47
			2. Encoder cable fault. <Checking method> Check that the encoder cable is broken or shorted.	Repair or change the cable.	
			3. The encoder detected high acceleration rate due to oscillation and other causes. <Checking method> Check that the servo motor does not vibrate or does not make unusual noise.	1. Decrease the position loop gain. 2. Reduce the response setting of the auto tuning.	8
			4. Encoder fault.	Change the servo motor.	
			5. A communication error occurred due to external noise. <Checking method> 1. Check that the encoder cable and the power cables are wired side by side. 2. Check that the driver is not influenced by noise of magnetic valves, magnetic contactors or relays. 3. Check the grounding of the driver and the servo motor. 4. Check that there is no cause of static electricity around. 5. Check that the shield of the encoder cable is made correctly.	Ground correctly or take noise reduction measures.	
AL.21	Encoder error 3 (during runtime)	Error occurred in encoder.	Detection circuit error in encoder.	Change the servo motor.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.24	Main circuit error	Ground fault occurred in servo motor power (U, V, W).	1. Power input wires and servo motor power wires are in contact. (A power input cable and a servo motor power cable are in contact at the main circuit terminal block (TE1).)	Modify the wiring.	
			2. Short or ground fault occurs at a servo motor power cable. (A sheath of a servo motor power cable deteriorated, resulting in short or ground fault.)	Repair the cable.	
			3. Driver fault. <Checking method> The alarm (AL.24) occurs even after removing servo motor power cables (U, V, W).	Change the driver.	
			4. Servo motor fault. <Checking method> The servo motor power cables (U, V, W) are disconnected on the servo motor terminal side. After that, the servo motor is turned on, and the alarm (AL.24) does not occur.	Change the servo motor.	
			5. External dynamic brake fault <Checking method> The servo motor power cables (U, V, W) are disconnected on the external dynamic brake terminal side. After that, the servo motor is turned on, and the alarm (AL.24) does not occur.	1. Check parameters and the dynamic brake interlock. 2. Replace the external dynamic brake.	
			6. External noise caused erroneous operation to the overcurrent detection circuit. <Checking method> 1. Check that the driver is not influenced by noise of magnetic valves, magnetic contactors or relays. 2. Check the grounding of the driver and the servo motor.	Ground correctly or take noise reduction measures.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.25	Absolute position erase	Absolute position data is erased.	1. Voltage drop in encoder. (Battery disconnected.)	Change the battery and make home position setting again.	
			2. Battery voltage fell to about 2.8V or less.	Change the battery. Always make home position setting again.	
			3. Battery cable or battery is faulty.		
			4. Encoder cable fault.	Repair or change the encoder cable.	
			5. Encoder fault.	Change the servo motor.	
		Power was switched on for the first time in the absolute position detection system.	6. Home position not set.	Change the battery and make home position setting again.	
AL.30	Regenerative error	Permissible regenerative power of the built-in regenerative resistor or regenerative option is exceeded.	1. Incorrect setting of parameter No. PA02	Set correctly.	1
			2. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative option to be exceeded. <Checking method> Call the status display software (MR Configurator2™), and check the regenerative load ratio.	1. Reduce the frequency of positioning. 2. Use the regenerative option of larger capacity. 3. Reduce the load.	
			3. Bus voltage is abnormal. LECSB□-□: 400VDC or more	Check the power supply.	
			4. Built-in regenerative resistor or regenerative option is not connected.	Connect correctly.	4
			5. Built-in regenerative resistor or regenerative option faulty.	Change the driver or regenerative option.	
		Regenerative transistor fault	6. Driver fault. (Regenerative transistor fault.) <Checking method> 1. The regenerative option has overheat abnormally. 2. The alarm occurs even after removal of the built-in regenerative resistor or regenerative option.	Change the driver	
			7. Driver fault. (Regenerative circuit fault.)	Change the driver.	2

<table>
<tr><th>Display</th><th>Name</th><th>Definition</th><th>Cause</th><th>Action</th><th>(Note 2)
Alarm details</th></tr>
<tr><td rowspan="5">AL.31</td><td rowspan="5">Overspeed</td><td rowspan="5">Speed has exceeded the instantaneous permissible speed.</td><td>1. Input command pulse frequeroy is too high.</td><td>Set command pulse frequency correctly.</td><td rowspan="5"></td></tr>
<tr><td>2. Small acceleration/deceleration time constant caused overshoot to be large.</td><td>Increase acceleration/ deceleration time constant.</td></tr>
<tr><td>3. Servo system is instable to cause overshoot.</td><td>1. Re-set servo gain to proper value.
2. If servo gain cannot be set to proper value.
1) Reduce load inertia moment ratio; or
2) Reexamine acceleration/decelerati on time constant.</td></tr>
<tr><td>4. Electronic gear ratio is large.
(Setting by parameters No. PA06, PA07)</td><td>Set correctly.</td></tr>
<tr><td>5. Encoder faulty.</td><td>Change the servo motor.</td></tr>
<tr><td rowspan="6">AL.32</td><td rowspan="6">Overcurrent</td><td rowspan="6">Current that flew is higher than the permissible current of the driver.</td><td>1. Short or ground fault occurs at a servo motor power cable.
(A sheath of a servo motor power cable deteriorated, resulting in short or ground fault.)
<Checking method>
The servo motor power cables (U, V, W) are disconnected on the servo motor terminal side. After that, the servo motor is turned on, and the alarm (AL.32) occurs.</td><td>Repair the cable.</td><td rowspan="5"></td></tr>
<tr><td>2. External dynamic brake fault
<Checking method>
The servo motor power cables (U, V, W) are disconnected on the external dynamic brake terminal side. After that, the servo motor is turned on, and the alarm (AL.32) does not occur.</td><td>1. Check parameters and the dynamic brake interlock.
2. Replace the external dynamic brake.</td></tr>
<tr><td>3. Driver fault.
<Checking method>
The servo motor power cables (U, V, W) are disconnected. After that, the servo motor is turned on, and the alarm (AL.32) occurs.</td><td>Change the driver.</td></tr>
<tr><td>4. Servo motor fault.
<Checking method>
The servo motor power cables (U, V, W) are disconnected on the external dynamic brake terminal side. After that, the servo motor is turned on, and the alarm (AL.32) does not occur.</td><td>Change the servo motor.</td></tr>
<tr><td>5. External noise caused erroneous operation to the overcurrent detection circuit.
<Checking method>
1. Check that the driver is not influenced by noise of magnetic valves, magnetic contactors or relays.
2. Check the grounding of the driver and the servo motor.</td><td>Ground correctly or take noise reduction measures.</td></tr>
<tr><td>6. Encoder fault.</td><td>Change the servo motor.</td><td>2</td></tr>
</table>

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.33	Overvoltage	Bus voltage exceeded to following voltage. LECSB□-□: 400VDC	1. Regenerative option is not used.	Use the regenerative option.	
			2. Though the regenerative option is used, the parameter No.PA02 setting is "□□00 (not used)".	Set correctly.	
			3. Lead of built-in regenerative resistor or regenerative option is open or disconnected.	1. Change the lead. 2. Connect correctly.	
			4. Wire breakage of built-in regenerative resistor or regenerative option	1. For wire breakage of built-in regenerative resistor, change the driver. 2. For wire breakage of regenerative option, change the regenerative option.	
			5. Capacity of built-in regenerative resistor or regenerative option is insufficient.	Add regenerative option or increase capacity.	
			6. The jumper across BUE-SD of the FR-BU2(Mitsubishi Electric Corporation) brake unit is removed.	Fit the jumper across BUE-SD.	
			7. Impedance at main circuit power supply cable (L_1, L_2, L_3) is high, and leak current from servo motor power supply cable (U, V, W) is large.	Use the regenerative option.	
			8. Ground fault occurred in servo motor power (U, V, W).	Correct the wiring.	
			9. Power supply voltage high.	Check the power supply.	
			10. Driver fault. (Regenerative transistor fault.)	Change the driver.	
AL.35	Command pulse frequency error	Input pulse frequency of the command pulse is too high.	1. Frequency of the command pulse is too high.	Change the command pulse frequency to a lower value.	
			2. Noise entered command pulses.	Take action against noise.	
			3. Command device failure	Change the command device.	
AL.37	Parameter error	Parameter setting is incorrect.	1. Regenerative option not used with driver was selected in parameter No.PA02.	Set parameter No.PA02 correctly.	2
			2. For a drive unit of (MR-J3-DU30KA: Mitsubishi Electric Corporation) or higher, parameter No.PC22 is set to "□□□1 (Valid)".	Set parameter No.PC22 to "□□□0 (Invalid)" and turn the power off then on.	
			3. The number of write times to EEP-ROM exceeded 100,000 due to parameter write, etc.	Change the driver.	1, 2
			4. Driver fault caused the parameter setting to be rewritten.	Change the driver.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.45	Main circuit device overheat	Main circuit device overheat	1. Ambient temperature of driver is over 55℃ (131℉).	Check environment so that ambient temperature is 0 to 55℃ (32 to 131℉).	
			2. Used beyond the specifications of close mounting.	Use within the range of specifications. (Refer to section 2.1.)	
			3. The power supply was turned on and off continuously by overloaded status.	The drive method is reviewed.	
			4. Foreign matter caught in a cooling fan or heat sinks.	Clean the cooling fan or the heat sinks.	
			5. Driver fault. (When it occurs immediately after power-on)	Change the driver.	
AL.46	Servo motor overheat	Servo motor temperature rise actuated the thermal sensor.	1. Ambient temperature of servo motor is over 40℃ (104℉).	Check environment so that ambient temperature is 0 to 40℃ (32 to 104℉).	1, 2, 10, 20
			2. Servo motor is overloaded.	1. Reduce load. 2. Check operation pattern. 3. Use servo motor that provides larger output.	
			3. Thermal sensor in encoder is faulty.	Change the servo motor.	1
AL.47	Cooling fan alarm	The cooling fan of the driver stopped, or its speed decreased to or below the alarm level.	1. Cooling fan life expiration (Refer to section 2.5.)	Change the cooling fan of the driver.	
			2. Foreign matter caught in the cooling fan stopped rotation.	Remove the foreign matter.	
			3. The power supply of the cooling fan failed.	Change the driver.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.50	Overload 1	Load exceeded overload protection characteristic of driver.	1. Driver is used in excess of its continuous output current.	1. Reduce load. 2. Check operation pattern. 3. Check that the electromagnetic brake is not applied. 4. Check that the machine is not fractioned. 5. Use servo motor and driver that provides larger output.	1
			2. After Overload 2 (AL.51) occurred, turn OFF/ON the power supply to clear the alarm. Then the overload operation is repeated.	1. Reduce load. 2. Check operation pattern. 3. Use servo motor that provides larger output.	1
			3. The servo system is instable and causes oscillation or hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change the auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually. 4. Check that the coupling with the servo motor shaft is not loose.	1, 2
			4. Encoder fault. <Checking method> When the servo motor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.51	Overload 2	Machine collision or the like caused a continuous maximum current for a few seconds.	1. Driver fault. <Checking method> The servo motor is disconnected on the machine side and then the servo motor is test-operated. The alarm (AL.51) does not occur. (Check after setting the gain to the initial value.)	Change the driver.	
			2. The servo system is instable and causes oscillation or hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change the auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually. 4. Check that the coupling with the servo motor shaft is not loose.	
			3. Machine struck something.	1. Check operation pattern. 2. Install limit switches. 3. Check that the electromagnetic brake is not applied.	
			4. Incorrect connection of servo motor. Driver 's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.	
			5. Encoder fault. <Checking method> When the servo motor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.	
			6. A power cable is disconnected.	Repair the cable.	
			7. Servo motor fault.	Change the servo motor.	

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
AL.52	Error excessive	The difference between the model position and the actual servo motor position exceeds three rotations. (Refer to the function block diagram in section 1.2.)	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/ deceleration time constant.	
			2. Forward rotation torque limit (parameter No.PA11) or reverse rotation torque limit (parameter No.PA12) are too small.	Increase the torque limit value.	
			3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Check the power supply capacity. 2. Use servo motor which provides larger output.	
			4. Position loop gain 1 (parameter No.PB08) value is small.	Increase set value and adjust to ensure proper operation.	
			5. Servo motor shaft was rotated by external force.	1. When torque is limited, increase the limit value. 2. Reduce load. 3. Use servo motor that provides larger output.	
			6. Machine struck something.	1. Check operation pattern. 2. Install limit switches.	
			7. Encoder faulty	Change the servo motor.	
			8. Incorrect connection of servo motor. Driver 's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.	
			9. A power cable is broken.	Repair the cable.	
			10. A command is input when the torque limit is "0".	Set the torque limit to the proper value.	8
AL.8A	Serial communication time-out error	USB communication or RS-422 communication stopped for longer than the specified time.	1. Communication cable breakage.	Repair or change the communication cable.	
			2. Communication cycle longer than regulated time.	Shorten the communication cycle.	
			3. Incorrect protocol.	Correct protocol.	
AL.8E	Serial communication error	Serial communication error occurred between driver and communication device (e.g. personal computer).	1. Communication cable fault (Open cable or short circuit)	Repair or change the cable.	1, 2
			2. Communication device (e.g. personal computer) faulty	Change the communication device (e.g. personal computer).	
			3. A character code is faulty.	Check the character codes.	4
			4. A command is faulty.	Check the commands.	8
			5. A data No. is faulty.	Check the data No.	10

Display	Name	Definition	Cause	Action	(Note 2) Alarm details
(Note 1) 88888	Watchdog	CPU, parts faulty	1. Fault of parts in driver <Checking method> Alarm (88888) occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change the driver.	
			2. The CPU in the servo motor is malfunctioned due to external noise.	1. Check that the driver is not influenced by noise of magnetic valves, magnetic contactors or relays. 2. Check the grounding of the driver and the servo motor.	

Note 1. At power-on, "88888" appears instantaneously, but it is not an error.

2. Software (MR Configurator2™) is required to check the alarm detailed information. The alarm detailed information can be checked on the "alarm history list" window. The window appears by slecting alarm/alarm history on software (MR Configurator2™).

9.3 Remedies for warnings

CAUTION	・If an absolute position counter warning (AL.E3) occurred, always to make home position setting again. Not doing so may cause unexpected operation.

POINT

- When any of the following alarms has occurred, do not resume operation by switching power of the driver OFF/ON repeatedly. The driver and servo motor may become faulty. If the power of the driver is switched OFF/ON during the alarms, allow more than 30 minutes for cooling before resuming operation.
  - Excessive regenerative warning (AL.E0)
  - Overload warning 1 (AL.E1)

If AL.E6 or AL.EA occurs, the servo off status is established. If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed.
Remove the cause of warning according to this section. Use the software (MR Configurator2TM) to refer to a factor of warning occurrence.

Display	Name	Definition	Cause	Action
AL.92	Battery cable disconnection warning	Absolute position detection system battery voltage is low.	1. Battery cable is open.	Repair cable or changed.
			2. Battery voltage supplied from the driver to the encoder fell to about 3V or less. (Detected with the encoder)	Change the battery.
			3. An encoder cable is broken.	Repair or replace the encoder cable.
AL.96	Home position setting warning	Home position setting could not be made.	1. The position is out of in-position range at the home position setting.	Set the home position within the in-position range.
			2. A command pulse is input during the home position setting.	Input the command pulse after the home position setting.
			3. Creep speed high.	Reduce creep speed.
AL.99	Stroke limit warning	The stroke end (LSP or LSN) of the direction which gave instructions was turned off.	The forward rotation stroke end (LSP) is turned off at the forward rotation command.	Review the moving range to avoid turning off LSP/LSN.
			The reverse rotation stroke end (LSN) is turned off at the reverse rotation command.	
AL.9F	Battery warning	Voltage of battery for absolute position detection system reduced.	Battery voltage fell to 3.2V or less. (Detected with the driver)	Change the battery.
AL.E0	Excessive regenerative warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative resistor or regenerative option.	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative resistor or regenerative option. <Checking method> Call the status display or software (MR Configurator2TM), and check regenerative load ratio.	1. Reduce frequency of positioning. 2. Change the regenerative option for the one with larger capacity. 3. Reduce load. 4. Replace the driver / servo motor with one of larger capacity.

Display	Name	Definition	Cause	Action
AL.E1	Overload warning 1	There is a possibility that overload alarm 1 or 2 may occur.	Load increased to 85% or more of overload alarm 1 or 2 occurrence level.	Refer to AL.50, AL.51.
AL.E3	Absolute position counter warning	Absolute position encoder pulses faulty.	1. Noise entered the encoder.	Take noise suppression measures.
			2. Encoder faulty.	Change the servo motor.
		The multi-revolution counter value of the absolute position encoder exceeded the maximum revolution range.	3. The travel distance from the home position exceeded a 32767 rotation or −37268 rotation in succession.	Make home position setting again.
AL.E5	ABS time-out warning		1. PC or PLC…etc ladder program incorrect.	Contact the program.
			2. Reverse rotation start (ST2) ・ Limiting torque (TLC) improper wiring	Connect properly.
			3. If you are using in the ABS transfer (Parameter No. PA03 is set to "0001") by the DIO, CN1-22 pin (ABSB0 during ABS transfer mode) and CN1-23 pin (ABSB1 during ABS transfer mode), CN1-25 pin (ABST during ABS transfer mode) of false connection.	Connect properly.
AL.E6	Servo emergency stop warning	EMG is off.	External emergency stop was made valid. (EMG was turned off.)	Ensure safety and deactivate emergency stop.
AL.E8	Cooling fan speed reduction warning	The speed of the driver decreased to or below the warning level.	1. Cooling fan life expiration (Refer to section 2.5.)	Change the cooling fan of the driver.
			2. The power supply of the cooling fan is broken.	Change the driver.
			3. Foreign matter is caught in the cooling fan and decreased speed.	Remove the foreign matter.
AL.E9	Main circuit off warning	Servo-on (SON) was switched on with main circuit power off.		Switch on main circuit power.
AL.EA	ABS servo-on warning	Servo-on (SON) turned on more than 1s after driver had entered absolute position data transfer mode.	1. PC or PLC…etc ladder program incorrect.	1. Correct the program.
			2. Servo-on (SON) improper wiring.	2. Connect properly.
AL.EC	Overload warning 2	Operation, in which a current exceeding the rating flew intensively in any of the U, V and W phases of the servo motor, was repeated.	During a stop, the status in which a current flew intensively in any of the U, V and W phases of the servo motor occurred repeatedly, exceeding the warning level.	1. Reduce the positioning frequency. 2. Reduce the load. 3. Replace the driver / servo motor with the one of larger capacity.
AL.ED	Output watt excess warning	The status, in which the output wattage (speed × torque) of the servo motor exceeded the rated output, continued steadily.	Continuous operation was performed with the output wattage (speed × torque) of the servo motor exceeding 150% of the rated output.	1. Reduce the servo motor speed. 2. Reduce the load. 3. Replace the driver /servo motor with one of larger capacity.

9.4 Troubles without an alarm/warning

POINT
・Even if a driver, a servo motor, or an encoder malfunctions, the following phenomena may occur.

The following shows the examples of the estimated causes of the troubles without alarms/warnings. Refer to this chapter and remove their causes.

Phenomena	Checkpoint	Estimated cause	Action
A LED indication turns off.	When fixing by disconnecting all the connectors other than the power supply, check if the disconnected cables are not shorted.	An external I/O terminal is shorted.	Check the wiring of the I/O signal.
	Check that the control circuit power is not turned off.	The control circuit power is not turned on.	Turn the control circuit power on.
	Check that the control circuit power voltage is not low.	The control circuit power voltage decreased.	Set the control circuit power voltage within the rated range.
The servo motor does not operate.	Check that a warning (AL.99) does not occur.	The forward rotation stroke end (LSP) or the reverse rotation stroke end (LSN) is not turned on.	Turn on both the forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN).
	Check the connection with the servo motor.	The U, V, W output terminals of the driver is not connected with each U, V, W input terminals of the servo motor.	Connect each U, V, W phase properly.
	Check that a warning (AL.E9) does not occur.	The servo-on (SON) is turned on while the main circuit power of the driver is off.	Turn the main circuit power on.
	Check that the servo alarm/ warning is occurring.	A servo alarm is occurring.	Check the details of the alarm and remove its cause.
	Check the external input signal is on or off. 1. Check the external I/O signal display in the diagnostic mode. 2. Check that the input signal is ON or OFF on the "I/O interface display" command of the "Monitor" menu on software (MR Configurator2™).	The servo-on (SON) is off.	Turn on the servo-on (SON).
		Reset (RES) is on.	Turn reset (RES) off.
		<Speed control mode> 1. Both the forward rotation start (ST1) and the reverse rotation start (ST2) are off. 2. Both the forward rotation start (ST1) and the reverse rotation start (ST2) are on.	Input the forward rotation start (ST1) and the reverse rotation start (ST2) properly.
		<Torque control mode> 1. Both the forward rotation selection (RS1) and the reverse rotation selection (RS2) are off. 2. Both the forward rotation selection (RS1) and the reverse rotation selection (RS2) are on.	Input the forward rotation selection (RS1) and the reverse rotation selection (RS2) properly.
		<Speed control mode/torque control mode> The setting of the speed selection 1 (SP1), the speed selection 2 (SP2) or the speed selection 3 (SP3) is incorrect.	1. Review the wiring. 2. Check the setting of the speed selection 1 (SP1), the speed selection 2 (SP2) and the speed selection 3 (SPV).

Phenomena	Checkpoint	Estimated cause	Action
The servo motor does not operate.	Check the cumulative command pulses with the status display or software (MR Configurator2™). The display does not change even if the pulse train command is input.	The wiring of the command pulse train signal is incorrect.	Check the type of the command pulse train (the differential receiver system or the open collector system). Supply an external power (24VDC) between OPC and DOCOM for the open collector system.
		The command pulses are not input.	Review the driver setting.
		The settings of the parameter No.PA13 (command pulse input form) are incorrect.	Set the same value as the pulse output form of the driver.
	Check the settings of the parameter No.PA01 (control mode).	The settings of the parameter No.PA01 (control mode) are incorrect.	Review the settings of the parameter No.PA01 (control mode).
	Check that the generated torque does not exceed the torque limit value. 1. Check "instantaneous occurrence torque" with "status display". 2. Check the torque ripple with the "Graph" command on the "Monitor" menu on software (MR Configurator2™).	1. The maximum torque is lacking. The servo capacity is lacking. Or the load is too large.	1. Change the mass or the shape of the work to reduce the load. 2. Make the acceleration/ deceleration time shorter to make the effective load ratio lower.
		2. Unintended torque limit is valid. Or the setting of the torque limit is 0 (no generating torque). (Set with the parameter No.PA11/ PA12/PC35.)	Review the torque limit setting.
	Check the status of the analog input voltage. 1. Check with the status display. 2. Check with the "Display all" command on the "Monitor" menu on software (MR Configurator2™).	<Position control mode> The input voltage of the analog torque limit (TLA) is incorrect.	Review the settings of the analog torque limit (TLA) and the analog input voltage.
		<Speed control mode> The input voltage of the analog speed command (VC) or that of the analog torque limit (TLA) is incorrect.	Review the settings of the analog speed command (VC), the analog torque limit (TLA) and the analog input voltage.
		<Torque control mode> The input voltage of the analog torque command (TC) or that of the analog speed limit (TLA) is incorrect.	Review the settings of the analog torque command (TC), the analog speed limit (VLA) and the analog input voltage.
	Check that machine interference occurs.	Machine interference occurs.	Eliminate the machine interference.
	Check the power supply for the servo motor with an electromagnetic brake.	The electromagnetic brake is not released.	Turn the electromagnetic brake power on to release the brake.
	The ABSM signal is on while the absolute position detection system is used.	1. The driver operates in the ABS transfer mode. 2. The absolute position data transfer is not complete.	Set the driver setting (parameter No.PA03), wiring and ladder program of the driver properly.
	Check the electronic gear settings.	The electronic gear settings are incorrect.	Set the proper electronic gear.

Phenomena	Checkpoint	Estimated cause	Action
The servo motor speed is not accelerated. Or too fast.	Check the settings of the speed command, the speed limit and the electronic gear.	The setting of the speed command, the speed limit or the electronic gear is incorrect.	Review the settings of the speed command, the speed limit and the electronic gear is incorrect.
	Check the external input signal is on or off. 1. Check with the external I/O signal display in the diagnostic mode. 2. Check the I/O signal status on the "I/O interface display" command on the "Monitor" menu on software (MR Configurator2™).	<Speed control mode/torque control mode> The setting of the speed selection 1 (SP1), the speed selection 2 (SP2) or the speed selection 3 (SP3) is incorrect.	1. Review the wiring. 2. Check the setting of the speed selection 1 (SP1), the speed selection 2 (SP2) and the speed selection 3 (SP3).
	Check the power supply cable of the servo motor.	An output circuit is open.	Review the wiring of the servo motor power supply cable.
	Check that the main circuit power voltage is not low.	The main circuit power voltage decreased.	1. Set the main circuit power supply within the specified range of the permissible voltage fluctuation. 2. Review the wiring of the main circuit power supply.
	Check the power supply for the servo motor with a lock.	The lock is not released.	Turn the lock power on to release the brake.
The servo motor vibrates due to low frequency.	If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning.	The load to motor inertia moment ratio by the auto tuning is not estimated correctly. The load to motor inertia moment ratio setting (parameter No.PB06) is incorrect when the auto tuning mode 2 or the manual mode is used.	Adjust the gains. (Refer to chapter 7.) Review the load to motor inertia moment ratio (parameter No.PB06) when the auto tuning mode 2 or the manual mode is used.
	Check commands from the driver.	Commands from the driver are unstable.	1. Review the commands from the driver. 2. Check the command cable if errors do not occur such as breaking.
	Check the mechanical part if errors do not occur. (Examples) 1. Check that the timing belt is not loose. 2. Check that the machine is not worn.	The load of the mechanical part is changed.	1. Adjust the gains again. (Refer to chapter 7.) 2. Maintain the mechanical part.
	Check the machine required torque does not exceed the maximum torque of the servo motor.	The acceleration/deceleration torque overshot at stop due to exceed its servo motor performance.	Reduce loads by setting the acceleration/deceleration longer or making the work mass lighter, etc.
	Increase the auto tuning response (parameter No.PA09). (except the manual mode)	1. The servo gain is low. 2. The auto tuning response is low.	Increase the auto tuning response and then adjust the gains again. (Refer to chapter 7.)

Phenomena	Checkpoint	Estimated cause	Action
Unusual noise is generated from the driver.	1. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning. 2. Reduce the auto tuning response (parameter No.PA09).	1. The servo gain is high. 2. The auto tuning response is high.	Reduce the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
	If the safe operation is possible, remove the load and then check the noise with only the servo motor.	When unusual noise is generated, the cause is the bearing life.	Replace the servo motor.
		When unusual noise is not generated, the cause is the backlash increase on the machine side.	Maintain on the machine side.
	Check that the brake is not dragged for the servo motor with a lock.	1. The electromagnetic brake release sequence is incorrect. 2. The power supply for the lock is faulty.	1. Review the lock release sequence. 2. Check the power supply for the lock.
	The brake clacks for the servo motor with a lock.	This sound is from a clearance of the lock joint part. This is not a malfunction.	
The servo motor vibrates.	1. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning. 2. Reduce the auto tuning response (parameter No.PA09). (except the manual mode)	1. The servo gain is too high. 2. The auto tuning response is too high.	Reduce the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
	If the safe operation is possible, execute the adaptive tuning.	The machine vibrates (in sympathy).	Adjust the machine resonance suppression filter. (Refer to section 8.2)
	If the safe operation is possible, execute the tuning with the advanced gain search on software (MR Configurator2^{TM}).	The machine vibrates (in sympathy).	Adjust the gains. (Refer to chapter 7.)
	If the safe operation is possible, execute the tuning with the advanced vibration suppression control.	A machine terminal vibrates.	Adjust the filter. (Refer to section 8.4)
	Display the cumulative feedback pulses with the "High speed monitor" command on the "Monitor" menu on software (MR Configurator2^{TM}). Check the numerical values are not skipped.	Noises are overlapped in the encoder cable. This causes miscounting of the cumulative feedback pulses.	Reduce the noises by setting the encoder cable apart from the power supply cable, etc.
	Check that the mechanical parts are not unstable or do not have backlashes.	The servo motor and the machine (gear, coupling, etc.) have backlashes.	Adjust the coupling or the backlash of the mechanical parts.
	Check the mounting part of the servo motor.	The mounting part of the servo motor is not enough rigid.	Improve the rigidity by using a thicker board for the mounting part, backing up with ribs, etc.
	Check the power supply cable of the servo motor.	An output circuit is open.	Review the wiring of the servo motor power supply cable.
	Check that the degree of vibration changes depending on the motor speed.	The unbalanced torque is big on the machine side.	Adjust the balance on the machine side.

Phenomena	Checkpoint	Estimated cause	Action
The servo motor vibrates.	Check the mounting accuracy of the servo motor and the machine.	The eccentricity is big by the core gaps.	Review the direct connection accuracy.
	Check the axial end load on the servo motor.	The axial end load on the servo motor is large.	Adjust the axial end load within the specifications of the servo motor. Refer to Servo motor Instruction Manual (Vol.2) for details of the axial end load on the servo motor.
	Check the vibration from the outside.	The outside vibration propagated to the servo motor.	Control the vibration from the outside source.
Rotation accuracy is not satisfactory. (The speed is unstable.)	1. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning. 2. Increase the auto tuning response (parameter No.PA09). (except the manual mode)	1. The servo gain is low. 2. The auto tuning response is low.	Increase the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
	Check if the limiting torque (TLC) is not on. 1. Check with the external I/O signal display in the diagnostic mode. 2. Check the torque ripple with the "I/O interface display" command on the "Monitor" menu on software (MR Configurator2™).	Unintended torque limit is valid. (The torque limit (TLC) is on while the torque limit is valid.)	Release the torque limit.
	Check if the maximum torque does not exceed the torque limit value. 1. Check "instantaneous torque" on the status display. 2. Check the torque ripple with the "Graph" command on the "Monitor" menu on software (MR Configurator2™).	The maximum torque is lacking. 1. The servo capacity is lacking. 2. The load is too large.	1. Change the mass or the shape of the work to reduce the load. 2. Make the acceleration/ deceleration time shorter to make the effective load ratio lower.
		The torque limit settings are incorrect. (Set with the parameter No.PA11/ PA12/PC35.)	Review the torque limit setting.
	Check the status of the analog input voltage. 1. Check with the status display. 2. Check with the "Display all" command on the "Monitor" menu on software (MR Configurator2™).	Input voltage of the analog speed command (VC) or the analog speed limit (VLA) is instable.	Review the settings of the analog speed command (VC), the analog speed limit (VLA) and the analog input voltage.
	Check commands from the driver. Check the ripple of the command frequency with the "Graph" command on the "Monitor" menu on software (MR Configurator2™).	Commands from the driver are unstable.	1. Review the commands from the driver. 2. Check the command cable if errors do not occur such as breaking.
The servo motor wobbles at stop.	1. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning. 2. Increase the auto tuning response (parameter No.PA09). (except the manual mode)	1. The servo gain is low. 2. The auto tuning response is low.	Increase the auto tuning response and then adjust the gains again. (Refer to chapter 7.)

Phenomena	Checkpoint	Estimated cause	Action
The servo motor starts immediately when the driver power supply is turned on/The servo motor starts immediately when servo-on is executed.	Check that the servo-on (SON) is not on. 1. Check with the external I/O signal display in the diagnostic mode. 2. Check with the "I/O interface display" command on the "Monitor" menu on software (MR Configurator2^{TM}).	The servo-on (SON) is on status at power-on.	1. Review the wiring of the servo-on (SON). 2. Review the sequence of the servo-on (SON).
	Check the brake release timing for the servo motor with an electromagnetic brake.	1. The electromagnetic brake release sequence is incorrect. 2. The power supply for the electromagnetic brake is faulty.	1. Review the electromagnetic brake release sequence. 2. Check the power supply for the electromagnetic brake.
	Check the status of the analog speed command (VC) and the analog torque command (TC). 1. Check with the status display. 2. Check with the "Display all" command on the "Monitor" menu on software (MR Configurator2^{TM}).	1. The analog speed command (VC) and the analog torque command (TC) has already input at power-on. 2. The offset voltage of the analog speed command (VC) or the analog torque command (TC) is incorrect.	Set the offset voltage of the analog speed command (VC) and the analog torque command (TC) properly.
	Check the power supply cable of the servo motor.	An output circuit is open.	Review the wiring of the servo motor power supply cable.
The position is misaligned at home position return.	A certain amount (one revolution) of misalignment occurs.	The zero pulse detection occurs near the dog off position. (dog type home position return)	Adjust the proximity dog installation.
	Check the in-position range (parameter No.PA10).	The in-position range is too large.	Set the in-position range smaller than the current setting.
	Check that the proximity dog signal is set properly.	1. The proximity dog switch is malfunction. 2. The proximity dog switch is not installed properly.	1. Repair or replace the proximity dog switch. 2. Adjust the proximity dog switch installation.
	Check the proximity dog switch installation.	The proximity dog switch is misaligned or not installed properly.	Adjust the proximity dog switch installation.
	Check the driver program. 1. The home position address settings 2. The sequence programs and others	The driver programs are incorrect.	Review the driver programs.

Phenomena	Checkpoint	Estimated cause	Action
The position is misaligned in operation after the home position return.	Check the servo alarm/warning.	1. A servo alarm is occurring. 2. The servo motor coasts due to a servo alarm.	Check the details of the alarm and remove its cause.
	The output pulse counter and the driver cumulative command pulses of the driver do not match.	1. An output pulses miscounting due to noises. 2. A shield of a command cable is made incorrectly. 3. A command cable is connected loosely or broken.	1. Check that the shield of the command cable is made correctly. 2. When wiring with the open collector system, change it to the differential system. 3. Wire apart from the strong electric circuit. 4. Install the data line filters. (Refer to section 12.17.)
		The servo-on (SON) is turned off.	Review the wiring and the driver programs in order that the servo-on (SON) is not turned to off in operation.
		The command pulses voltage level is low at the open collector system. (normal value: 24VDC)	Review the wiring and command pulse specifications. Replace the driver if an error cannot be detected.
		The command pulses ripple error occurs due to a long command cable.	Shorten the wiring length. Differential system: 10m or shorter Open collector system: 2m or shorter
	The cumulative feedback pulses x the travel distance per pulse does not match with the actual machine position.	1. A machine slipped. 2. A machine backlash is big.	Adjust the machine parts.
The position is misaligned in operation after the home position return.	The cumulative feedback pulses do not match with the cumulative command pulses × the electronic gear setting value.	Temporary breaking of a power line	Review the wiring.
		1. The servo gain is low. 2. The auto tuning response is low. 3. The setting time is late.	Increase the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
		1. The forward rotation stroke end (LSP) or the reverse rotation stroke end (LSN) is turned off. (AL.99 occurred.) 2. Clear (CR) or reset (RES) is turned on.	1. Review the wiring and the sequence of each signal. 2. If a noise may malfunction greatly, make the input filter setting (parameter No.PD19) value bigger.
	1. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning. 2. Increase the auto tuning response (parameter No.PA09). (except the manual mode)	The auto tuning response is low.	Increase the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
	Check the settings as follows for the geared servo motor. 1. The travel distance per revolution of the servo motor (Set by the driver) 2. Command input pulses per revolution (parameter No.PA05) 3. Electronic gear (parameter No.PA06/PA07)	The calculation of the reduction ratio is not correct.	Review the setting of the reduction ratio.
	Check the in-position range (parameter No.PA10).	The in-position range is too large.	Set the in-position range smaller than the current setting.

Phenomena	Checkpoint	Estimated cause	Action
The absolute position reconstruction position is misaligned at recovery by the absolute position detection system.	Check the settings as follows for the geared servo motor. 1. The travel distance per servo motor revolution (Set with the driver.) 2. Command input pulses per revolution (parameter No.PA05) 3. Electronic gear (parameter No.PA06/PA07)	The calculation of the reduction ratio is not correct.	Review the setting of the reduction ratio.
	The positioning after is not misaligned after the home position return.	The maximum permissible speed at power failure (3000r/min) is exceeded while the driver is off.	Review the machine configuration in order that the servo motor speed does not exceed 3000r/min.
		The transfer data to the driver is incorrect.	Review the driver programs.
The overshoot/ undershoot occurs.	1. Check that the overshoot/ undershoot occurs to confirm the speed ripple with the "Graph" command on the "Monitor" menu on software (MR Configurator2™). 2. If the safe operation is possible, repeat acceleration/deceleration 4 times or more to complete the auto tuning.	1. The servo gain is too low or too high. 2. The auto tuning response is low or too high.	Adjust the auto tuning response and then adjust the gains again. (Refer to chapter 7.)
	Check if the maximum torque does not exceed the torque limit value. 1. Check the "instantaneous torque" with the status display. 2. Check the torque ripple with the "Graph" command on the "Monitor" menu on software (MR Configurator2™).	The maximum torque is lacking. 1. The servo capacity is lacking. 2. The load is too large.	1. Change the mass or the shape of the work to reduce the load. 2. Make the acceleration/ deceleration time shorter to make the effective load ratio lower.
		The torque limit settings are incorrect. (Set with the parameter No.PA11/ PA12/PC35.)	Review the torque limit setting.
	Check that the machine parts are not unstable or do not have backlashes.	The servo motor and the machine (gear, coupling, etc.) have backlashes.	Adjust the coupling or the backlash of the mechanical parts.
The communication cannot be made with the driver by software (MR Configurator2™).	Check that the status is on-line.	The status is off-line.	Set the status to on-line. Select "On-line" on "System settings" on the "Setup" menu.
	Check that the communication cables are not damaged.	A communication cable is faulty.	Replace the communication cable.
	Check the communication settings (baud rate and port). Check with the "system settings" on the "setup" menu.	The communication setting is incorrect.	Set the communication settings correctly.
	Check that the model selection is set correctly. Check with the "System settings" command on the "Setup" menu.	The other model, which differs from the one connected on the model selection, is selected.	Set the model settings correctly.
	Check that "MITSUBISHI MELSERVO USB Controller" is displayed under the driver by the device manager of the personal computer.	The device is not set correctly.	Delete the unknown device or other devices. Turn the driver power on and then re-set with found new hardware wizard. Refer to the software (MR Configurator2™) help for details.

Phenomena	Checkpoint	Estimated cause	Action
An abnormal value is displayed on the monitor value on software (MR Configurator2™).	Check that the model selection is set correctly. Check with the "System settings" command on the "Setup" menu.	The other model, which differs from the one connected on the model selection, is selected.	Set the model settings correctly.
The electromagnetic brake does not work for the servo motor with the electromagnetic brake.	Remove the servo motor from the machine and remove all the wiring. Check that the servo motor shaft can be turned over by the hand. (If the shaft can be turned over, the electromagnetic brake is malfunction.)	The electromagnetic brake reached the end of its usefulness or malfunctioned. Refer to Servo motor Instruction Manual (Vol.2) for details of the life of the electromagnetic brake.	Replace the servo motor.
The servo motor coasting amount is enlarged.	Check that a load is not increased.	If a load is increased, the value exceeded the permissible load to motor inertia moment ratio of the dynamic brake. (Refer to section 11.3)	1. Reduce the load. 2. Replace the driver.
	For the servo motor with an electromagnetic brake 1. Check that the external relay, which is connected to the electromagnetic brake interlock (MBR), operates properly. 2. Check that the electromagnetic brake is not malfunction.	1. An external relay malfunctions. 2. The electromagnetic brake interlock (MBR) wiring is incorrect. 3. The electromagnetic brake reached the end of its usefulness or malfunctioned.	1. Replace the external relay. 2. Review the wiring. 3. Replace the servo motor.

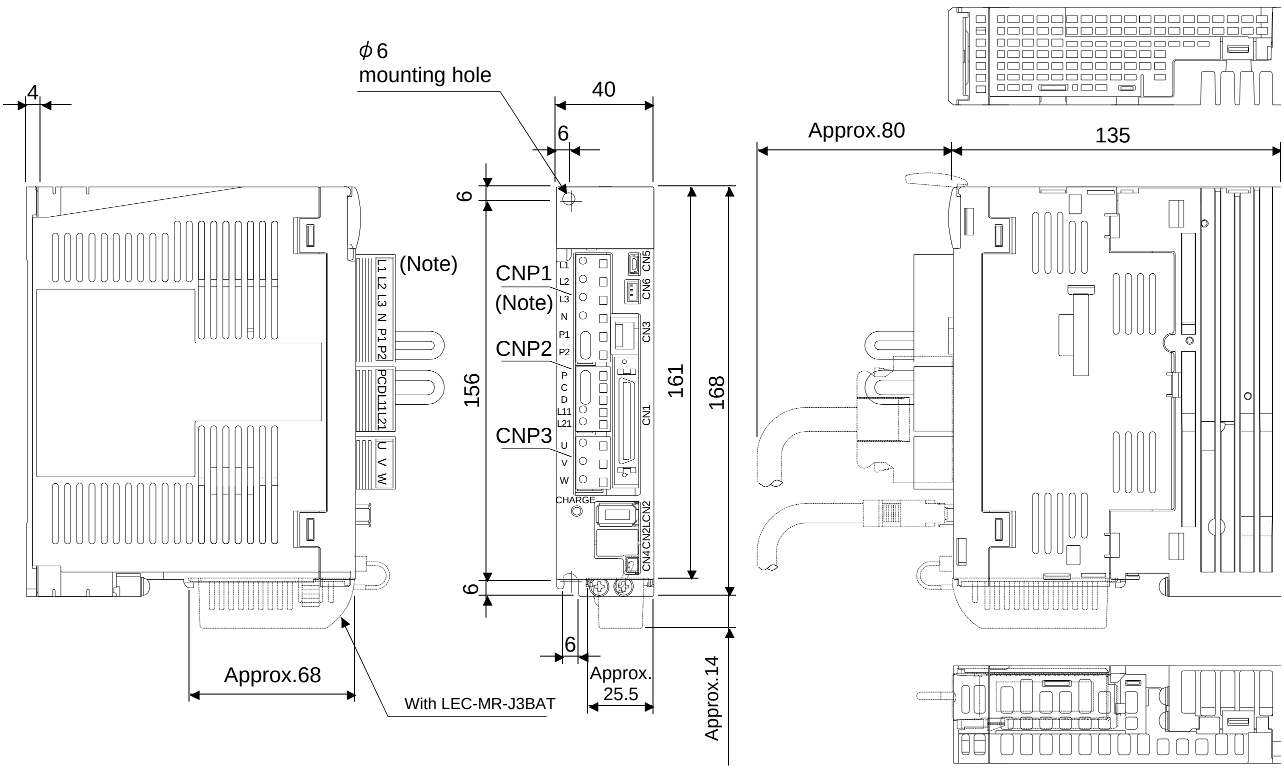
10. OUTLINE DRAWINGS

10. OUTLINE DRAWINGS

10.1 Driver

(1) LECSB□-S5・LECSB□-S7

[Unit: mm]



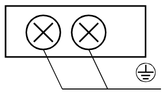
Note. This data applies to the 3-phase or 1-phase 200 to 230VAC power supply models.
For 1-phase, 100 to 120VAC power supply, refer to the terminal signal layout.

Mass: 0.8 [kg] (1.76 [lb])

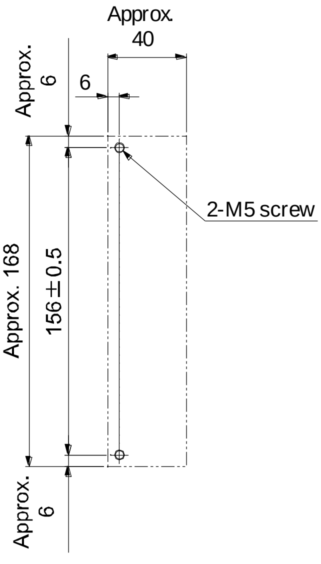
Terminal signal layout

Connector	For 1-phase 100 to 120VAC	For 3-phase 200 to 230VAC and 1-phase 230VAC
CNP1	L_1	L_1
	(none)	L_2
	L_2	L_3
	N	N
	P_1	P_1
	P_2	P_2
CNP2	P	P
	C	C
	D	D
	L_{11}	L_{11}
	L_{21}	L_{21}
CNP3	U	U
	V	V
	W	W

PE terminal



Screw size: M4
Tightening torque: 1.2 [N・m] (10.6 [lb・in])

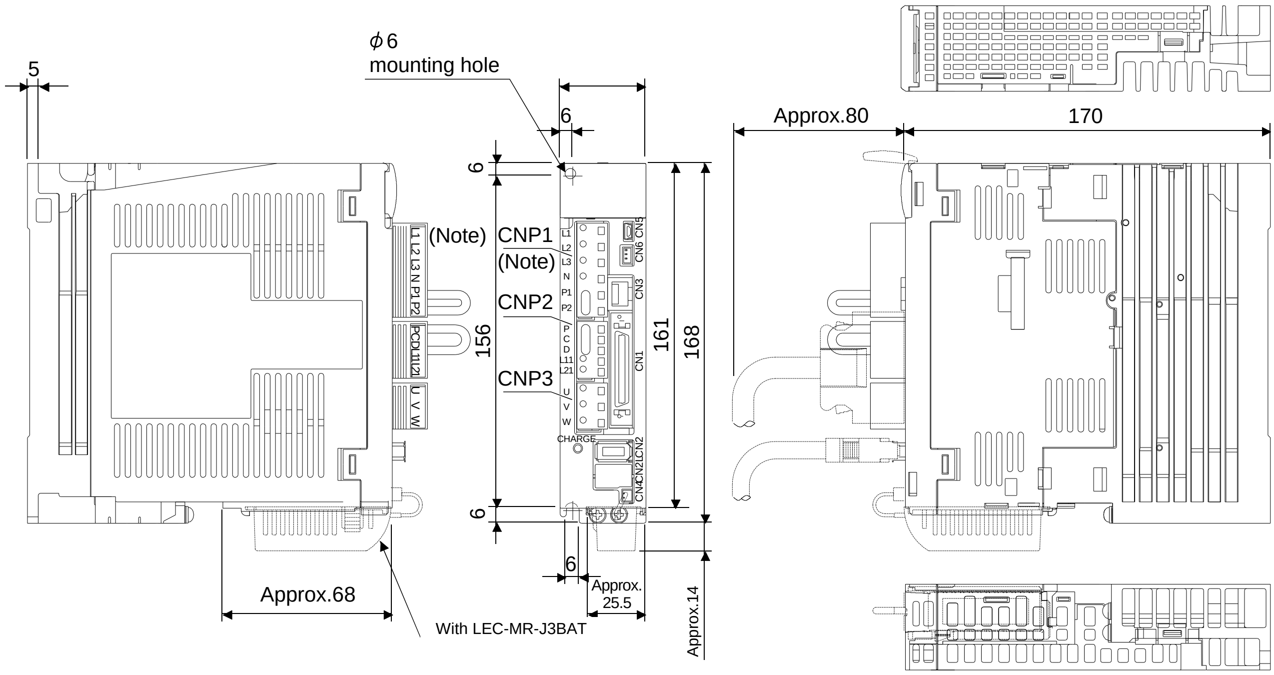


Mounting hole process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.24[N・m] (28.7[lb・in])

(2) LECSB□-S8

[Unit: mm]



Note. This data applies to the 3-phase or 1-phase 200 to 230VAC and 1-phase 230VAC power supply models.
For 1-phase, 100 to 120VAC power supply, refer to the terminal signal layout.

Mass: 1.0 [kg] (2.21 [lb])

Terminal signal layout

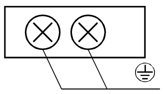
For 1-phase 100 to 120VAC

CNP1	L_1
	(blank)
	L_2
	N
	P_1
	P_2
CNP2	P
	C
	D
	L_{11}
	L_{21}
CNP3	U
	V
	W

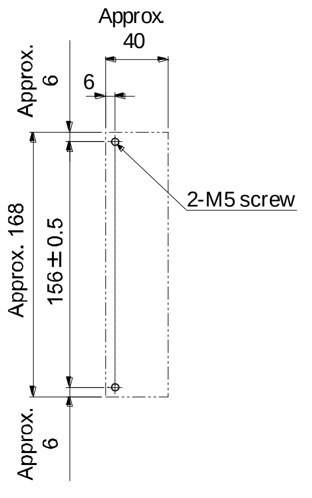
For 3-phase 200 to 230VAC and 1-phase 230VAC

CNP1	L_1
	L_2
	L_3
	N
	P_1
	P_2
CNP2	P
	C
	D
	L_{11}
	L_{21}
CNP3	U
	V
	W

PE terminal



Screw size: M4
Tightening torque: 1.2 [N・m] (10.6 [lb・in])



Mounting hole process drawing

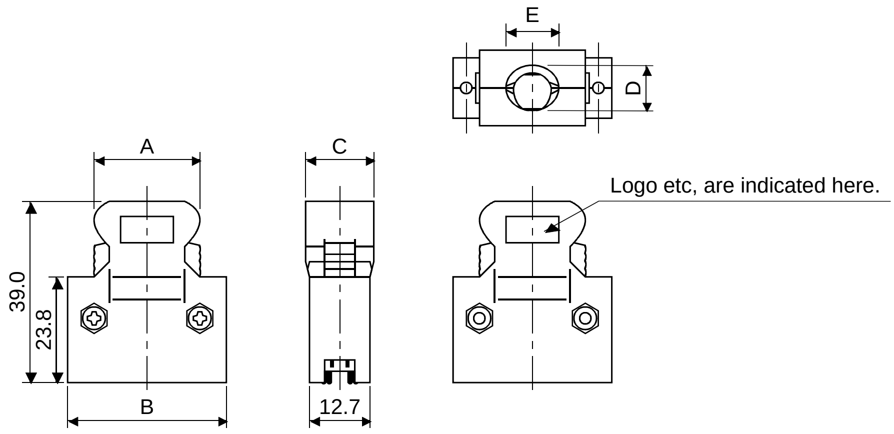
Mounting screw
Screw size: M5
Tightening torque: 3.24[N・m] (28.7[lb・in])

10.2 Connector

(1) Miniature delta ribbon (MDR) system (Sumitomo 3M Limited)

(a) One-touch lock type

[Unit: mm]



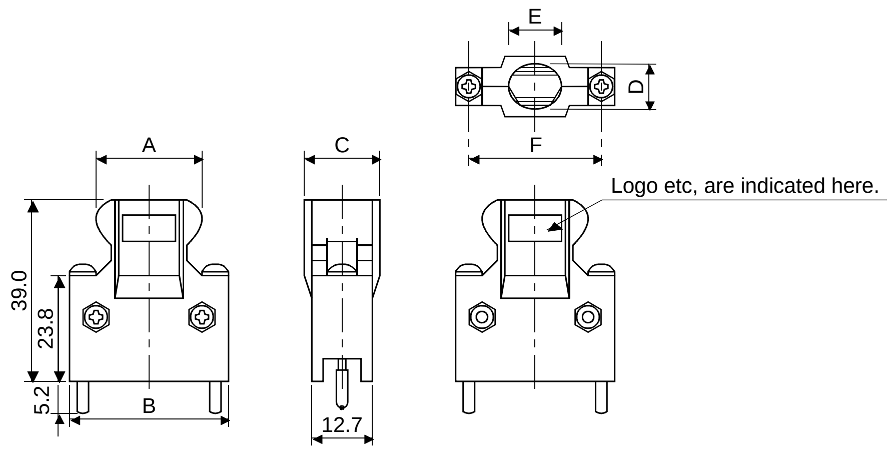
Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10150-3000PE	10350-52F0-008	41.1	52.4	18.0	14.0	17.0

Applicable wire size: AWG24~30

(b) Jack screw M2.6 type

This is not available as option.

[Unit: mm]

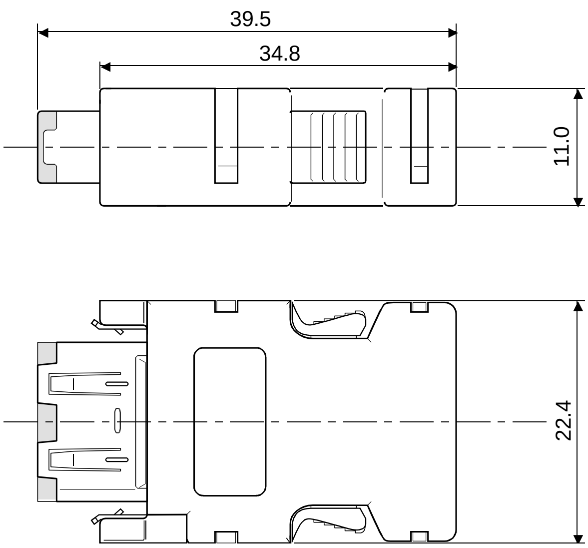


Connector	Shell kit	Each type of dimension					
		A	B	C	D	E	F
10150-3000PE	10350-52A0-008	41.1	52.4	18.0	14.0	17.0	46.5

Applicable wire size: AWG24~30

(2) SCR connector system (Sumitomo 3M Limited)
Receptacle: 36210-0100PL
Shell kit : 36310-3200-008

[Unit: mm]



11. CHARACTERISTICS

11. CHARACTERISTICS

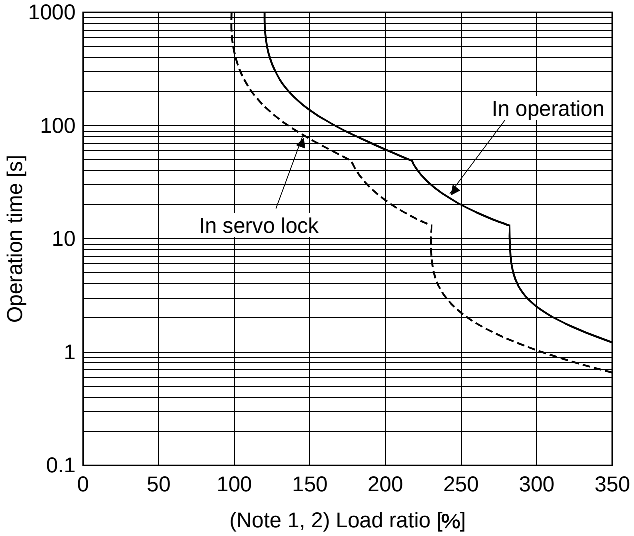
11.1 Overload protection characteristics

An electronic thermal relay is built in the driver to protect the servo motor, driver and servo motor power line from overloads. Overload 1 alarm (AL.50) occurs if overload operation performed is above the electronic thermal relay protection curve shown in any of Figs 11.1. Overload 2 alarm (AL.51) occurs if the maximum current flows continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.

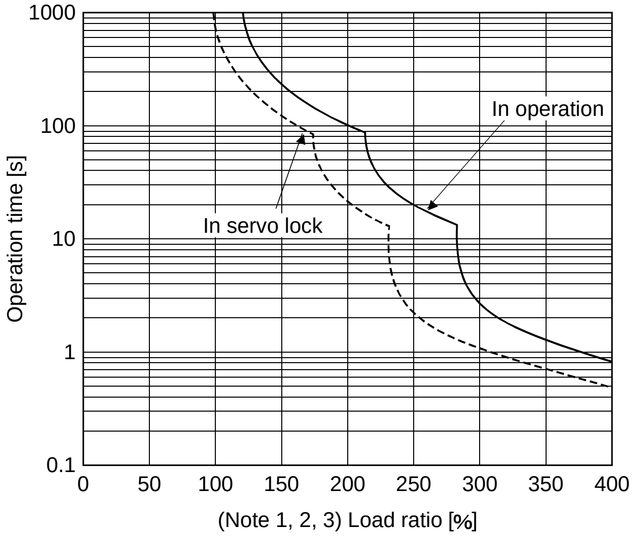
In a machine like the one for vertical lift application where unbalanced torque will be produced, it is recommended to use the machine so that the unbalanced torque is 70% or less of the rated torque.

When you carry out adhesion mounting of the driver, make circumference temperature into 0 to 45℃ (32 to 113℉), or use it at 75% or smaller effective load ratio.

Driver LECSB□-□ series has solid-state servo motor overload protection. (The motor full load current is 115% rated current.)



LECSB□-S5



LECSB□-S7, LECSB□-S8

Note 1. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo lock status) or in a 30r/min or less low-speed operation status, the driver may fail even when the electronic thermal relay protection is not activated.

Fig 11.1 Electronic thermal relay protection characteristics

11.2 Power supply equipment capacity and generated loss

(1) Amount of heat generated by the driver

Table 11.1 indicates drivers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 11.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and servo off according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the driver's generated heat will not change.

Table 11.1 Power supply capacity and generated heat per driver at rated output

Driver	Servo motor	(Note 1) Power supply capacity [kVA]	(Note 2) Driver-generated heat [W]		Area required for heat dissipation [m2]
			At rated torque	With servo off	
LECSB□-S5	LE-S5-□	0.3	25	15	0.5
	LE-S6-□	0.3	25	15	0.5
LECSB□-S7	LE-S7-□	0.5	25	15	0.5
LECSB□-S8	LE-S8-□	0.9	35	15	0.7

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value is applicable when the power factor improving AC reactor or power factor improving DC reactor is not used.

2. Heat generated during regeneration is not included in the driver-generated heat. To calculate heat generated by the regenerative option, refer to section 12.2.

(2) Heat dissipation area for enclosed driver

The enclosed control box (hereafter called the control box) which will contain the driver should be designed to ensure that its temperature rise is within +10℃ at the ambient temperature of 40℃. (With a 5℃ (41°F) safety margin, the system should operate within a maximum 55℃ (131°F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 11.1.

$$A=\frac{P}{K\cdot\Delta T} \quad \text{(11.1)}$$

where, A : Heat dissipation area [m^2]
P : Loss generated in the control box [W]
ΔT : Difference between internal and ambient temperatures [℃]
K : Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with Equation 11.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 11.1 for heat generated by the driver. "A" indicates the effective area for heat dissipation, but if the enclosure is directly installed on an insulated wall, that extra amount must be added to the enclosure's surface area.

The required heat dissipation area will vary wit the conditions in the enclosure. If convection in the enclosure is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the enclosure and the use of a cooling fan should be considered.

Table 11.1 lists the enclosure dissipation area for each driver when the driver is operated at the ambient temperature of 40℃ (104°F) under rated load.

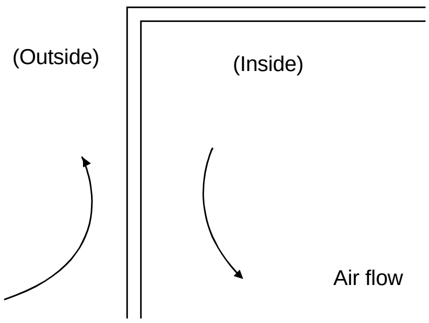


Fig. 11.2 Temperature distribution in enclosure

When air flows along the outer wall of the enclosure, effective heat exchange will be possible, because the temperature slope inside and outside the enclosure will be steeper.

11.3 Dynamic brake characteristics

POINT

- Dynamic brake operates at occurrence of alarm, servo emergency stop warning (AL.E6) and when power is turned off. Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- Maximum usage time of dynamic brake for a machine operating under recommended load inertia moment ratio is 1000 time while decelerating from rated speed to a stop with frequency of once in 10 minutes.
- Be sure to make emergency stop (EMG) valid after servo motor stops when using emergency stop (EMG) frequently in other than emergency.

11.3.1 Dynamic brake operation

(1) Calculation of coasting distance

Fig. 11.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 11.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (2) (a), (b) in this section.)

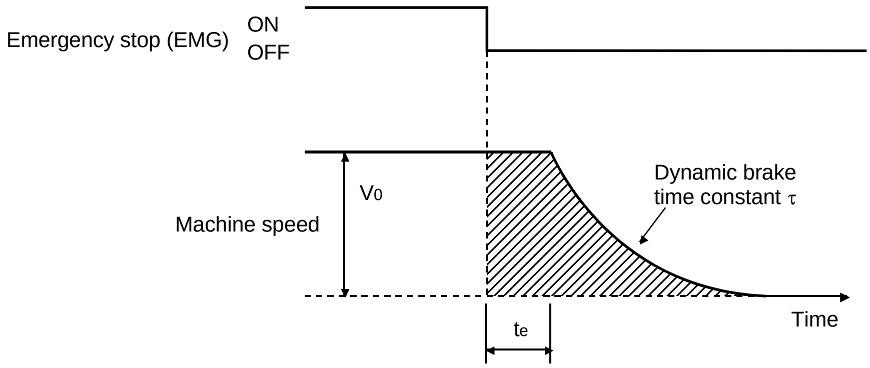


Fig. 11.3 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \qquad (11.2)$$

L_{max} : Maximum coasting distance .... [mm][in]

V_o : Machine rapid feed rate .... [mm/min][in/min]

J_M : Servo motor inertial moment .... [kg・cm^2][oz・in^2]

J_L : Load inertia moment converted into equivalent value on servo motor shaft .... [kg・cm^2][oz・in^2]

τ : Dynamic brake time constant .... [s]

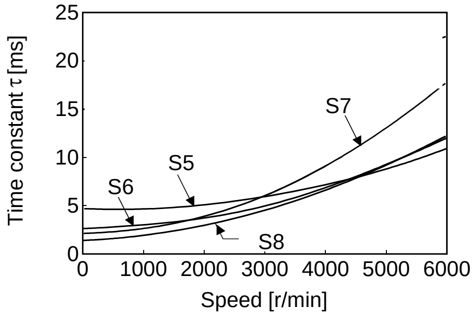
t_e : Delay time of control section .... [s]

For 7kW or lower servo, there is internal relay delay time of about 10ms. For 11k to 22kW servo, there is delay caused by magnetic contactor built into the external dynamic brake (about 50ms) and delay caused by the external relay.

(2) Dynamic brake time constant

The following shows necessary dynamic brake time constant τ for the equations (11.2).

(a) 200V class servo motor



LE-S□−□ series

11.3.2 The dynamic brake at the load inertia moment

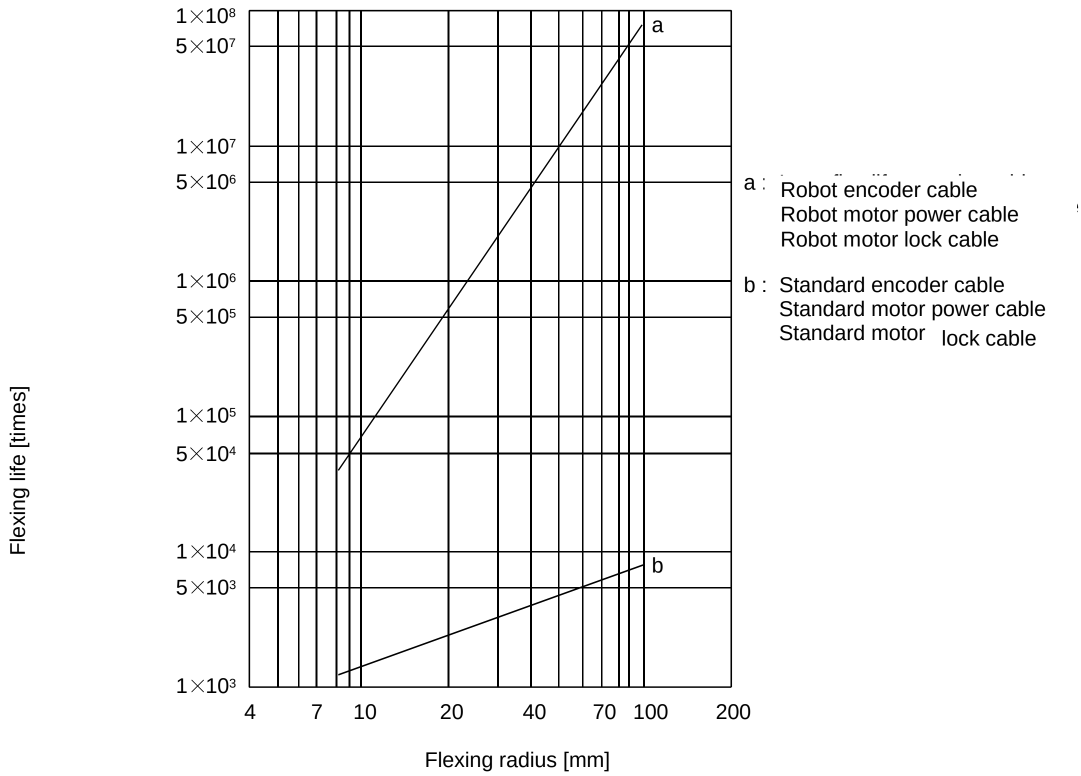
Use the dynamic brake under the load inertia moment ratio indicated in the following table. If the load inertia moment is higher than this value, the dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact your local sales office.

The values of the load inertia moment ratio in the table are the values at the maximum rotation speed of the servo motor.

Driver	Servo motor
	LE−□−□
LECSB□−□	30

11.4 Cable flexing life

The flexing life of the cables is shown below. This graph calculated values. Since they are not guaranteed values, provide a little allowance for these values. The minimum bending radius : Min. 45mm.



11.5 Inrush currents at power-on of main circuit and control circuit

The following table indicates the inrush currents (reference data) that will flow when the maximum permissible voltage (200V class: 253VAC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

Driver	Inrush currents (A_{0-p})	
	Main circuit power supply (L_1, L_2, L_3)	Control circuit power supply (L_{11}, L_{21})
LECSB1-□	38A (Attenuated to approx. 14A in 10ms)	20 to 30A (Attenuated to approx. 0A in 1 to 2ms)
LECSB2-□	30A (Attenuated to approx. 5A in 10ms)	

Since large inrush currents flow in the power supplies, always use no-fuse breakers and magnetic contactors. (Refer to section 12.6.)

When circuit protectors are used, it is recommended to use the inertia delay type that will not be tripped by an inrush current.

12. OPTIONS AND AUXILIARY EQUIPMENT

WARNING	・Before connecting any option or peripheral equipment, turn off the power and wait for 15 minutes or longer until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the driver whether the charge lamp is off or not.

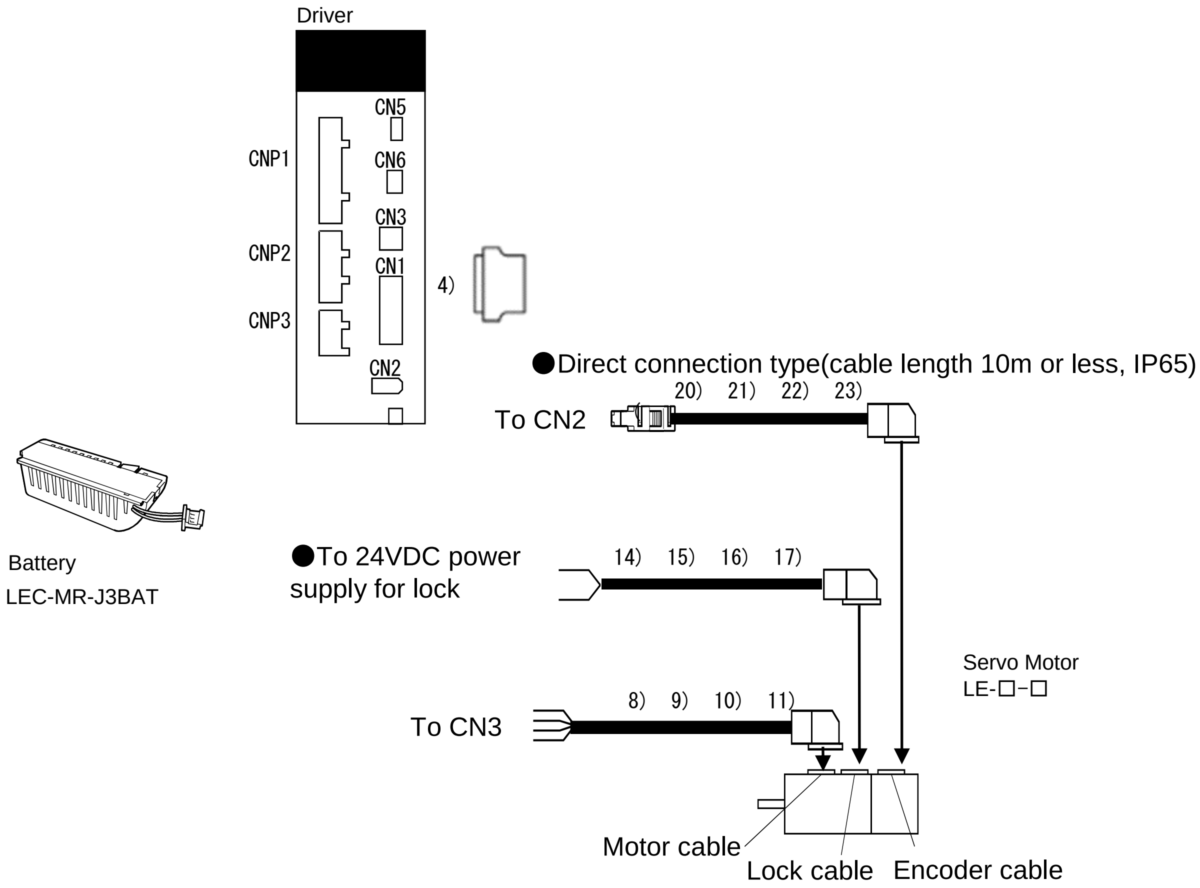
CAUTION	・Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.

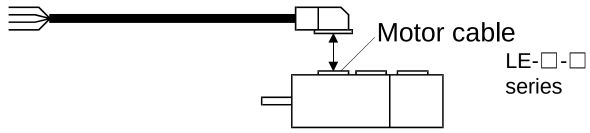
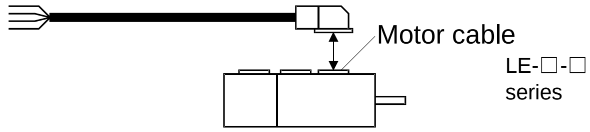
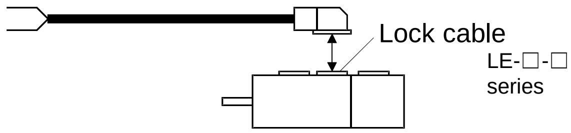
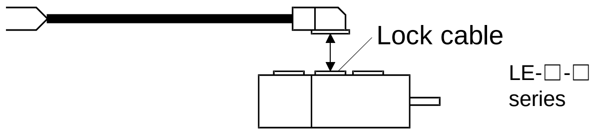
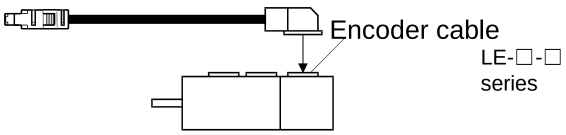
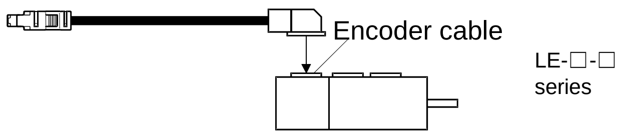
12.1 Cable/connector sets

POINT
・The IP rating indicated is the cable's or connector's protection against ingress of dust and water when the cable or connector is connected to a driver or servo motor. If the IP rating of the cable, connector, driver and servo motor vary, the overall IP rating depends on the lowest IP rating of all components.

As the cables and connectors used with this servo, purchase the options indicated in this section.

12.1.1 Combinations of cable/connector sets



No.	Product	Model	Description	Application
4)	CN1 connector set	LE-CSNB	Connector: 10150-3000PE Shell kit: 10350-52F0-008 (Sumitomo 3M Limited or equivalent) 	
8)	Motor cable	LE-CSM-S□A Cable length: 2・5・10m	 Refer to section 12.1.3 for details.	IP65 Axis side lead
9)	Motor cable	LE-CSM-R□A Cable length: 2・5・10m		IP65 Axis side lead Robot cable
10)	Motor cable	LE-CSM-S□B Cable length: 2・5・10m	 Refer to section 12.1.3 for details.	IP65 Counter axis side lead
11)	Motor cable	LE-CSM-R□B Cable length: 2・5・10m		IP65 Counter axis side lead Robot cable
14)	Lock cable	LE-CSB-S□A Cable length: 2・5・10m	 Refer to section 12.1.4 for details.	IP65 Axis side lead
15)	Lock cable	LE-CSB-R□A Cable length: 2・5・10m		IP65 Axis side lead Robot cable
16)	Lock cable	LE-CSB-S□B Cable length: 2・5・10m	 Refer to section 12.1.4 for details.	IP65 Counter axis side lead
17)	Lock cable	LE-CSB-R□B Cable length: 2・5・10m		IP65 Counter axis side lead Robot cable
20)	Encoder cable	LE-CSE-S□A Cable length: 2・5・10m	 Refer to section 12.1.2 (1) for details.	IP65 Axis side lead
21)	Encoder cable	LE-CSE-R□A Cable length: 2・5・10m		IP65 Axis side lead Robot cable
22)	Encoder cable	LE-CSE-S□B Cable length: 2・5・10m	 Refer to section 12.1.2 (1) for details.	IP65 Counter axis side lead
23)	Encoder cable	LE-CSE-R□B Cable length: 2・5・10m		IP65 Counter axis side lead Robot cable

Note. Use this option when the connector is expected to receive large vibration and shock.

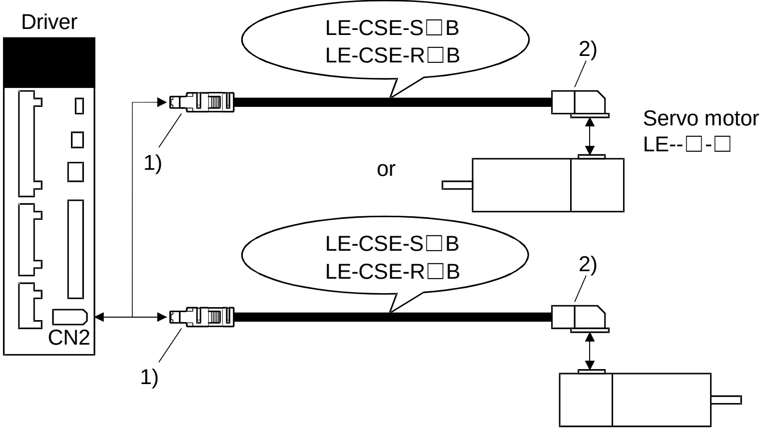
12.1.2 Encoder cable

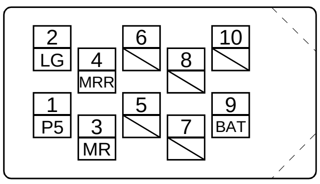
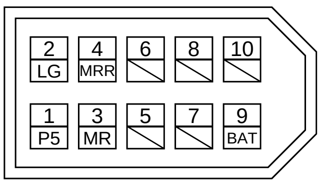
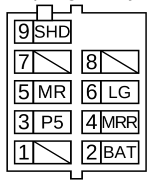
(1) LE-CSE-□□A・LE-CSE-□□B

These cables are encoder cables for the LE-□-□ series servo motors. The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.

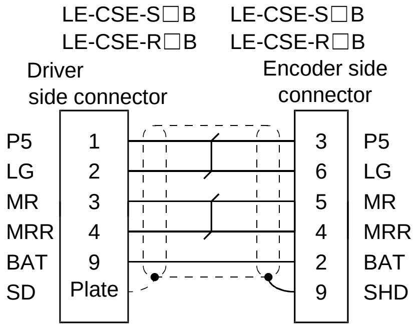
Cable model	Cable length			IP rating	Cable type	Application
	2m	5m	10m			
LE-CSE-S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSE-R□A	2	5	A	IP65	Robot cable	
LE-CSE-S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSE-R□B	2	5	A	IP65	Robot cable	

(a) Connection of driver and servo motor



Cable model	1) For CN2 connector	2) For encoder connector
LE-CSE-S□A LE-CSE-R□A LE-CSE-S□B LE-CSE-R□B	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (Sumitomo 3M Limited) (Note) Signal layout  View seen from wiring side. or Connector set: 54599-1019 (Molex) (Note) Signal layout  View seen from wiring side. Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the driver cannot operate normally.	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (Tyco Electronics) (Note) Signal layout  View seen from wiring side. Note. Keep open the pin shown with an ⧅.

(b) Cable internal wiring diagram

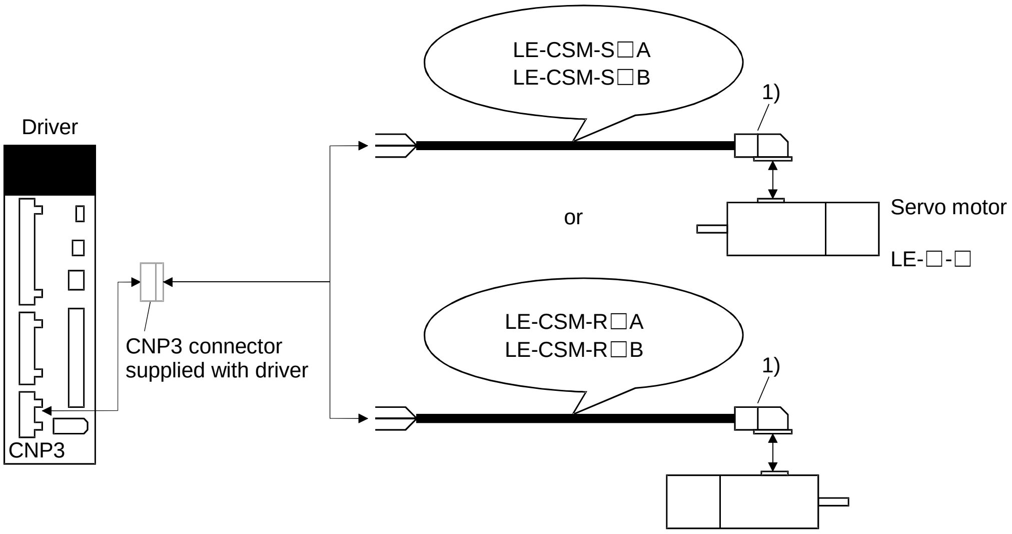


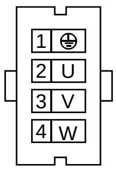
12.1.3 Motor cables

These are Motor cables for the LE-□-□ series servo motors. The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.
Refer to section 3.10 when wiring.

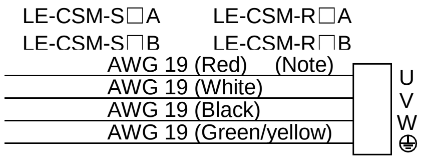
Cable model	Cable length			IP rating	Cable type	Application
	2m	5m	10m			
LE-CSM−S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSM-−S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSM−R□A	2	5	A	IP65	Robot cable	For LE-□-□ servo motor Axis side lead
LE-CSM−R□B	2	5	A	IP65	Robot cable	For LE-□-□ servo motor Counter axis side lead

(1) Connection of driver and servo motor



Cable model	1) For motor power supply connector	
LE-CSM−S□A LE-CSM-−S□B LE-CSM−R□A LE-CSM−R□B	Connector: JN4FT04SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout  View seen from wiring side.

(2) Internal wiring diagram



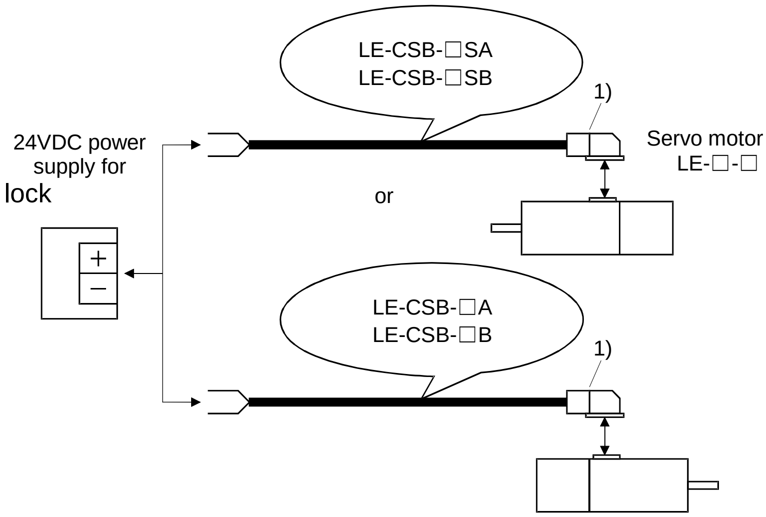
Note. These are not shielded cables.

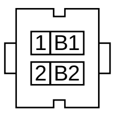
12.1.4 Lock cables

These are Lock cables for the LE-□-□ series servo motors. The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.
Refer to section 3.11 when wiring.

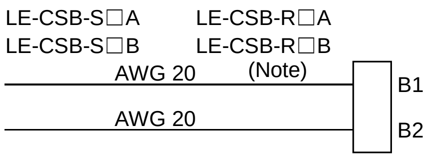
Cable model	Cable length			IP rating	Flex life	Application
	2m	5m	10m			
LE-CSB-S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSB-S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSB-R□A	2	5	A	IP65	Robot cable	For LE-□-□ servo motor Axis side lead
LE-CSB-R□B	2	5	A	IP65	Robot cable	For LE-□-□ servo motor Counter axis side lead

(1) Connection of power supply for lock and servo motor



Cable model	1) For motor brake connector	
LE-CSB-S□A	Connector: JN4FT02SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout  View seen from wiring side.
LE-CSB-S□B		
LE-CSB-R□A		
LE-CSB-R□B		

(2) Internal wiring diagram



Note. These are not shielded cables.

12.2 Regenerative options

⚠CAUTION	・The specified combinations of regenerative options and drivers may only be used. Otherwise, a fire may occur.

(1) Combination and regenerative power

The power values in the table are resistor-generated powers and not rated powers.

Driver	Regenerative power [W]		
	Built-in regenerative resistor	LEC-MR-RB-032 [40Ω]	LEC-MR-RB-12 [40Ω]
LECSB□-S5		30	
LECSB□-S7	10	30	100
LECSB□-S8	10	30	100

Note 1. Always install a cooling fan.

2. Values in parentheses assume the installation of a cooling fan.

(2) Selection of the regenerative option

Please refer to the manual and the catalog of each actuator when the selection of the regenerative option.

(3) Parameter setting

Set parameter No.PA02 according to the option to be used.

Parameter No.PA02

0 0 □ □

Selection of regenerative option
00: Regenerative option is not used
・For driver of 100W, regenerative resistor is not used.
・For driver of 200 to 7kW, built-in regenerative resistor is used.
02: LEC-MR-RB-032
03: LEC-MR-RB-12

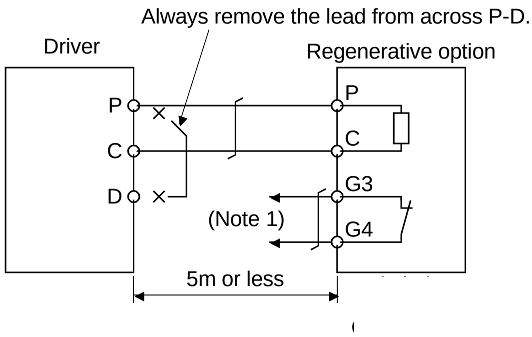
(4) Connection of the regenerative option

POINT
・For the sizes of wires used for wiring, refer to section 12.6.

The regenerative option will cause a temperature rise of 100℃ relative to the ambient temperature. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant wire and keep them clear of the regenerative option body. Always use twisted cables of max. 5m length for connection with the driver.

(a) LECSB□-□

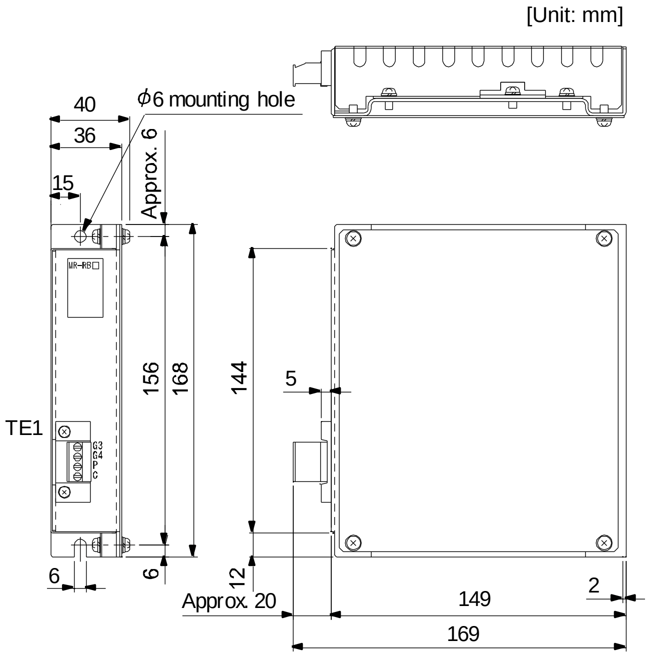
Always remove the wiring from across P-D and fit the regenerative option across P-C.
The G3 and G4 terminals act as a thermal sensor. G3-G4 is disconnected when the regenerative option overheats abnormally.



Note 1. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

(5) Outline drawings

(a) LEC-MR-RB-12



・TE1

Terminal block

G3
G4
P
C

Applicable wire size: 0.2 to 2.5mm^2 (AWG24 to AWG12)

Tightening torque: 0.5 to 0.6 [N・m] (4 to 5 [lb・in])

・Mounting screw

Screw size: M5

Tightening torque: 3.24 [N・m] (28.7 [lb・in])

Mass: 1.1 [kg] (2.4 [lb])

12.3 Set up software(MR Configurator2™)

The set up software(MR Configurator2 ™ :LEC-MRC2E) uses the communication function of the driver to perform parameter setting changes, graph display, test operation, etc. on a personal computer.
When setup software (MR Configurator2 ™) is used, the selection of the model of LECSB□-□ is needed.
Please select 'MR-J3-A' by "Model" - "New" - "Project".

(1) Specifications

Item	Description
Compatibility with a driver	The set up software(MR Configurator2 ™) software version compatible with the driver is C4 or later.
Monitor	Display, high speed monitor, trend graph Minimum resolution changes with the processing speed of the personal computer.
Alarm	Display, history, amplifier data
Diagnostic	Digital I/O, no motor rotation, total power-on time, driver version info, motor information, tuning data, absolute encoder data, automatic voltage control, Axis name setting.
Parameters	Parameter list, turning, change list, detailed information
Test operation	JOG operation, positioning operation, motor-less operation, Do forced output, program operation.
Advanced function	Machine analyzer, gain search, machine simulation, robust disturbance compensation, advanced gain search.
File operation	Data read, save, delete, print
Others	Automatic demo, help display

(2) System configuration

(a) Components

To use this software, the following components are required in addition to the driver and servo motor.

Equipment		Set up software(MR Configurator2 TM) LEC-MRC2E
Personal computer (Note 1, 2, 3, 4 5, 6, 7, 8, 9)	OS	Microsoft® Windows® 10 Edition, Microsoft® Windows® 10 Enterprise, Microsoft® Windows® 10 Pro, Microsoft® Windows® 10 Home, Microsoft® Windows® 8.1 Enterprise Microsoft® Windows® 8.1 Pro Microsoft® Windows® 8.1 Microsoft® Windows® 8 Enterprise, Microsoft® Windows® 8 Pro, Microsoft® Windows® 8, Microsoft® Windows® 7 Ultimate Microsoft® Windows® 7 Enterprise Microsoft® Windows® 7 Professional Microsoft® Windows® 7 Home Premium Microsoft® Windows® 7 Starter Microsoft® Windows Vista® Ultimate Microsoft® Windows Vista® Enterprise Microsoft® Windows Vista® Business Microsoft® Windows Vista® Home Premium Microsoft® Windows Vista® Home Basic Microsoft® Windows® XP Professional, Service Pack2 or later Microsoft® Windows® XP Home Edition, Service Pack2 or later IBM PC/AT compatible PC
	Hard Disk	1GB or more of free space
Display		One whose resolution is 1024×768 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.
Keyboard		Connectable with the above personal computer.
Mouse		Connectable with the above personal computer.
Printer		Connectable with the above personal computer.
USB cabl0 (Note 10)		LEC-MR-J3USB

Note 1. Using a PC for setting Windows® 10, upgrade to version 1.52E.
Using a PC for setting Windows® 8.1, upgrade to version 1.25B.
Using a PC for setting Windows® 8, upgrade to version 1.20W.
Refer to Mitsubishi Electric Corporation’s website for version upgrade information.

2. Windows® and Windows Vista® is the registered trademarks of Microsoft Corporation in the United States and other countries.

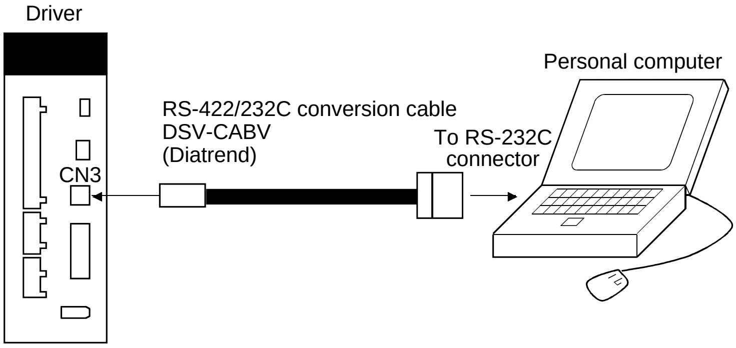
3. On some personal computers, set up software (MR Configurator2TM) may not run properly.

4. The following functions cannot be used. If any of the following functions is used, this product may not operate normally.
・Start of application in Windows® compatible mode.
・Fast User Switching.
・Remote Desktop.
・Windows XP Mode.
・Windows Touch or Touch.
・Modern UI
・Client Hyper-V
・Tablet Mode
・Virtual desktop
・Does not support 64-bit Operating System, except for Microsoft® Windows® 7 or later.

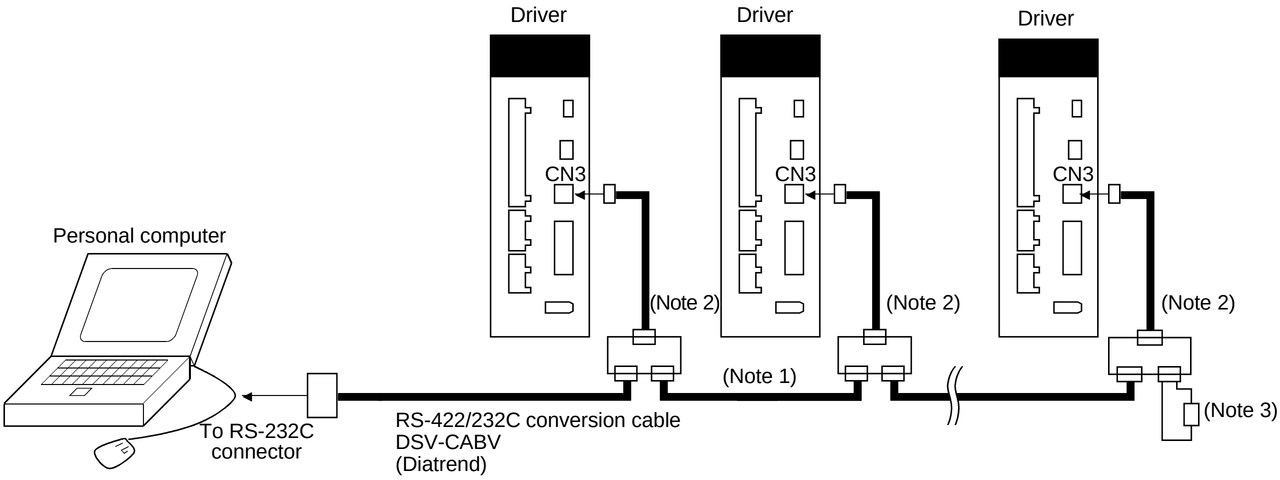
5. Multi-display is set, the screen of this product may not operate normally.
6. The size of the text or other items on the screen is not changed to the specified value (96DPI, 100%, 9pt, etc.), the screen of this product may not operate normally.
7. Changed the resolution of the screen during operating, the screen of this product may not operate normally.
8. Please use by "Standard User", "Administrator" in Windows Vista® or later.
9. If .NET Framework 3.5 (including .NET 2.0 and 3.0) have been disabled in Windows® 7 or later, it is necessary to enable it.
10. Order USB cable separately.
    This cable is shared with Set up software (MR Configurator™ : LEC-MR-SETUP221E).

(b) Connection with driver

1) For use of RS-422



2) For use of RS-422 to make multidrop connection



Note 1. Refer to section 13.1 for cable wiring.

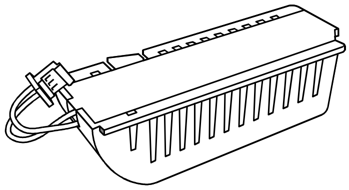
2. The BMJ-8 (Hakko Electric Machine Works) is recommended as the branch connector.

3. The final axis must be terminated between RDP (pin No.3) and RDN (pin No.6) on the receiving side (driver) with a 150Ω resistor.

12.4 Battery unit LEC-MR-J3BAT

POINT
· Refer to appendix 7 and 8 for battery transportation and the new EU Battery Directive.

(1) Purpose of use for LEC-MR-J3BAT
This battery is used to construct an absolute position detection system. Refer to section 14.3 for the fitting method, etc.



(2) Year and month when LEC-MR-J3BAT is manufactured
Production year and month of the LEC-MR-J3BAT are indicated in a serial number on the rating plate of the battery back face.
The year and month of manufacture are indicated by the last one digit of the year and 1 to 9, X(10), Y(11), Z(12).
For October 2004, the Serial No. is like, "SERIAL□4X□□□□□□".

12.5 Selection example of wires

POINT

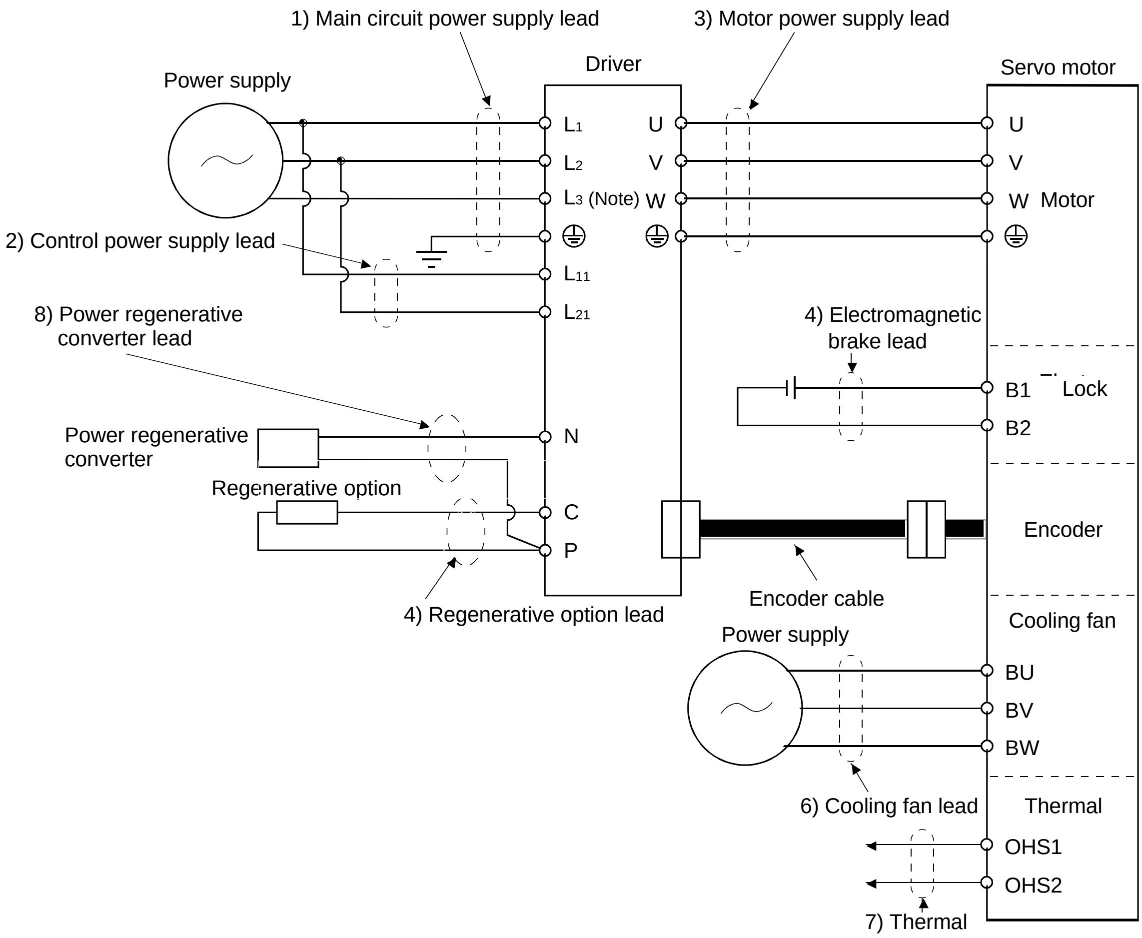
- Wires indicated in this section are separated wires. When using a cable for power line (U, V, and W) between the driver and servo motor, use a 600V grade EP rubber insulated chloroprene sheath cab-tire cable (2PNCT). For selection of cables, refer to appendix 6.
- To comply with the UL/CSA Standard, use the wires shown in appendix 10 for wiring. To comply with other standards, use a wire that is complied with each standard.
- Selection condition of wire size is as follows.
  Construction condition: One wire is constructed in the air
  Wire length: 30m or less

(1) Wires for power supply wiring

POINT

- Always use the 600V grade heat-resistant polyvinyl chloride insulated wire (HIV wire) when using the HF-JP series servo motor.

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



Note. There is no L3 for 1-phase 100 to 120VAC power supply.

(a) When using the 600V Polyvinyl chloride insulated wire (IV wire)
Selection example of wire size when using IV wires is indicated below.

Table 12.1 Wire size selection example 1 (IV wire)

Driver	Wires [mm^2] (Note 1, 4)						
	1) L_1 ・ L_2 ・ L_3 ・ ⏚	2) L_{11} ・ L_{21}	3) U ・ V ・ W ・ ⏚	4) P ・ C	5) B1 ・ B2	6) BU ・ BV ・ BW	7) OHS1 ・ OHS2
LECSB□-S5	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)	1.25(AWG16)		
LECSB□-S7							
LECSB□-S8							

(b) When using the 600V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Selection example of wire size when using HIV wires is indicated below. For the wire (8)) for power regenerative converter (FR-RC-(H) (Mitsubishi Electric Corporation)), use the IV wire indicated in (1) (a) in this section.

Table 12.2 Wire size selection example 2 (HIV wire)

Driver	Wires [mm^2] (Note 1, 4)						
	1) L_1 ・ L_2 ・ L_3 ・ ⏚	2) L_{11} ・ L_{21}	3) U ・ V ・ W ・ ⏚	4) P ・ C	5) B1 ・ B2	6) BU ・ BV ・ BW	7) OHS1 ・ OHS2
LECSB□-S5	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)	1.25(AWG16)		
LECSB□-S7							
LECSB□-S8							

(c) Selection example of crimping terminals

Selection example of crimping terminals for the driver terminal box when using the wires mentioned in (1) (a) and (b) in this section is indicated below.

Symbol	Driver side crimping terminals				
	(Note 2) Crimping terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S			Japan Solderless Terminals
(Note 1)b	8-4NS	YHT-8S			
c	FVD14-6	YF-1 ・ E-4	YNE-38	DH-122 ・ DH-112	
d	FVD22-6			DH-123 ・ DH-113	
(Note 1)e	38-6	YPT-60-21		TD-124 ・ TD-112	
		YF-1 ・ E-4	YET-60-1		
(Note 1) f	R60-8	YPT-60-21		TD-125 ・ TD-113	
		YF-1 ・ E-4	YET-60-1		
g	FVD2-4	YNT-1614			
h	FVD2-M3				
j	FVD5.5-6	YNT-1210S			
k	FVD5.5-8				
l	FVD8-6	YF-1 ・ E-4	YNE-38	DH-121 ・ DH-111	
m	FVD14-8			DH-122 ・ DH-112	
n	FVD22-8			DH-123 ・ DH-113	
(Note 1) p	R38-8	YPT-60-21		TD-124 ・ TD-112	
		YF-1 ・ E-4	YET-60-1		
q	FVD2-6	YNT-1614			

Note 1. Coat the part of crimping with the insulation tube.

2. Some crimping terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

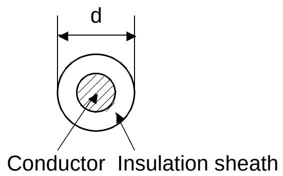
(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent.

Table 12.3 Wires for option cables

TypeEncoder cable	Model	Length [m]	Core size [mm^2]	Number of Cores	Characteristics of one core			(Note 3) Finishing OD [mm]	Wire model
					Structure [Wires/mm]	Conductor resistance [Ω/mm]	Insulation coating OD d [mm] (Note 1)		
Encoder cable	LE-CSE−S□A	2 to 10	AWG22	6 (3 pairs)	7/0.26	53 or less	1.2	7.1±0.3	(Note 3) VSVP 7/0.26 (AWG#22 or equivalent)-3P Ban-gi-shi-16823
	LE-CSE−S□B								
	LE-CSE−R□A	2 to 10	AWG22	6 (3 pairs)	70/0.08	56 or less	1.2	7.1±0.3	(Note 3) ETFE SVP 70/0.08 (AWG#22 or equivalent)-3P Ban-gi-shi-16824
	LE-CSE−R□B								
Motor cable	LE-CSM−S□A	2 to 10	AWG18	4	34/0.18	21.8 or less	1.71	62±0.3	HRZFEV-A(CL3) AWG18 4-cores
	LE-CSM−S□B	2 to 10							
	LE-CSM−R□A	2 to 10	(Note 6) AWG19 (0.75mm^2)	4	150/0.08	29.1 or less	1.63	5.7±0.5	(Note 4) RMFES-A(CL3X) AWG19 4-cores
	LE-CSM−R□B	2 to 10							
Lock cable	LE-CSB−S□A	2 to 10	AWG20	2	21/0.18	34.6 or less	1.35	4.7±0.1	(Note 4) HRZFEV-A(CL3) AWG20 2-cores
	LE-CSB−S□B	2 to 10							
	LE-CSB−R□A	2 to 10	(Note 6) AWG20 (0.75mm^2)	2	110/0.08	39.0 or less	1.37	4.5±0.3	RMFES-A(CL3X) AWG20 2-cores
	LE-CSB−R□B	2 to 10							

Note 1. d is as shown below.



2. Purchase from Toa Electric Industry
3. Standard OD. Max. OD is about 10% greater.
4. Purchase from Taisei
5. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.
6. These models consist with solid wires. Specify the color, separately.

12.6 No-fuse breakers, fuses, magnetic contactors

Always use one no-fuse breaker and one magnetic contactor with one driver. When using a fuse instead of the no-fuse breaker, use the one having the specifications given in this section.

<table>
<tr><th rowspan="3">Driver</th><th colspan="3">No-fuse breaker</th><th colspan="3">Fuse</th><th rowspan="3">(Note 2) Magnetic contactor</th></tr>
<tr><th colspan="2">Current</th><th rowspan="2">Voltage AC</th><th rowspan="2">(Note 1) Class</th><th rowspan="2">Current [A]</th><th rowspan="2">Voltage AC [V]</th></tr>
<tr><th>Not using power factor improving reactor</th><th>Using power factor improving reactor</th></tr>
<tr><td>LECSB□-S5</td><td>30A frame 5A</td><td>30A frame 5A</td><td rowspan="4">240V</td><td rowspan="4">T</td><td>10</td><td rowspan="4">300V</td><td rowspan="4">S-N10</td></tr>
<tr><td>LECSB2-S7</td><td>30A frame 5A</td><td>30A frame 5A</td><td>10</td></tr>
<tr><td>LECSB1-S7</td><td>30A frame 10A</td><td>30A frame 10A</td><td>15</td></tr>
<tr><td>LECSB2-S8</td><td>30A frame 10A</td><td>30A frame 5A</td><td>15</td></tr>
</table>

Note 1. When not using the driver as a UL/CSA Standard compliant product, K5 class fuse can be used.

2. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

12.7 Noise reduction techniques

Noises are classified into external noises which enter the driver to cause it to malfunction and those radiated by the driver to cause peripheral devices to malfunction. Since the driver is an electronic device which handles small signals, the following general noise reduction techniques are required.
Also, the driver can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices malfunction due to noises produced by the driver, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

(1) Noise reduction techniques

(a) General reduction techniques

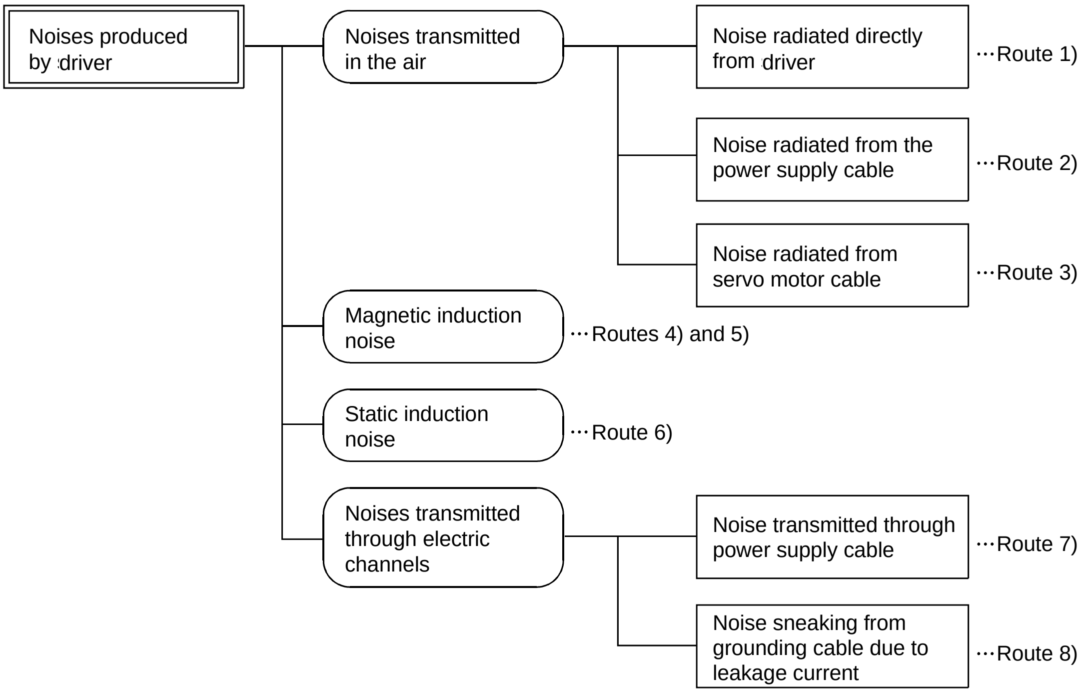
- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the driver, servo motor, etc. together at one point (refer to section 3.12).

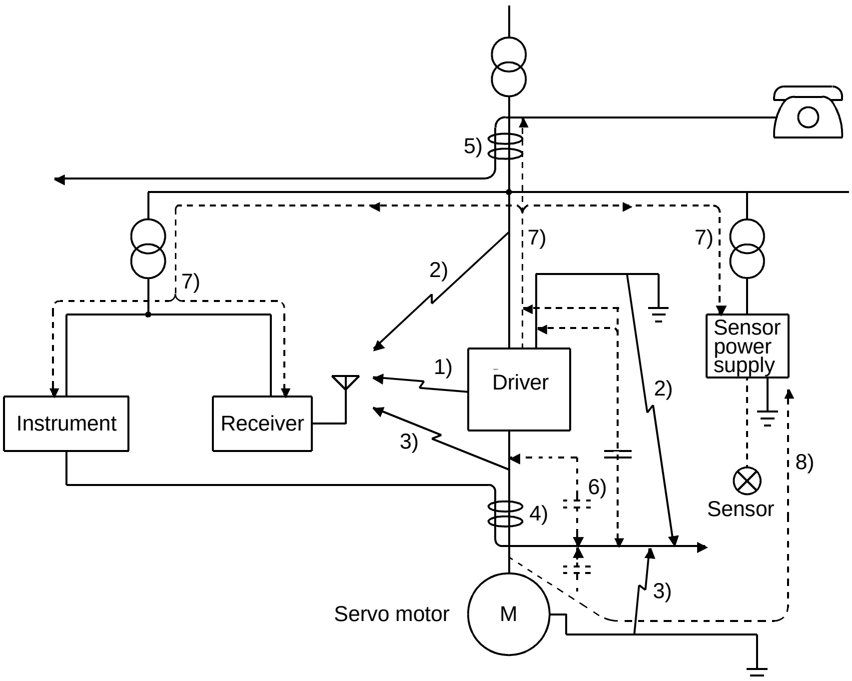
(b) Reduction techniques for external noises that cause the driver to malfunction

If there are noise sources (such as a magnetic contactor, a lock, and many relays which make a large amount of noise) near the driver and the driver may malfunction, the following countermeasures are required.

- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.
- Although a surge absorber is built into the driver, to protect the driver and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

(c) Techniques for noises radiated by the driver that cause peripheral devices to malfunction Noises produced by the driver are classified into those radiated from the cables connected to the driver and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.





Noise transmission route	Suppression techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the driver or run near the driver, such devices may malfunction due to noises transmitted through the air. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the driver. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the driver. 3. Avoid laying the power lines (Input cables of the driver) and signal cables side by side or bundling them together. 4. Insert a line noise filter to the I/O cables or a radio noise filter on the input line. 5. Use shielded wires for signal and power cables or put cables in separate metal conduits.
4) 5) 6)	When the power lines and the signal cables are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the driver. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the driver. 3. Avoid laying the power lines (I/O cables of the driver) and signal cables side by side or bundling them together. 4. Use shielded wires for signal and power cables or put the cables in separate metal conduits.
7)	When the power supply of peripheral devices is connected to the power supply of the driver system, noises produced by the driver may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. 1. Insert the radio noise filter (FR-BIF-(H) (Mitsubishi Electric Corporation)) on the power cables (Input cables) of the driver. 2. Insert the line noise filter (FR-BSF01・FR-BLF (Mitsubishi Electric Corporation)) on the power cables of the driver.
8)	When the cables of peripheral devices are connected to the driver to make a closed loop circuit, leakage current may flow to malfunction the peripheral devices. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

(2) Noise reduction products

(a) Data line filter (Recommended)

Noise can be prevented by installing a data line filter onto the encoder cable, etc.

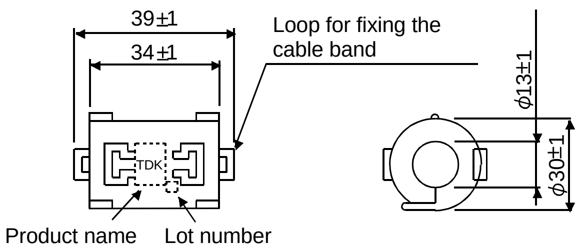
For example, the ZCAT3035-1330 of TDK and the ESD-SR-250 of NEC TOKIN make are available as data line filters.

As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below.

This impedances is reference values and not guaranteed values.

Impedance [Ω]	
10 to 100MHz	100 to 500MHz
80	150

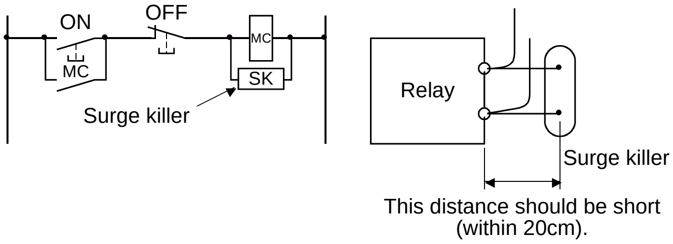
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge killer

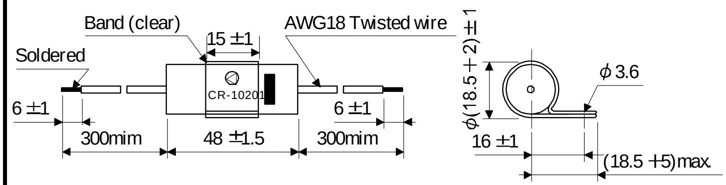
The recommended surge killer for installation to an AC relay, AC valve or the like near the driver is shown below. Use this product or equivalent.



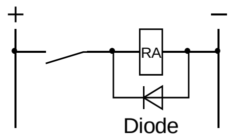
(Ex.) CR-50500
(OKAYA Electric Industries Co., Ltd.)

Rated voltage AC [V]	C [μF±20%]	R [Ω±30%]	Test voltage AC [V]
250	0.5	50 (1/2W)	Between terminals: 625VAC 50/60Hz 60s Between terminal and case: 2,000VAC 50/60Hz 60s

Outline drawing [Unit: mm]



Note that a diode should be installed to a DC relay, DC valve or the like.
Maximum voltage: Not less than 4 times the drive voltage of the relay or the like
Maximum current: Not less than twice the drive current of the relay or the like

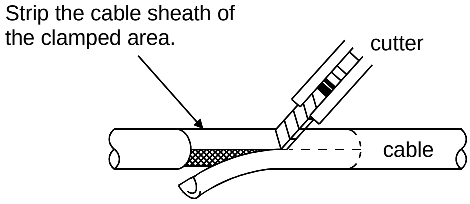


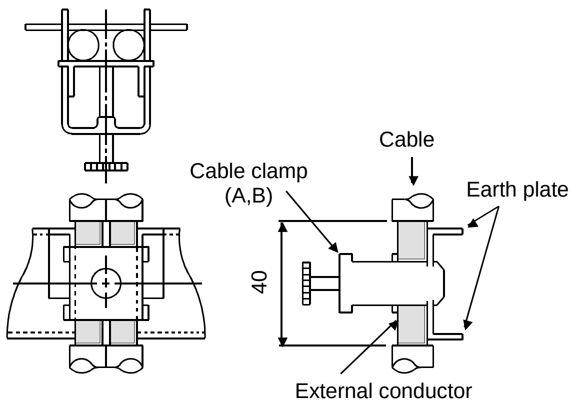
(c) Cable clamp fitting (AERSBAN -□ SET (Mitsubishi Electric Corporation))

Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below. Install the earth plate near the driver for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The clamp comes as a set with the earth plate.

[Unit: mm]



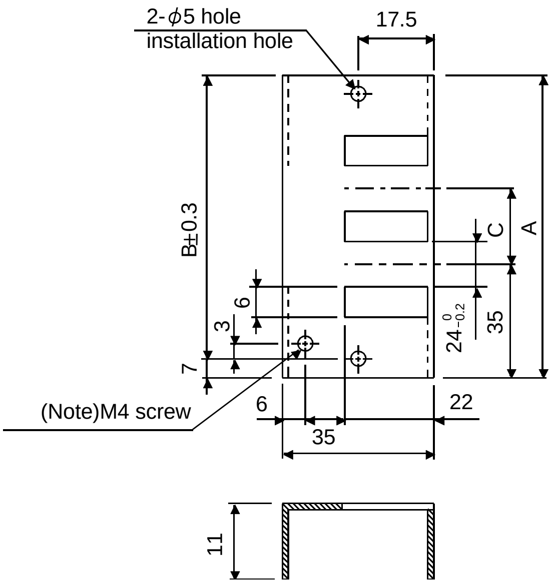


Clamp section diagram

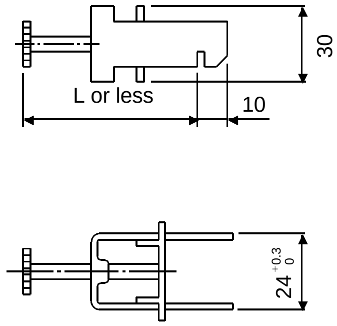
・Outline drawing

[Unit: mm]

Earth plate



Clamp section diagram



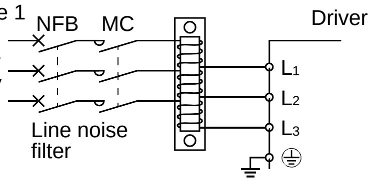
Note. Screw hole for grounding. Connect it to the earth plate of the control box.

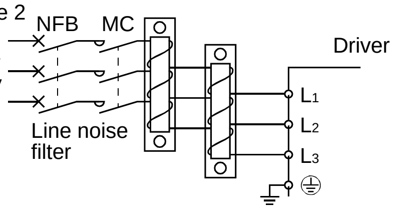
Type	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	clamp A: 2pcs.
AERSBAN-ESET	70	56		clamp B: 1pc.

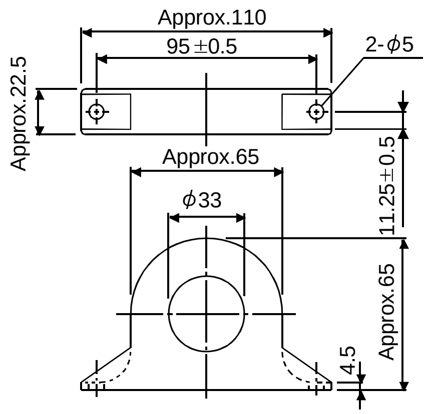
Clamp fitting	L
A	70
B	45

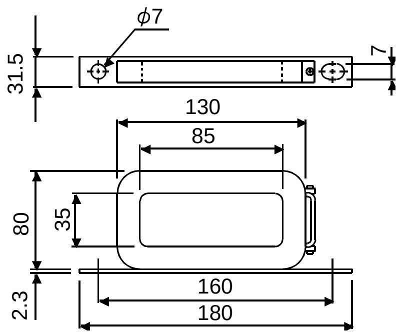
(d) Line noise filter (FR-BSF01, FR-BLF (Mitsubishi Electric Corporation))

This filter is effective in suppressing noises radiated from the power supply side and output side of the driver and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5M to 5MHz band.

<table>
<tr><th>Connection diagram</th><th>Outline drawing [Unit: mm]</th></tr>
<tr><td rowspan="2">
Use the line noise filters for wires of the main power supply (L_1・L_2・L_3) and of the servo motor power supply (U・V・W). Pass all wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the motor power supply, passes must be four times or less. Do not pass the grounding (earth) wire through the filter, or the effect of the filter will drop. Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2. Place the line noise filters as close to the driver as possible for their best performance.
Example 1


(Number of turns: 4)
Example 2


Two filters are used
(Total number of turns: 4)
</td>
<td>
FR-BSF01 (for wire size 3.5mm² (AWG12) or less)
(Mitsubishi Electric Corporation)


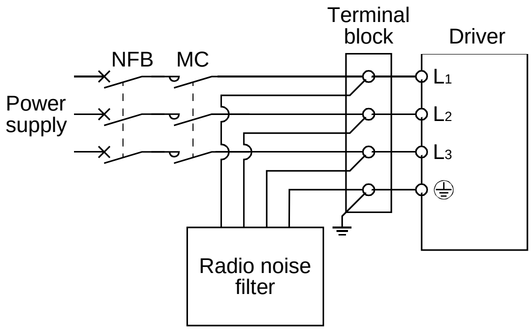
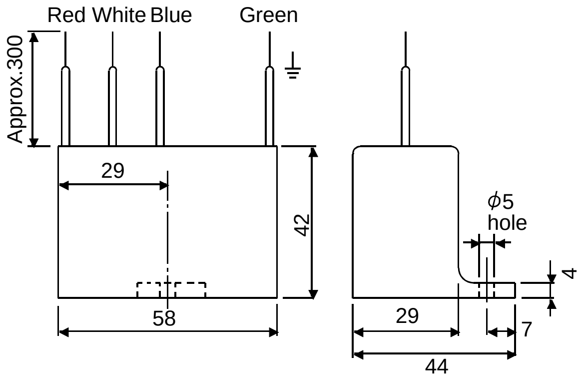
</td></tr>
<tr><td>
FR-BLF(for wire size 5.5mm² (AWG10) or more)
(Mitsubishi Electric Corporation)


</td></tr>
</table>

(e) Radio noise filter (FR-BIF-(H) (Mitsubishi Electric Corporation))

This filter is effective in suppressing noises radiated from the power supply side of the driver especially in 10MHz and lower radio frequency bands. The FR-BIF-(H) (Mitsubishi Electric Corporation) is designed for the input only.

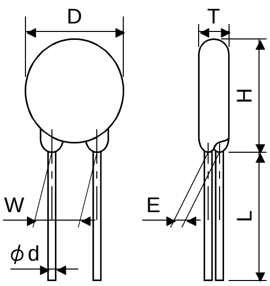
200V class: FR-BIF(Mitsubishi Electric Corporation)

<table>
<tr><th>Connection diagram</th><th>Outline drawing (Unit: mm)</th></tr>
<tr><td>Make the connection wires as short as possible.
Grounding is always required. When using the FR-BIF (Mitsubishi Electric Corporation) with a single-phase power supply, always insulate the wires that are not used for wiring.

</td><td>Leakage current: 4mA

</td></tr>
</table>

(f) Varistors for input power supply (Recommended)

Varistors are effective to prevent exogenous noise and lightning surge from entering the driver. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K, TND20V-471K and TND20V-102K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power				
		AC [V_{rms}]	DC [V]	8/20μs [A]	2ms [J]	[W]	[A]	[V]	[pF]	[V]
100V class	TND20V-431K	275	350	10000/1 time	195	1.0	100	710	1300	430(387 to 473)
200V class	TND20V-471K	300	385	7000/2 time	215			775	1200	470(423 to 517)
400V class	TND20V-102K	625	825	7500/1 time 6500/2 time	400			1650	500	1000(900 to 1100)



[Unit: mm]

Model	D Max.	H Max.	T Max.	E ±1.0	(Note)L min.	φd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			
TND20V-102K	22.5	25.5	9.5	6.4			

Note. For special purpose items for lead length (L), contact the manufacturer.

12.8 Leakage current breaker

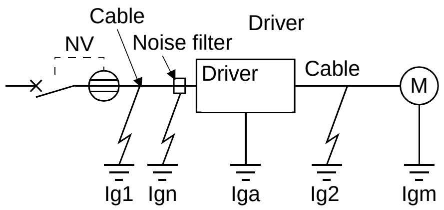
(1) Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor which is run with a commercial power supply.

Select a leakage current breaker according to the following formula, and ground the driver, servo motor, etc. securely.

Make the input and output cables as short as possible, and also make the grounding cable as long as possible (about 30cm) to minimize leakage currents.

Rated sensitivity current $\geq 10 \cdot \{Ig1 + Ign + Iga + K \cdot (Ig2 + Igm)\}$ [mA] ....(12.1)



K: Constant considering the harmonic contents

Leakage current breaker		K
Type	Products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-L	1
General models	BV-C1 NFB NV-L	3

Ig1 : Leakage current on the electric channel from the leakage current breaker to the input terminals of the driver (Found from Fig. 12.3.)

Ig2 : Leakage current on the electric channel from the output terminals of the driver to the servo motor (Found from Fig. 12.3.)

Ign : Leakage current when a filter is connected to the input side (4.4mA per one FR-BIF-(H) (Mitsubishi
Iga Electric Corporation))

Igm : Leakage current of the driver (Found from Table 12.5.)

: Leakage current of the servo motor (Found from Table 12.4.)

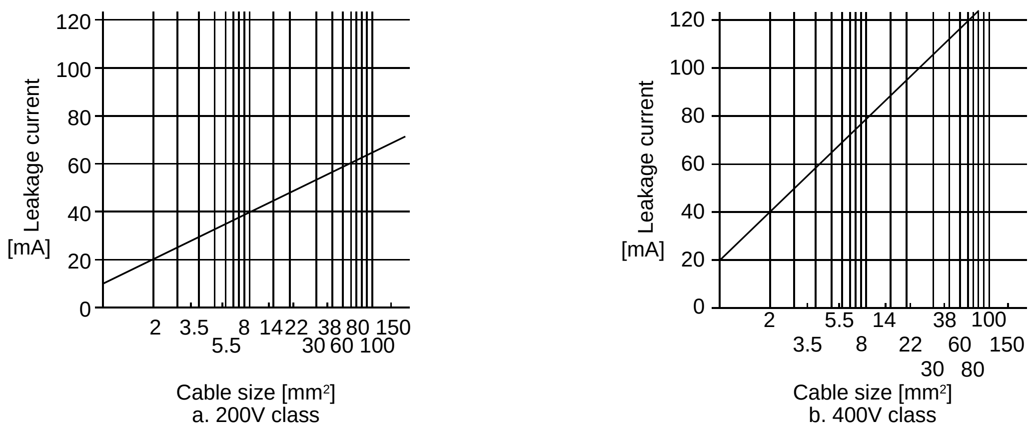


Fig. 12.3 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

Table 12.4 Servo motor's leakage current example (Igm)

Servo motor power [kW]	Leakage current [mA]
0.05 to 1	0.1
2	0.2
3.5	0.3
5	0.5
7	0.7
11	1.0
15	1.3
22	2.3

Table 12.5 Driver's leakage current example (Iga)

Driver capacity [kW]	Leakage current [mA]
0.1 to 0.6	0.1
0.75 to 3.5 (Note)	0.15
5・7	2
11・15	5.5
22	7

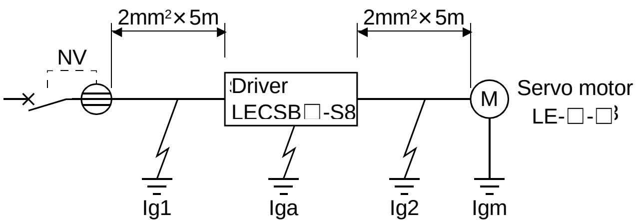
Note. For the 3.5kW of 400V class, leakage current is 2mA, which is the same as for 5kW and 7kW.

Table 12.6 Leakage circuit breaker selection example

Driver	Rated sensitivity current of leakage circuit breaker [mA]
LECSB2-□ LECSB1-□	15

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions.



Use a leakage current breaker generally available.
Find the terms of Equation (12.1) from the diagram.

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (12.1).

$$Ig \geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\}$$

$$\geq 4.0 \text{ [mA]}$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 4.0[mA] or more. A leakage current breaker having Ig of 15[mA] is used with the NV-SP/SW/CP/CW/HW series.

12.9 EMC filter (recommended)

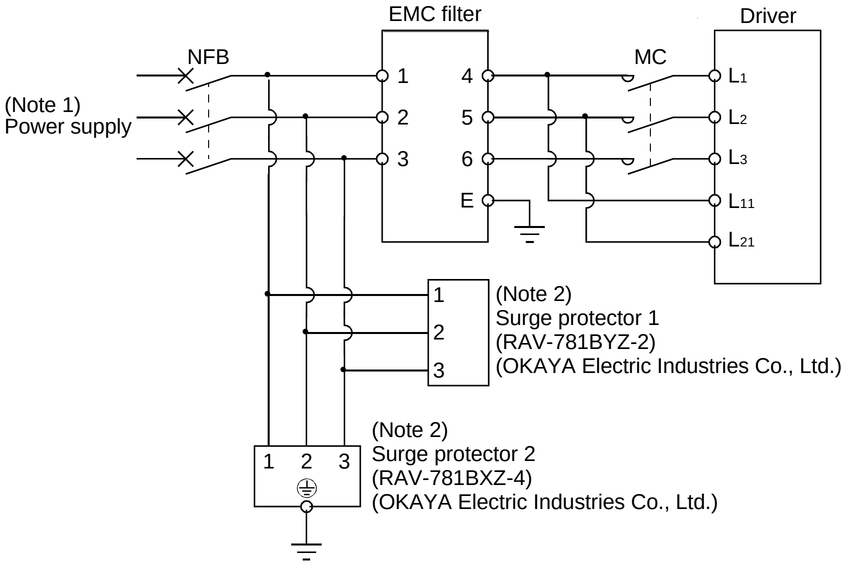
For compliance with the EMC directive of the IEC/EN Standard, it is recommended to use the following filter. Some EMC filters are large in leakage current.

(1) Combination with the driver

Driver	Recommended filter (Soshin Electric)		Mass [kg]([lb])
	Model	Leakage current [mA]	
LECSB2-□ LECSB1-□	(Note) HF3010A-UN	5	3 (6.61)

Note. A surge protector is separately required to use any of these EMC filters.

(2) Connection example



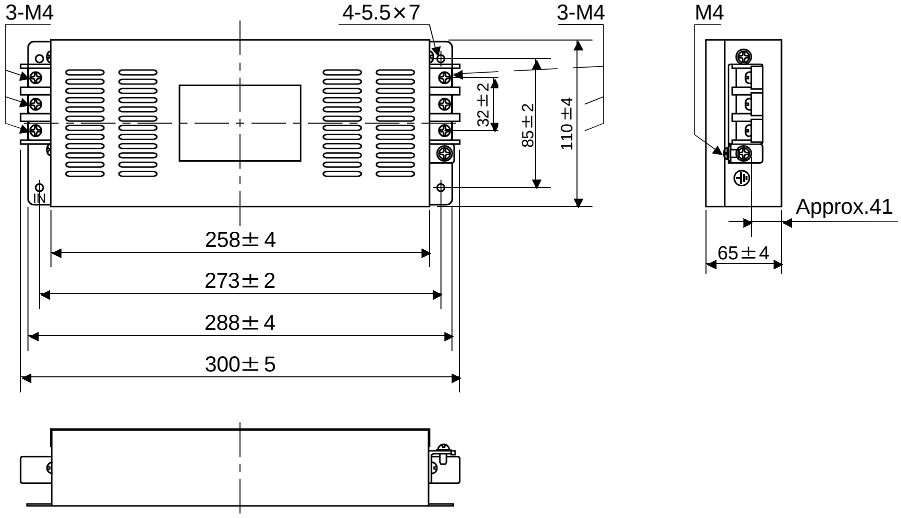
Note 1. For 1-phase 200 to 230VAC power supply, connect the power supply to L_1, L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. Refer to section 1.3 for the power supply specification.
2. The example is when a surge protector is connected.

(3) Outline drawing

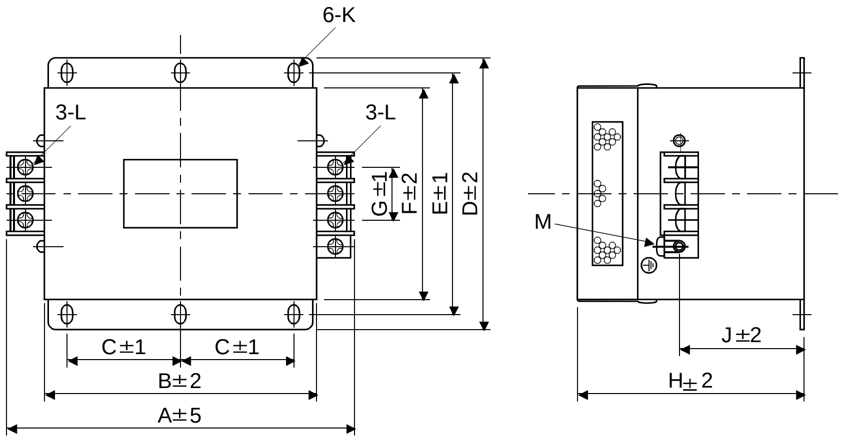
(a) EMC filter

HF3010A-UN

[Unit: mm]

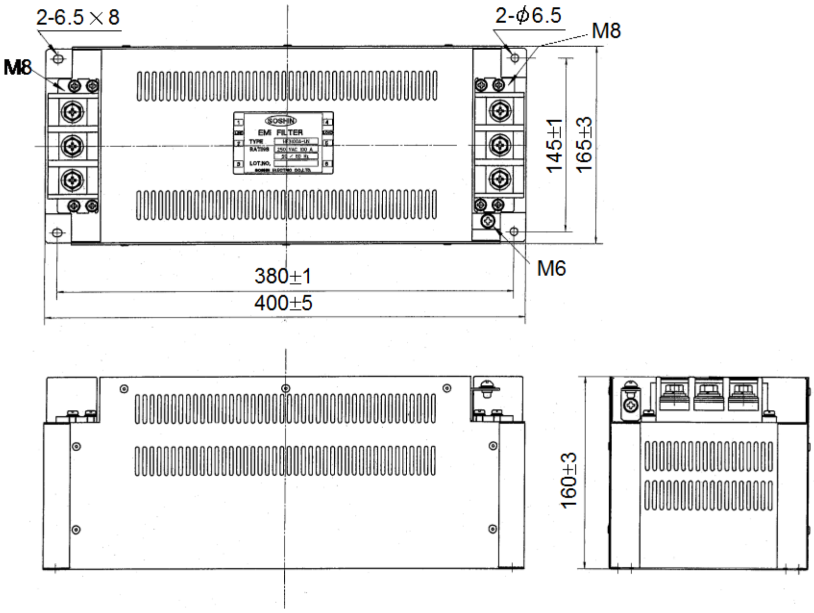


HF3030A-UN・HF-3040A-UN



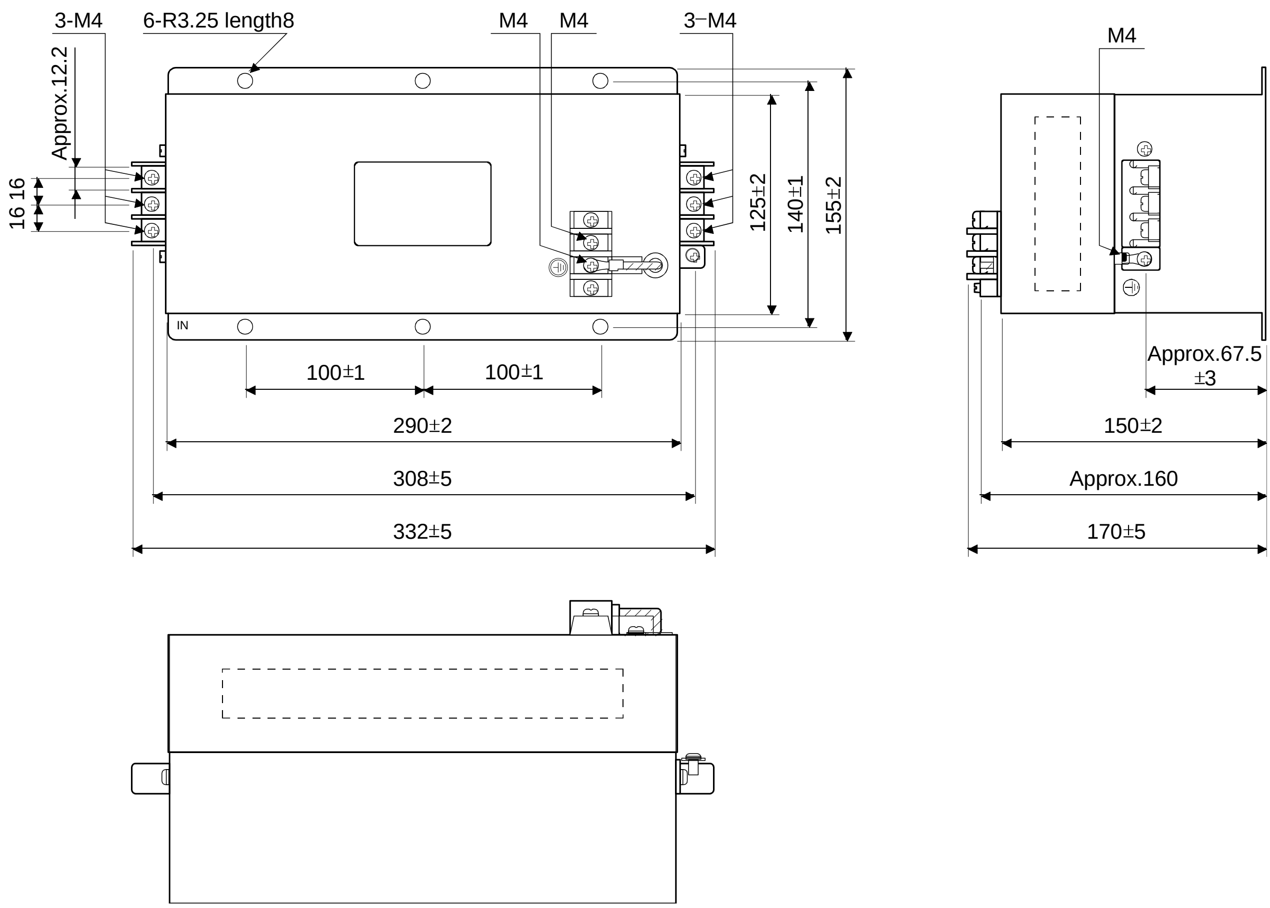
Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN	260	210	85	155	140	125	44	140	70	R3.25, length 8	M5	M4
HF3040A-UN	260	210	85	155	140	125	44	140	70		M5	M4

HF3100A-UN



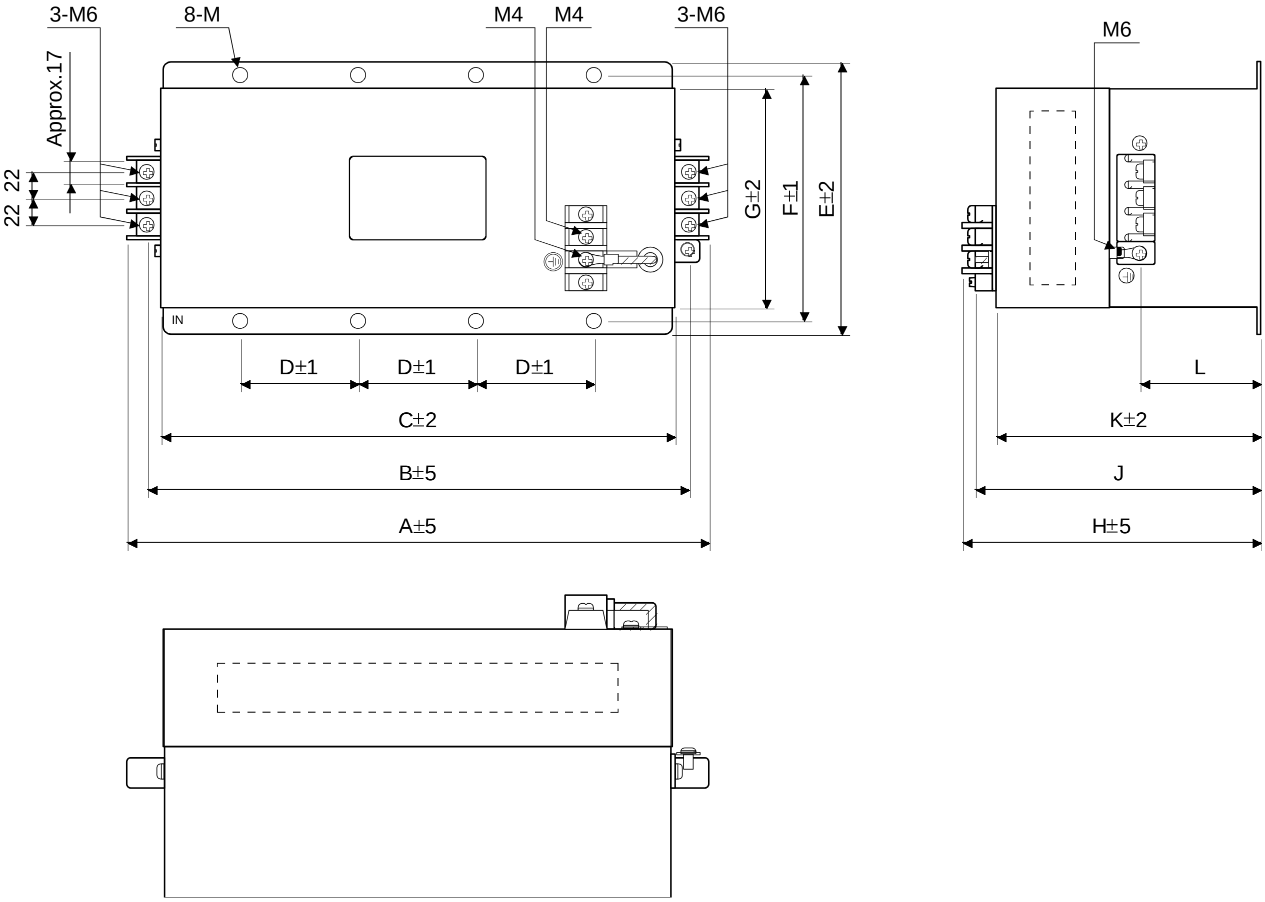
TF3005C-TX・TX3020C-TX・TF3030C-TX

[Unit: mm]



TF3040C-TX・TF3060C-TX

[Unit: mm]

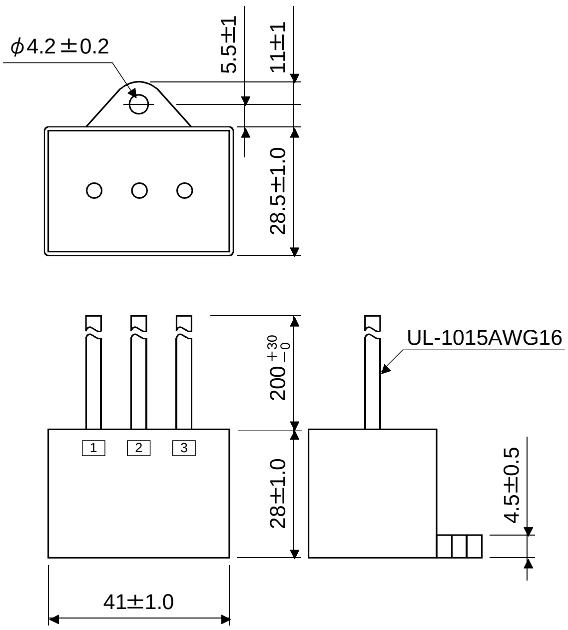


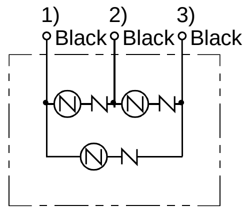
Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
TF3040C-TX TF3060C-TX	438	412	390	100	175	160	145	200	Approx.190	180	Approx.91.5	R3.25 length 8 (M6)

(b) Surge protector

RAV-781BYZ-2

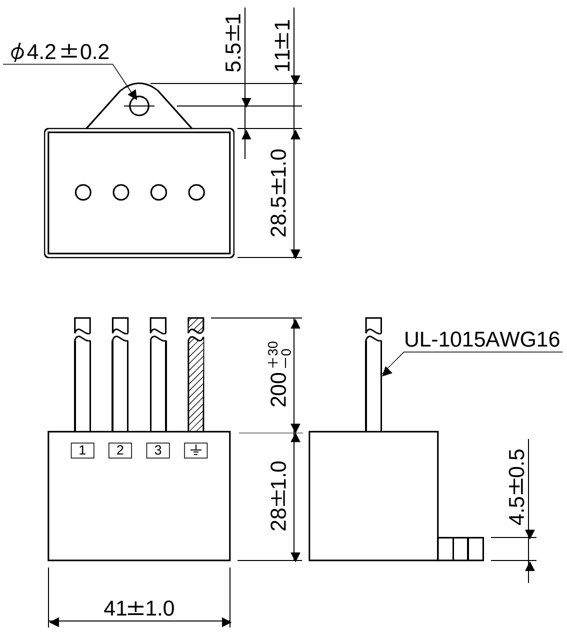
[Unit: mm]

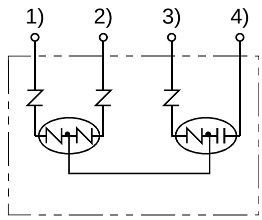




RAV-781BXZ-4

[Unit: mm]





13. COMMUNICATION FUNCTION

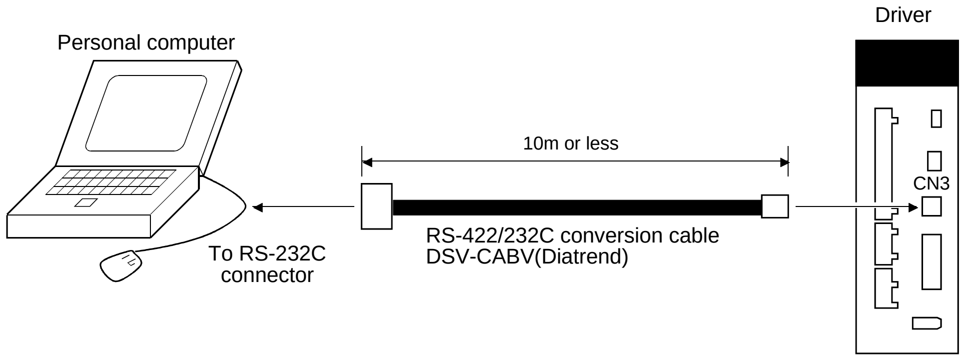
POINT
· The USB communication function (CN5 connector) and the RS-422 communication function (CN3 connector) are mutually exclusive functions. They cannot be used simultaneously.

Using the serial communication function of RS-422, this driver enables servo operation, parameter change, monitor function, etc.

13.1 Configuration

(1) Single axis

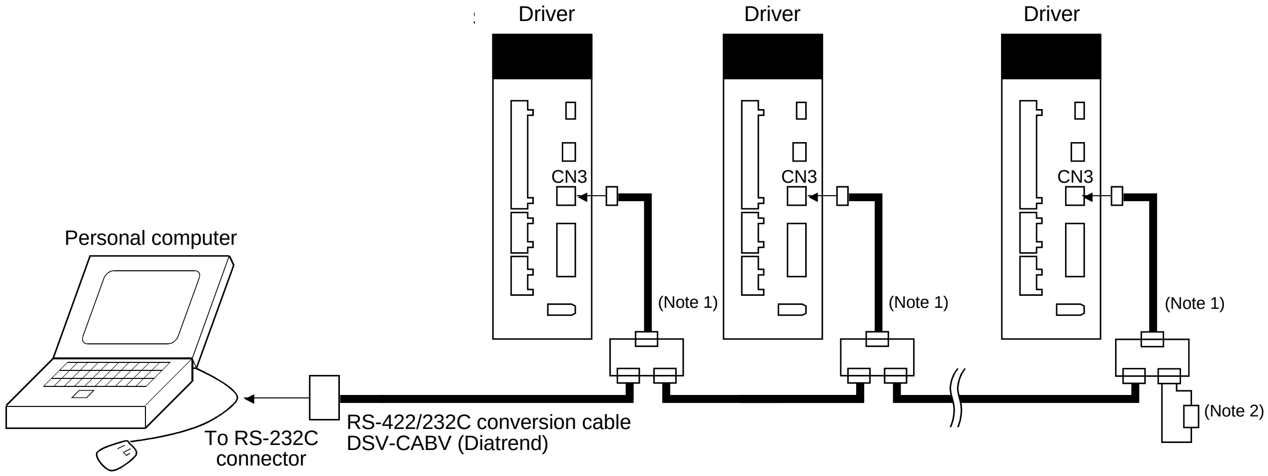
Operate the single-axis driver. It is recommended to use the following cable.



(2) Multidrop connection

(a) Diagrammatic sketch

Up to 32 axes of drivers from stations 0 to 31 can be operated on the same bus.

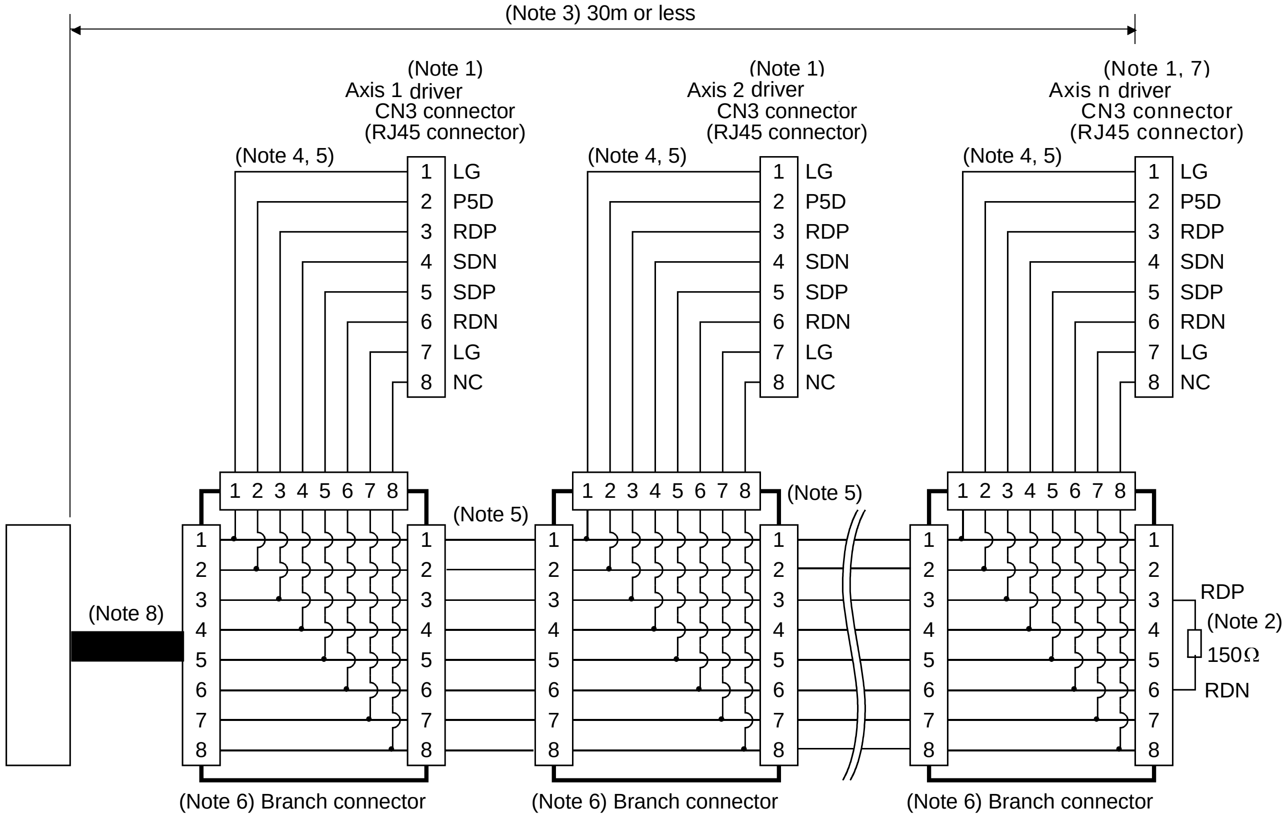


Note 1. The BMJ-8 (Hakko Electric Machine Works) is recommended as the branch connector.

2. The final axis must be terminated between RDP (pin No.3) and RDN (pin No.6) on the receiving side (driver) with a 150Ω resistor.

(b) Cable connection diagram

Wire the cables as shown below.



Note 1. Recommended connector (Hirose Electric)

Plug: TM10P-88P

Connection tool: CL250-0228-1

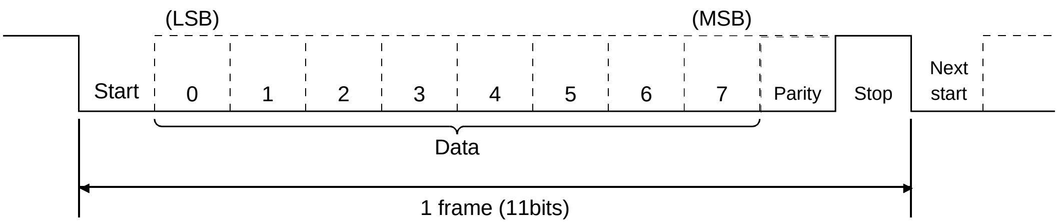
2. The final axis must be terminated between RDP (pin No.3) and RDN (pin No.6) on the receiving side (driver) with a 150Ω resistor.
3. The overall length is 30m or less in low-noise environment.
4. The wiring between the branch connector and driver should be as short as possible.
5. Use the EIA568-compliant cable (10BASE-T cable, etc.).
6. Recommended branch connector: BMJ-8 (Hakko Electric Machine Works)
7. n ≤ 32 (Up to 32 axes can be connected.)
8. RS-422/232C conversion cable DSV-CABV (Diatrend)

13.2 Communication specifications

13.2.1 Communication overview

This driver is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (driver) is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

Item	Description
Baud rate	9600/19200/38400/57600/115200 asynchronous system
Transfer code	Start bit : 1 bit Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system

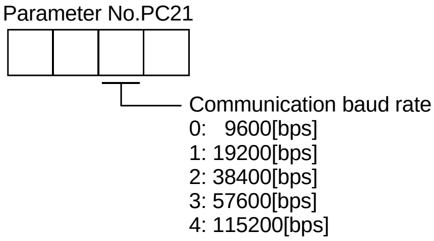


13.2.2 Parameter setting

When the USB/RS-422 communication function is used to operate the servo, set the communication specifications of the driver in the corresponding parameters.
After setting the values of these parameters, they are made valid by switching power off once, then on again.

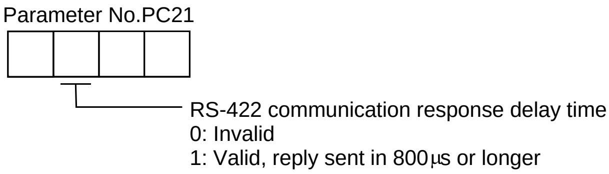
(1) Serial communication baud rate

Choose the communication speed. Match this value to the communication speed of the sending end (master station).



(2) RS-422 communication response delay time

Set the time from when the driver (slave station) receives communication data to when it sends back data. Set "0" to send back data in less than 800μs or "1" to send back data in 800μs or longer.



(3) Station number setting

Set the station number of the driver in parameter No.PC20. The setting range is station 0 to 31.

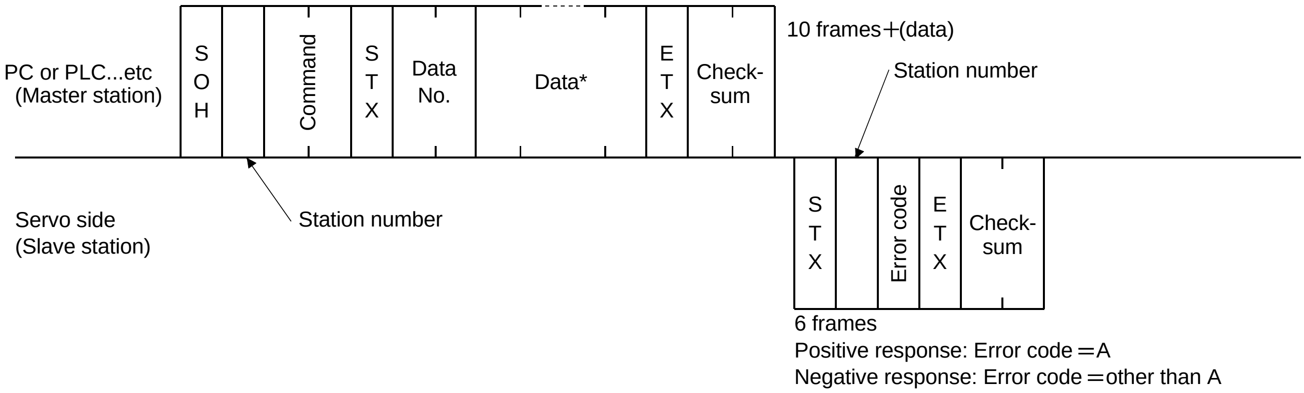
13.3 Protocol

13.3.1 Transmission data configuration

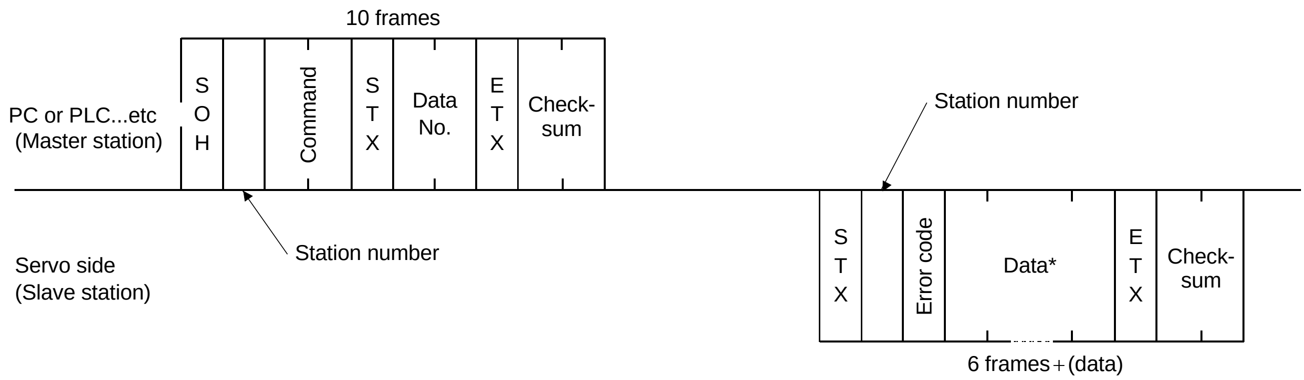
Since up to 32 axes may be connected to the bus, add a station number to the command, data No., etc. to determine the destination driver of data communication. Set the station number to each driver using the parameter. Transmission data is valid for the driver of the specified station number.

When "*" is set as the station number added to the transmission data, the transmission data is made valid for all drivers connected. However, when return data is required from the driver in response to the transmission data, set "0" to the station number of the driver which must provide the return data.

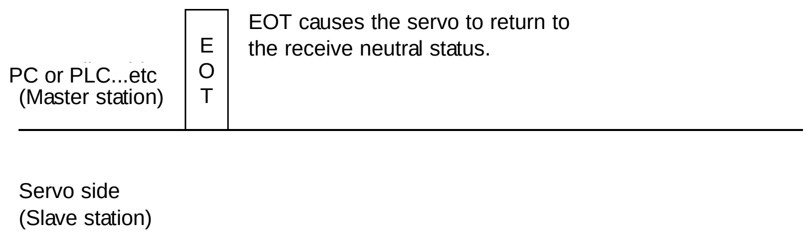
(1) Transmission of data from the PC or PLC...etc to the servo



(2) Transmission of data request from the PC or PLC...etc to the servo

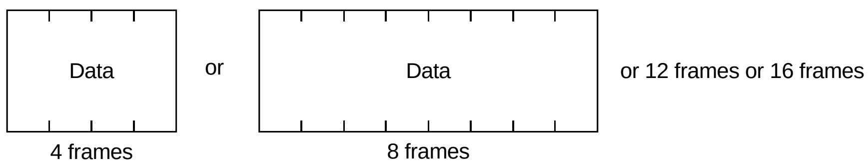


(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



13.3.2 Character codes

(1) Control codes

Code name	Hexadecimal (ASCII code)	Description	Personal computer terminal key operation (General)
SOH	01H	start of head	ctrl＋A
STX	02H	start of text	ctrl＋B
ETX	03H	end of text	ctrl＋C
EOT	04H	end of transmission	ctrl＋D

(2) Codes for data

ASCII unit codes are used.

b_8	0	0	0	0	0	0	0	0
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8 to b_5	b_4	b_3	b_2	b_1	R \ C	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	Space	0	@	P	`	p
	0	0	0	1	1	SOH	DC$_1$	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC$_2$	“	2	B	R	b	r
	0	0	1	1	3	ETX	DC$_3$	#	3	C	S	c	s
	0	1	0	0	4			$	4	D	T	d	t
	0	1	0	1	5			%	5	E	U	e	u
	0	1	1	0	6			&	6	F	V	f	v
	0	1	1	1	7			‘	7	G	W	g	w
	1	0	0	0	8			(	8	H	X	h	x
	1	0	0	1	9			)	9	I	Y	i	y
	1	0	1	0	10			＊	:	J	Z	j	z
	1	0	1	1	11			+	;	K	[	k	{
	1	1	0	0	12			,	<	L	¥	l	|
	1	1	0	1	13			−	=	M	]	m	}
	1	1	1	0	14			.	>	N	^	n	‾
	1	1	1	1	15			/	?	O	–	o	DEL

(3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the ASCII unit codes are used to specify the stations.

Station number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal for the station number of "0" (axis 1).

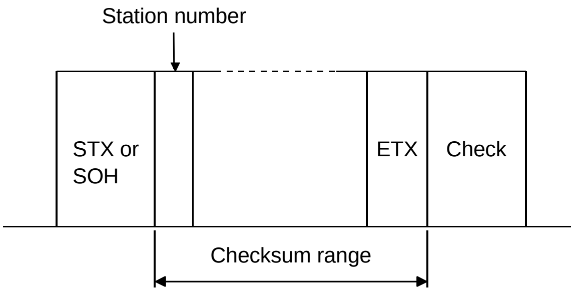
13.3.3 Error codes

Error codes are used in the following cases and an error code of single-code length is transmitted.
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station.
The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

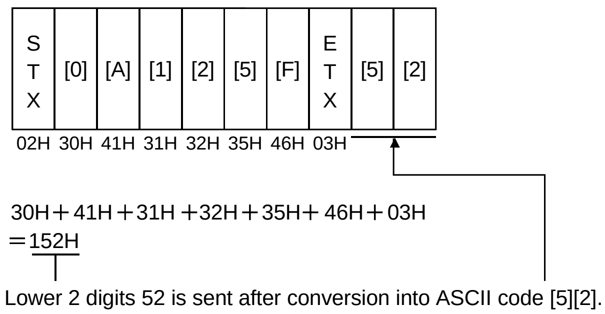
Error code		Error name	Description	Remarks
Servo normal	Servo alarm			
[A]	[a]	Normal	Data transmitted was processed properly.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	Character not existing in the specifications was transmitted.	
[E]	[e]	Command error	Command not existing in the specifications was transmitted.	
[F]	[f]	Data No. error	Data No. not existing in the specifications was transmitted.	

13.3.4 Checksum

The checksum is a ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).

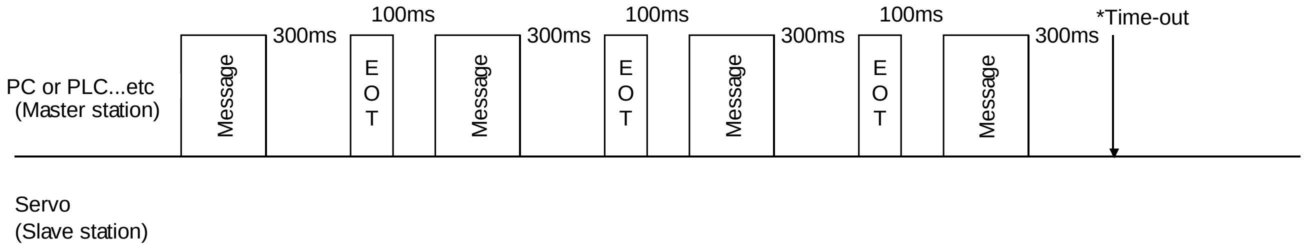


(Example)



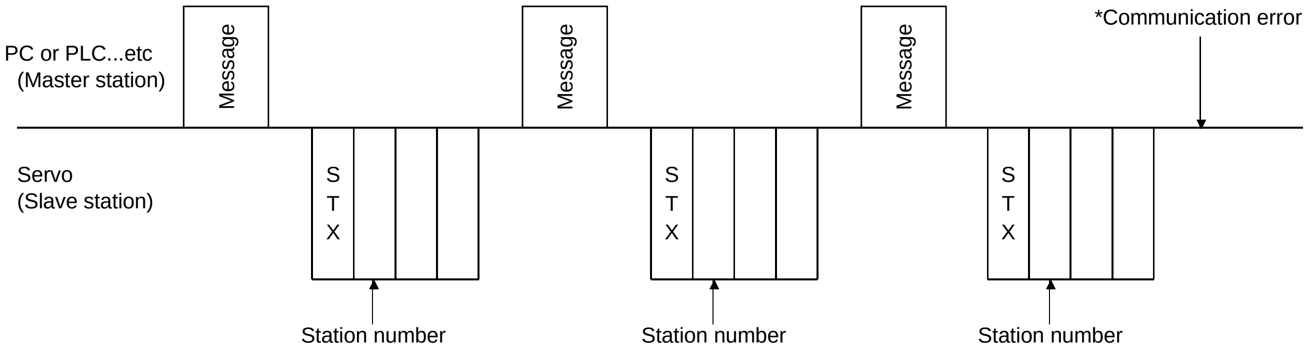
13.3.5 Time-out

The master station transmits EOT when the slave station does not start reply processing (STX is not received) 300[ms] after the master station has ended communication processing. 100[ms] after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above communication processing three times. (Communication error)



13.3.6 Retry

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (Retry processing). A communication error occurs if the above processing is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry processing is performed three times.

13.3.7 Initialization

After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after.

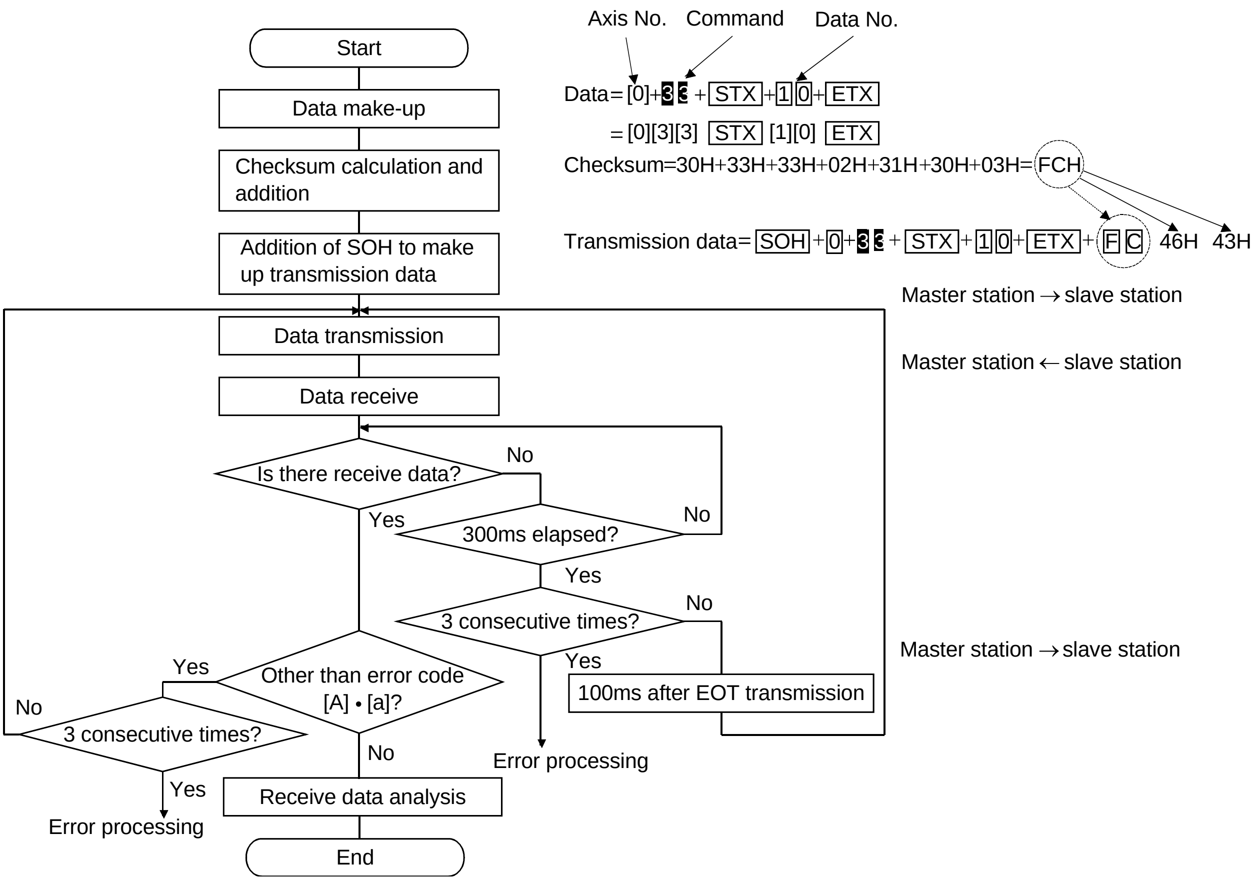
(1) 1s or longer time has elapsed after the slave station is switched on; and

(2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

13.3.8 Communication procedure example

The following example reads the set value of alarm history (last alarm) from the driver of station 0.

Data item	Value	Description
Station number	0	Driver station 0
Command	33	Read command
Data No.	10	Alarm history (last alarm)



13.4 Command and data No. list

POINT

- If the command and data No. are the same, the description may be different from that of the driver.

13.4.1 Read commands

(1) Status display (Command [0][1])

Command	Data No.	Description	Display item	Frame length
[0][1]	[0][0]	Status display name and unit	Cumulative feedback pulse	16
	[0][1]		Servo motor speed	
	[0][2]		Droop pulse	
	[0][3]		Cumulative command pulse	
	[0][4]		Command pulse frequency	
	[0][5]		Analog speed command voltage Analog speed limit voltage	
	[0][6]		Analog torque command voltage Analog torque limit voltage	
	[0][7]		Regenerative load ratio	
	[0][8]		Effective load ratio	
	[0][9]		Peak load ratio	
	[0][A]		Instantaneous torque	
	[0][B]		Within one-revolution position	
	[0][C]		ABS counter	
	[0][D]		Load inertia moment ratio	
	[0][E]		Bus voltage	
	[8][0]	Status display data value and processing information	Cumulative feedback pulse	12
	[8][1]		Servo motor speed	
	[8][2]		Droop pulse	
	[8][3]		Cumulative command pulse	
	[8][4]		Command pulse frequency	
	[8][5]		Analog speed command voltage Analog speed limit voltage	
	[8][6]		Analog torque command voltage Analog torque limit voltage	
	[8][7]		Regenerative load ratio	
	[8][8]		Effective load ratio	
	[8][9]		Peak load ratio	
	[8][A]		Instantaneous torque	
	[8][B]		Within one-revolution position	
	[8][C]		ABS counter	
	[8][D]		Load inertia moment ratio	
	[8][E]		Bus voltage	

(2) Parameters (Command [0][4] ･ [0][5] ･ [0][6] ･ [0][7] ･ [0][8] ･ [0][9])

Command	Data No.	Description	Frame length
[0][4]	[0][1]	Parameter group read 0000: Basic setting parameter (No.PA□□) 0001: Gain filter parameter (No.PB□□) 0002: Extension setting parameter (No.PC□□) 0003: I/O setting parameter (No.PD□□)	4
[0][5]	[0][1] to [F][F]	Current values of parameters Reads the current values of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before reading the current values, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0][6]	[0][1] to [F][F]	Upper limit values of parameter setting ranges Reads the permissible upper limit values of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before reading the upper limit values, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0][7]	[0][1] to [F][F]	Lower limit values of parameter setting ranges Reads the permissible lower limit values of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0][8]	[0][1] to [F][F]	Abbreviations of parameters Reads the abbreviations of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before reading the abbreviations, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	12
[0][9]	[0][1] to [F][F]	Write enable/disable of parameters Reads write enable/disable of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before reading write enable/disable, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. 0000: Write enabled 0001: Write disabled	4

(3) External I/O signals (Command [1][2])

Command	Data No.	Description	Frame length
[1][2]	[0][0]	Input device status	8
	[4][0]	External input pin status	
	[6][0]	Status of input device turned ON by communication	
	[8][0]	Output device status	
	[C][0]	External output pin status	

(4) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm occurrence sequence	Frame length
[3][3]	[1][0]	Alarm number in alarm history	most recent alarm	4
	[1][1]		first alarm in past	
	[1][2]		second alarm in past	
	[1][3]		third alarm in past	
	[1][4]		fourth alarm in past	
	[1][5]		fifth alarm in past	
	[2][0]	Alarm occurrence time in alarm history	most recent alarm	8
	[2][1]		first alarm in past	
	[2][2]		second alarm in past	
	[2][3]		third alarm in past	
	[2][4]		fourth alarm in past	
	[2][5]		fifth alarm in past	

(5) Current alarm (Command [0][2])

Command	Data No.	Description	Frame length
[0][2]	[0][0]	Current alarm number	4

Command	Data No.	Description	Display item	Frame length
[3][5]	[0][0]	Status display name and unit at alarm occurrence	Cumulative feedback pulse	16
	[0][1]		Servo motor speed	
	[0][2]		Droop pulse	
	[0][3]		Cumulative command pulse	
	[0][4]		Command pulse frequency	
	[0][5]		Analog speed command voltage Analog speed limit voltage	
	[0][6]		Analog torque command voltage Analog torque limit voltage	
	[0][7]		Regenerative load ratio	
	[0][8]		Effective load ratio	
	[0][9]		Peak load ratio	
	[0][A]		Instantaneous torque	
	[0][B]		Within one-revolution position	
	[0][C]		ABS counter	
	[0][D]		Load inertia moment ratio	
	[0][E]		Bus voltage	
	[8][0]	Status display data value and processing information at alarm occurrence	Cumulative feedback pulse	12
	[8][1]		Servo motor speed	
	[8][2]		Droop pulse	
	[8][3]		Cumulative command pulse	
	[8][4]		Command pulse frequency	
	[8][5]		Analog speed command voltage Analog speed limit voltage	
	[8][6]		Analog torque command voltage Analog torque limit voltage	
	[8][7]		Regenerative load ratio	
	[8][8]		Effective load ratio	
	[8][9]		Peak load ratio	
	[8][A]		Instantaneous torque	
	[8][B]		Within one-revolution position	
	[8][C]		ABS counter	
	[8][D]		Load inertia moment ratio	
	[8][E]		Bus voltage	

(6) Test operation mode (Command [0][0])

Command	Data No.	Description	Frame length
[0][0]	[1][2]	Test operation mode read 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0003: Motorless operation 0004: Output signal (DO) forced output	4

(7) Others

Command	Data No.	Description	Frame length
[0][2]	[9][0]	Servo motor end pulse unit absolute position	8
	[9][1]	Command unit absolute position	8
	[7][0]	Software version	16

13.4.2 Write commands

(1) Status display (Command [8][1])

Command	Data No.	Description	Setting range	Frame length
[8][1]	[0][0]	Status display data erasure	1EA5	4

(2) Parameters (Command [8][4] ・ [8][5])

Command	Data No.	Description	Setting range	Frame length
[8][4]	[0][1] to [F][F]	Write of parameters Writes the values of the parameters in the parameter group specified with the command [8][5]＋data No.[0][0]. Before writing the values, therefore, always specify the parameter group with the command [8][5]＋data No.[0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	Depending on the parameter	8
[8][5]	[0][0]	Parameter group write 0000: Basic setting parameter (No.PA□□) 0001: Gain filter parameter (No.PB□□) 0002: Extension setting parameter (No.PC□□) 0003: I/O setting parameter (No.PD□□)	0000 to 0003	4

(3) External I/O signal (Command [9][2])

Command	Data No.	Description	Setting range	Frame length
[9][2]	[6][0]	Communication input device signal	Refer to section 13.5.5	8

(4) Alarm history (Command [8][2])

Command	Data No.	Description	Setting range	Frame length
[8][2]	[2][0]	Alarm history erasure	1EA5	4

(5) Current alarm (Command [8][2])

Command	Data No.	Description	Setting range	Frame length
[8][2]	[0][0]	Alarm erasure	1EA5	4

(6) I/O device prohibition (Command [9][0])

Command	Data No.	Description	Setting range	Frame length
[9][0]	[0][0]	Turns OFF the input device, external analog input signal or pulse train input, except EMG, LSP and LSN, independently of the external ON/OFF status.	1EA5	4
	[0][3]	Disables all output devices (DO).	1EA5	4
	[1][0]	Cancels the prohibition of the input device, external analog input signal or pulse train input, except EMG, LSP and LSN.	1EA5	4
	[1][3]	Cancels the prohibition of the output device.	1EA5	4

(7) Operation mode selection (Command [8][B])

Command	Data No.	Description	Setting range	Frame length
[8][B]	[0][0]	Operation mode switching 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0003: Motorless operation 0004: Output signal (DO) forced output	0000 to 0004	4

(8) Test operation mode data (Command [9][2] ･ [A][0])

Command	Data No.	Description	Setting range	Frame length
[9][2]	[0][0]	Input signal for test operation	Refer to section 13.5.7.	8
	[A][0]	Forced output of signal pin	Refer to section 13.5.9.	8
[A][0]	[1][0]	Writes the speed in the test operation mode (JOG operation, positioning operation).	0000 to 7FFF	4
	[1][1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation, positioning operation).	00000000 to 7FFFFFFF	8
	[2][0]	Sets the moving distance in the test operation mode (JOG operation, positioning operation).	00000000 to 7FFFFFFF	8
	[2][1]	Selects the positioning direction of test operation (positioning operation). 0 □ 0 □ 0: Forward rotation direction 1: Reverse rotation direction 0: Command pulse unit 1: Encoder pulse unit	0000 to 0001	4
	[4][0]	Test operation (positioning operation) start command.	1EA5	4
	[4][1]	Used to make a temporary stop during test operation (positioning operation). □ in the data indicates a blank. STOP: Temporary stop GO□□: Restart for remaining distance CLR□: Remaining distance clear.	STOP GO□□ CLR□	4

13.5 Detailed explanations of commands

13.5.1 Data processing

When the master station transmits a command＋data No. or a command＋data No.＋data to a slave station, the driver returns a reply or data according to the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed according to the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing the read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

0	0	3	0	0	0	0	0	0	9	2	9

Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type)

Display type
0: Data must be converted into decimal.
1: Data is used unchanged in hexadecimal.

Decimal point position
0: No decimal point
1: First least significant digit (normally not used)
2: Second least significant digit
3: Third least significant digit
4: Forth least significant digit
5: Fifth least significant digit
6: Sixth least significant digit

Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(2) Writing the processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.

0							

Data is transferred in hexadecimal.

Decimal point position
0: No decimal point
1: First least significant digit
2: Second least significant digit
3: Third least significant digit
4: Forth least significant digit
5: Fifth least significant digit

By way of example, here is described how to process the set data when a value of "15.5" is sent.

Since the decimal point position is the second digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155→9B

Hence, "0200009B" is transmitted.

13.5.2 Status display

(1) Reading the status display name and unit

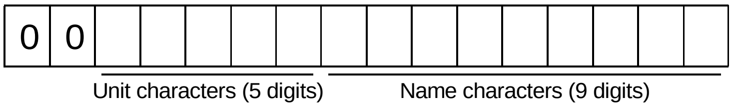
Read the status display name and unit.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read, [0][0] to [0][E]. (Refer to section 13.4.1.)

(b) Reply

The slave station sends back the status display name and unit requested.



(2) Status display data read

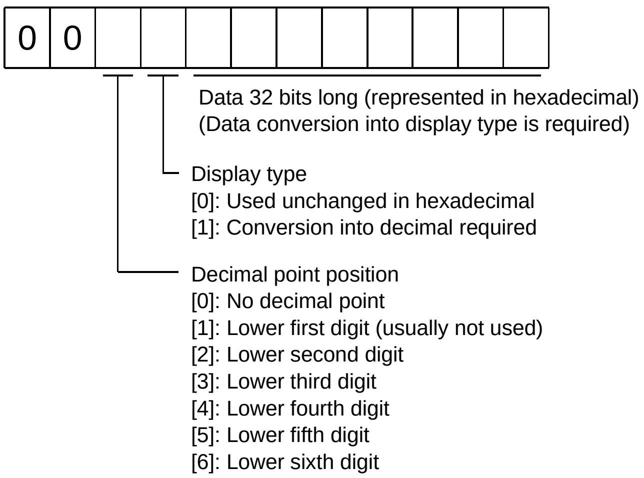
Read the status display data and processing information.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read.
Refer to section 13.4.1.

(b) Reply

The slave station sends back the status display data requested.



(3) Status display data clear

The cumulative feedback pulse data of the status display is cleared. Send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to zero.

Command	Data No.	Data
[8][1]	[0][0]	[1][E][A][5]

For example, after sending command [0][1] and data No.[8][0] and receiving the status display data, send command [8][1], data No.[0][0] and data [1EA5] to clear the cumulative feedback pulse value to zero.

13.5.3 Parameters

(1) Specify the parameter group

The group of the parameters to be operated must be specified in advance to read or write the parameter settings, etc. Write data to the driver as described below to specify the parameter group to be operated.

Command	Data No.	Transmission data	Parameter group
[8][5]	[0][0]	0000	Basic setting parameter (No.PA□□)
		0001	Gain filter parameter (No.PB□□)
		0002	Extension setting parameter (No.PC□□)
		0003	I/O setting parameter (No.PD□□)

(2) Reading the parameter group

Read the parameter group.

(a) Transmission

Send command [0][4] and data No.[0][1].

Command	Data No.
[0][4]	[0][1]

(b) Reply

The slave station sends back the preset parameter group.

0	0	0	

Parameter group
0: Basic setting parameter (No.PA□□)
1: Gain filter parameter (No.PB□□)
2: Extension setting parameter (No.PC□□)
3: I/O setting parameter (No.PD□□)

(3) Reading the symbol

Read the parameter name. Specify the parameter group in advance (refer to (1) in this section).

(a) Transmission

Transmit command [0][8] and the data No. corresponding to the parameter No., [0][1] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the name of the parameter No. requested.

0	0	0									

Name characters (9 digits)

(4) Reading the setting

Read the parameter setting. Specify the parameter group in advance (refer to (1) in this section).

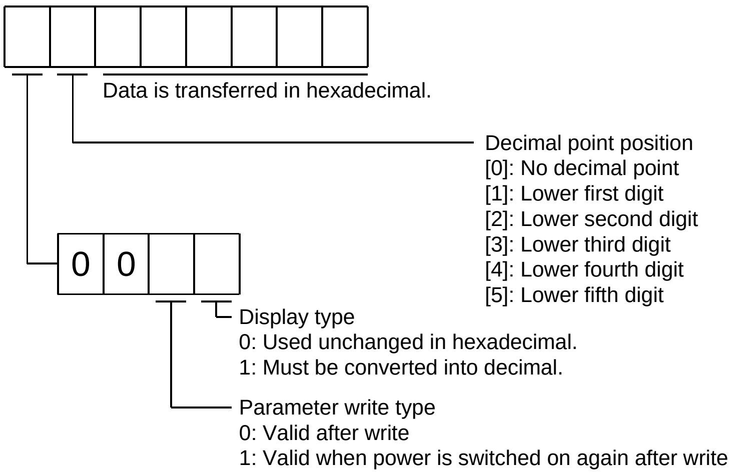
(a) Transmission

Transmit command [0][5] and the data No. corresponding to the parameter No., [0][1] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "1200270F" means 999.9 (decimal display format) and data "0003ABC" means 3ABC (hexadecimal display format).

When the display type is "0" (hexadecimal) and the decimal point position is other than 0, the display type is a special hexadecimal display format and "F" of the data value is handled as a blank. Data "01FFF053" means 053 (special hexadecimal display format).

"000000" is transferred when the parameter that was read is the one inaccessible for write/reference in the parameter write disable setting of parameter No.PA19.

(5) Reading the setting range

Read the parameter setting range. Specify the parameter group in advance (refer to (1) in this section).

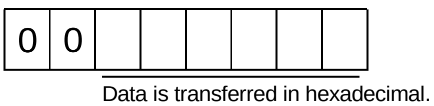
(a) Transmission

When reading the upper limit value, transmit command [0][6] and the data No. corresponding to the parameter No., [0][0] to [F][F]. When reading the lower limit value, transmit command [0][7] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "10FFFFEC" means -20.

(6) Parameter write

POINT
・If setting values need to be changed with a high frequency (i.e. one time or more per one hour), write the setting values to the RAM, not the EEP-ROM. The EEP-ROM has a limitation in the number of write times and exceeding this limitation causes the driver to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100, 000.

Write the parameter setting into EEP-ROM of the driver. Specify the parameter group in advance (refer to (1) in this section).
Write the value within the setting enabled range. For the setting enabled range, refer to chapter 5 or read the setting range by performing operation in (3) in this section.
Transmit command [8][4], the data No. , and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.
Write the data after making sure that it is within the upper/lower limit value range.
Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Set data
[8][4]	[0][0] to [F][F]	See below.

Data is transferred in hexadecimal.

Decimal point position
0: No decimal point
1: Lower first digit
2: Lower second digit
3: Lower third digit
4: Lower forth digit
5: Lower fifth digit

Write mode
0: Write to EEP-ROM
3: Write to RAM
When the parameter data is changed frequently through communication, set "3" to the write mode to change only the RAM data in the driver.
When changing data frequently (once or more within one hour), do not write it to the EEP-ROM.

13.5.4 External I/O signal statuses (DIO diagnosis)

(1) Reading of input device statuses

Read the statuses of the input devices.

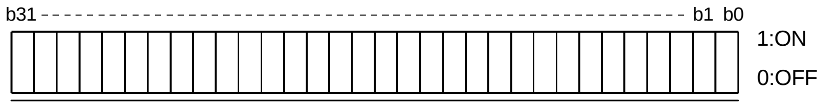
(a) Transmission

Transmit command [1][2] and data No.[0][0].

Command	Data No.
[1][2]	[0][0]

(b) Reply

The slave station sends back the statuses of the input pins.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(2) External input pin status read

Read the ON/OFF statuses of the external output pins.

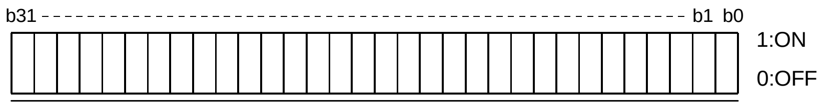
(a) Transmission

Transmit command [1][2] and data No.[4][0].

Command	Data No.
[1][2]	[4][0]

(b) Reply

The ON/OFF statuses of the input pins are sent back.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	CN1 connector pin
0	43
1	44
2	42
3	15
4	19
5	41
6	16
7	17

bit	CN1 connector pin
8	18
9	45
10	
11	
12	
13	
14	
15	

bit	CN1 connector pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	CN1 connector pin
24	
25	
26	
27	
28	
29	
30	
31	

(3) Read of the statuses of input devices switched on through communication

Read the ON/OFF statuses of the input devices switched on through communication.

(a) Transmission

Transmit command [1][2] and data No.[6][0].

Command	Data No.
[1][2]	[6][0]

(b) Reply

The slave station sends back the statuses of the input pins.

b31 -- b1 b0

1:ON

0:OFF

Command of each bit is transmitted to the master station as hexadecimal data.

bit	Abbreviation
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

bit	Abbreviation
8	SP1
9	SP2
10	SP3
11	ST1
12	ST2
13	CM1
14	CM2
15	LOP

bit	Abbreviation
16	
17	
18	
19	
20	STAB2
21	
22	
23	

bit	Abbreviation
24	
25	
26	
27	CDP
28	
29	
30	
31	

(4) External output pin status read

Read the ON/OFF statuses of the external output pins.

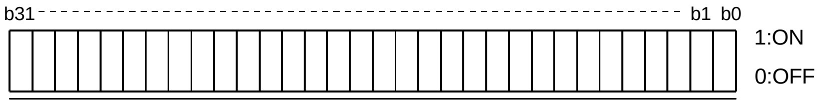
(a) Transmission

Transmit command [1][2] and data No.[C][0].

Command	Data No.
[1][2]	[C][0]

(b) Reply

The slave station sends back the ON/OFF statuses of the output pins.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	CN1 connector pin
0	49
1	24
2	23
3	25
4	22
5	48
6	33
7	

bit	CN1 connector pin
8	
9	
10	
11	
12	
13	
14	
15	

bit	CN1 connector pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	CN1 connector pin
24	
25	
26	
27	
28	
29	
30	
31	

(5) Read of the statuses of output devices

Read the ON/OFF statuses of the output devices.

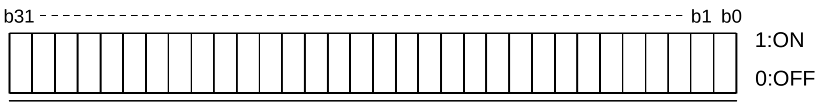
(a) Transmission

Transmit command [1][2] and data No.[8][0].

Command	Data No.
[1][2]	[8][0]

(b) Reply

The slave station sends back the statuses of the output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	Abbreviation
0	RD
1	SA
2	ZSP
3	TLC
4	VLC
5	INP
6	
7	WNG

bit	Abbreviation
8	ALM
9	OP
10	MBR
11	
12	ACD0
13	ACD1
14	ACD2
15	BWNG

bit	Abbreviation
16	
17	
18	
19	
20	
21	
22	
23	

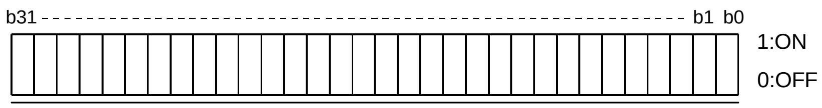
bit	Abbreviation
24	
25	CDPS
26	
27	ABSV
28	
29	
30	
31	

13.5.5 Input device ON/OFF

POINT
・The ON/OFF states of all devices in the driver are the states of the data received last. Hence, when there is a device which must be kept ON, send data which turns that device ON every time.

Each input device can be switched on/off. However, when the device to be switched off exists in the external input signal, also switch off that input signal.
Send command [9][2], data No.[6][0] and data.

Command	Data No.	Set data
[9][2]	[6][0]	See below.



Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

13.5.6 Disable/enable of I/O devices (DIO)

Inputs can be disabled independently of the I/O devices ON/OFF. When inputs are disabled, the input signals (devices) are recognized as follows. Among the input devices, EMG, LSP and LSN cannot be disabled.

Signal	Status
Input devices (DI)	OFF
External analog input signals	0V
Pulse train inputs	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.
Transmit the following communication commands.

(a) Disable

Command	Data No.	Data
[9][0]	[0][0]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Disabling/enabling the output devices (DO)

Transmit the following communication commands.

(a) Disable

Command	Data No.	Data
[9][0]	[0][3]	1EA5

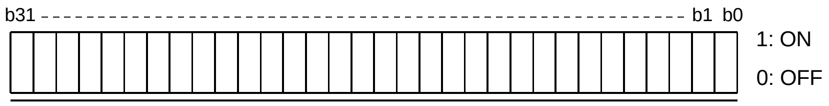
(b) Enable

Command	Data No.	Data
[9][0]	[1][3]	1EA5

13.5.7 Input devices ON/OFF (test operation)

Each input devices can be turned on/off for test operation. when the device to be switched off exists in the external input signal, also switch off that input signal.
Send command [9] [2], data No.[0] [0] and data.

Command	Data No.	Set data
[9][2]	[0][0]	See below



Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

13.5.8 Test operation mode

POINT
· The test operation mode is used to confirm operation. Do not use it for actual operation. · If communication stops for longer than 0.5s during test operation, the driver decelerates to a stop, resulting in servo lock. To prevent this, continue communication all the time, e.g. monitor the status display. · Even during operation, the driver can be put in the test operation mode. In this case, as soon as the test operation mode is selected, the base circuit is shut off, coasting the driver.

(1) Preparation and cancel of test operation mode

(a) Preparation of test operation mode

Set the test operation mode type in the following procedure.

1) Selection of test operation mode

Send the command [8][B]＋data No.[0][0] to select the test operation mode.

Command	Data No.	Transmission data	Test operation mode selection
[8][B]	[0][0]	0001	JOG operation
		0002	Positioning operation
		0003	Motorless operation
		0004	DO forced output (Note)

Note. Refer to section 13.5.9 for DO forced output.

2) Confirmation of test operation mode

Read the test operation mode set for the slave station, and confirm that it is set correctly.

a. Transmission

Send the command [0][0]＋data No.[1][2].

Command	Data No.
[0][0]	[1][2]

b. Return

The slave station returns the set test operation mode.

0	0	0	

Test operation mode read
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
3: Motorless operation
4: DO forced output

(b) Cancel of test operation mode

To terminate the test operation mode, send the command [8][B]＋data No.[0][0]＋data.

Command	Data No.	Transmission data	Test operation mode selection
[8][B]	[0][0]	0000	Test operation mode cancel

(2) JOG operation

Send the command, data No. and data as indicated below to execute JOG operation.

Start

Command: [8][B]
Data No. : [0][0]
Data : 0001(JOG operation)

Select the JOG operation in the test operation mode.

Servo motor speed setting

Command: [A][0]
Data No. : [1][0]
Data : Write the speed [r/min] in hexadecimal.

Acceleration/deceleration time constant setting

Command: [A][0]
Data No. : [1][1]
Data : Write the acceleration/ deceleration time constant [ms] in hexadecimal.

Set the operation pattern.

When LSP/LSN was turned OFF by external input signal

Start

Command : [9][2]
Data No. : [0][0]
Data : ・Forward rotation direction
00000807
(SON, LSP, LSN, ST1 turned ON)
・Reverse rotation direction
00001007
(SON, LSP, LSN, ST2 turned ON)

Stop

Command: [9][2]
Data No. : [0][0]
Data : 00000007
(SON, LSP, LSN turned ON)

When LSP/LSN was turned OFF by external input signal or automatically

Start

Command: [9][2]
Data No. : [0][0]
Data : ・Forward rotation direction
00000801
(SON, ST1 turned ON)
・Reverse rotation direction
00001001
(SON, ST2 turned ON)

Stop

Command: [9][2]
Data No. : [0][0]
Data : 00000001
(SON turned ON)

Start.

Stop.

END

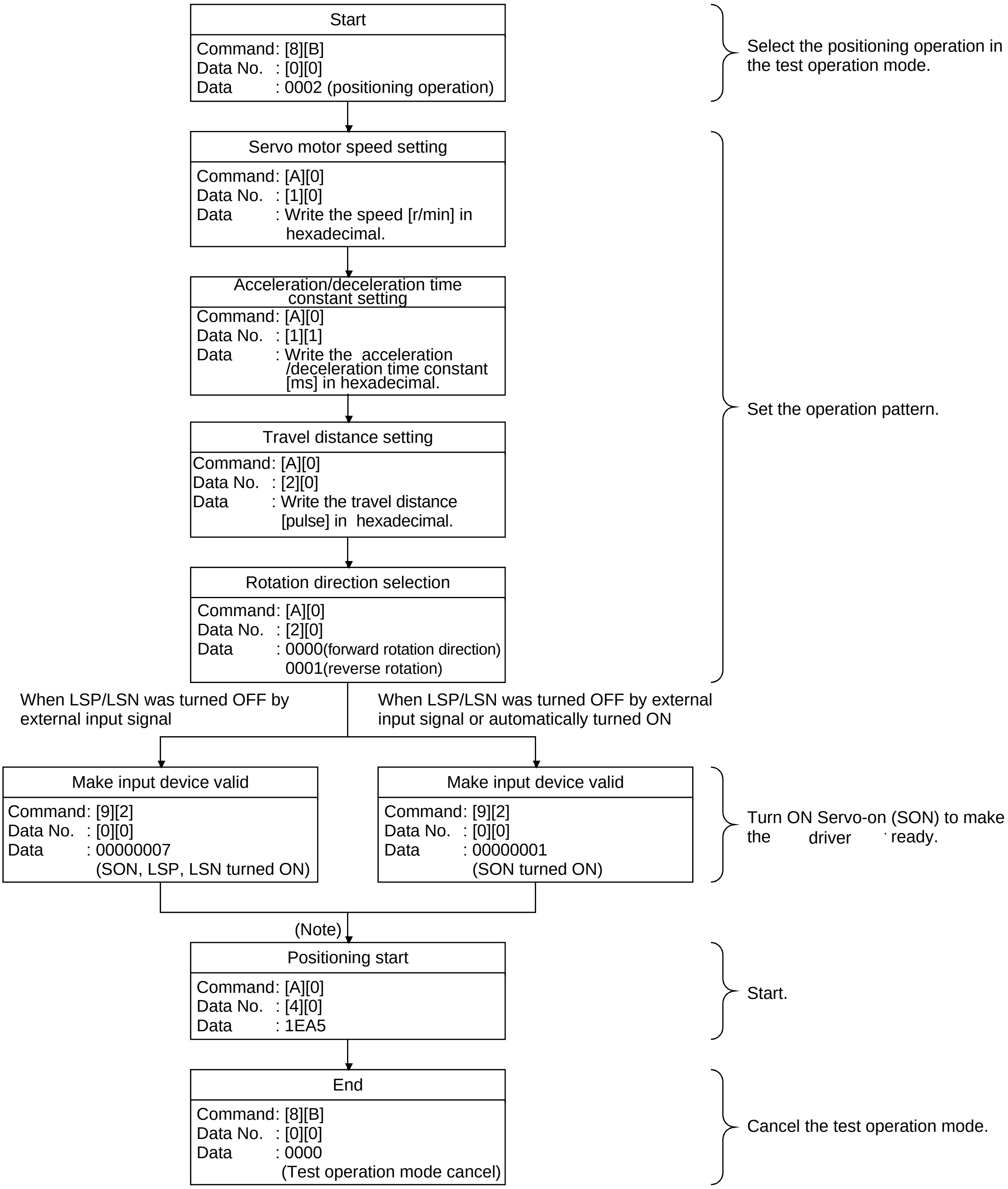
Command: [8][B]
Data No. : [0][0]
Data : 0000
(Test operation mode cancel)

Cancel the test operation mode.

(3) Positioning operation

(a) Operation procedure

Send the command, data No. and data as indicated below to execute positioning operation.



Note. There is a 100ms delay.

(b) Temporary stop/restart/remaining distance clear

Send the following command, data No. and data during positioning operation to make deceleration to a stop.

Command	Data No.	Data
[A][0]	[4][1]	STOP

Send the following command, data No. and data during a temporary stop to make a restart.

Command	Data No.	(Note) Data
[A][0]	[4][1]	GO☐☐

Note. ☐ indicates a blank.

Send the following command, data No. and data during a temporary stop to stop positioning operation and erase the remaining travel distance.

Command	Data No.	(Note) Data
[A][0]	[4][1]	CLR☐

Note. ☐ indicates a blank.

13.5.9 Output signal pin ON/OFF output signal (DO) forced output

In the test operation mode, the output signal pins can be turned on/off independently of the servo status. Using command [9][0], disable the output signals in advance.

(1) Choosing DO forced output in test operation mode

Transmit command [8][B]＋data No.[0][0]＋data "0004" to choose DO forced output.

0	0	0	4

Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal ON/OFF

Transmit the following communication commands.

Command	Data No.	Setting data
[9][2]	[A][0]	See below.

b31 - - - - - - - - - - b1 b0

1: ON
0: OFF

Command of each bit is sent to the slave station in hexadecimal.

bit	CN1 connector pin
0	49
1	24
2	23
3	25
4	22
5	48
6	33
7	

bit	CN1 connector pin
8	
9	
10	
11	
12	
13	
14	
15	

bit	CN1 connector pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	CN1 connector pin
24	
25	
26	
27	
28	
29	
30	
31	

(3) DO forced output

Transmit command [8][B]＋data No.[0][0]＋data to choose DO forced output.

Command	Data No.	Transmission data	Test operation mode selection
[8][B]	[0][0]	0000	Test operation mode cancel

13.5.10 Alarm history

(1) Alarm No. read

Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No.0 (last alarm) to No.5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No.[1][0] to [1][5]. Refer to section 13.4.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.

0	0		

Alarm No. is transferred in hexadecimal.

For example, "0032" means AL.32 and "00FF" means AL._ (no alarm).

(2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No.[2][0] to [2][5].

Refer to section 13.4.1.

(b) Reply

The alarm occurrence time is transferred in hexadecimal.
Hexadecimal must be converted into decimal.

For example, data "01F5" means that the alarm occurred in 501 hours after start of operation.

(3) Alarm history clear

Erase the alarm history.

Send command [8][2] and data No. [2][0].

Command	Data No.	Data
[8][2]	[2][0]	1EA5

13.5.11 Current alarm

(1) Current alarm read

Read the alarm No. which is occurring currently.

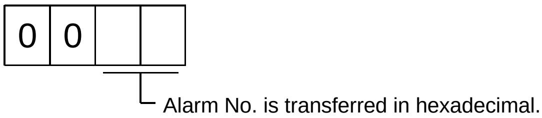
(a) Transmission

Send command [0][2] and data No.[0][0].

Command	Data No.
[0][2]	[0][0]

(b) Reply

The slave station sends back the alarm currently occurring.



For example, "0032" means AL.32 and "00FF" means AL._ (no alarm).

(2) Read of the status display at alarm occurrence

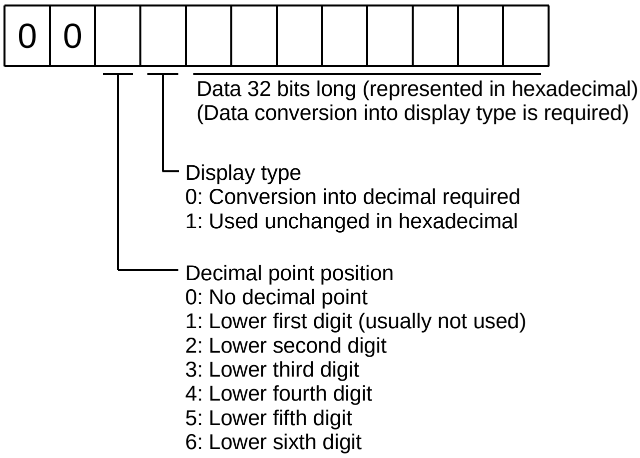
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

Send command [3][5] and any of data No.[8][0] to [8][E] corresponding to the status display item to be read. Refer to section 13.4.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.



(3) Current alarm clear

As by the reset (RES) on, reset the driver alarm to make the driver ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Command	Data No.	Data
[8][2]	[0][0]	1EA5

13.5.12 Other commands

(1) Servo motor side pulse unit absolute position

Read the absolute position in the servo motor side pulse unit.

Note that overflow will occur in the position of 8192 or more revolutions from the home position.

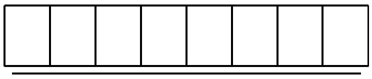
(a) Transmission

Send command [0][2] and data No.[9][0].

Command	Data No.
[0][2]	[9][0]

(b) Reply

The slave station sends back the requested servo motor side pulses.



For example, data "000186A0" is 100000 [pulse] in the motor side pulse unit.

(2) Command unit absolute position

Read the absolute position in the command unit.

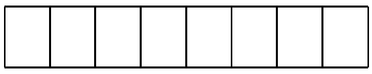
(a) Transmission

Send command [0][2] and data No.[9][1].

Command	Data No.
[0][2]	[9][1]

(b) Reply

The slave station sends back the requested command pulses.



For example, data "000186A0" is 100000 [pulse] in the command unit.

(3) Software version

Reads the software version of the driver.

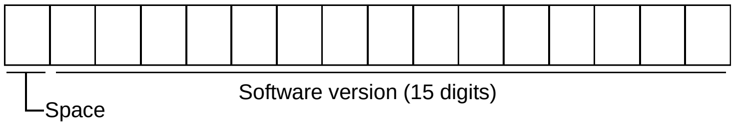
(a) Transmission

Send command [0][2] and data No.[7][0].

Command	Data No.
[0][2]	[7][0]

(b) Reply

The slave station returns the software version requested.



14. ABSOLUTE POSITION DETECTION SYSTEM

CAUTION	
⚠ CAUTION	・If an absolute position erase (AL.25) or absolute position counter warning (AL.E3) has occurred, always perform home position setting again. Not doing so can cause runaway. Not doing so may cause unexpected operation.

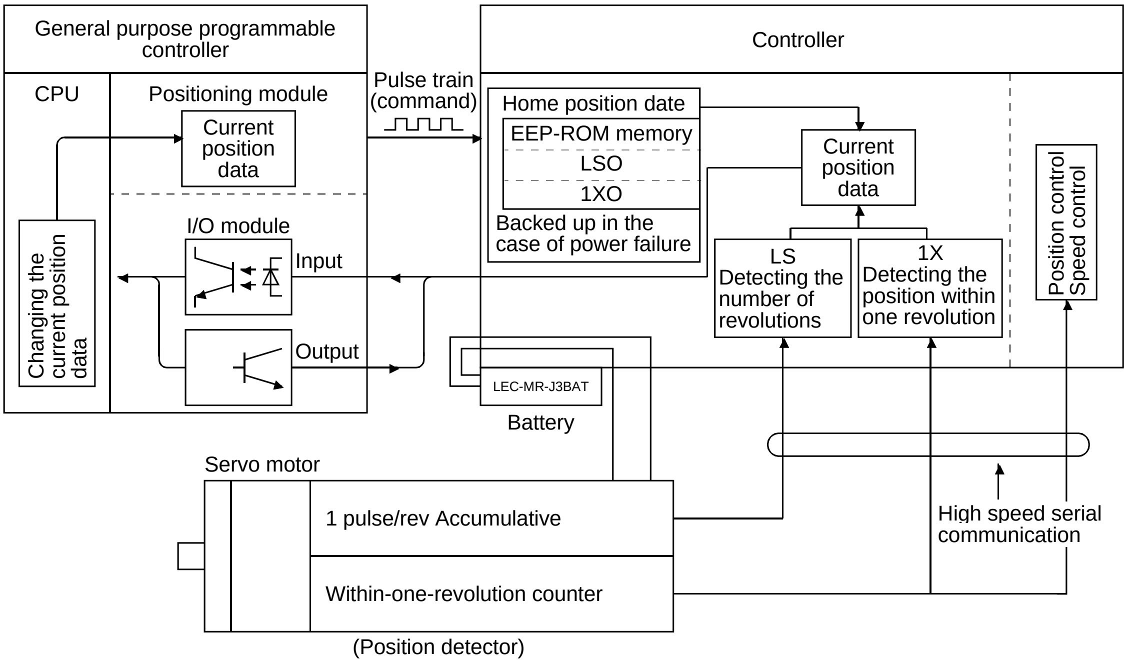
POINT

- If the encoder cable is disconnected, absolute position data will be lost in the following servo motor series. LE-□-□. After disconnecting the encoder cable, always execute home position setting and then positioning operation.
- When configuring an absolute position detection system using the QD75P/D PLC, refer to the Type QD75P/QD75D Positioning Module User's Manual (SH (NA) 080058).

14.1 Outline

14.1.1 Features

For normal operation, as shown below, the encoder consists of a detector designed to detect a position within one revolution and a cumulative revolution counter designed to detect the number of revolutions.
The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the general-purpose programming PC or PLC...etc power is on or off.
Therefore, once the home position is defined at the time of machine installation, home position return is not needed when power is switched on thereafter. If a power failure or a fault occurs, restoration is easy.



14.1.2 Restrictions

The absolute position detection system cannot be configured under the following conditions. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, choose incremental in parameter No.PA03.

(1) Speed control mode, torque control mode.

(2) Control switch-over mode (position/speed, speed/torque, torque/position).

(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning.

(4) Changing of electronic gear after home position setting.

(5) Use of alarm code output.

14.2 Specifications

(1) Specification list

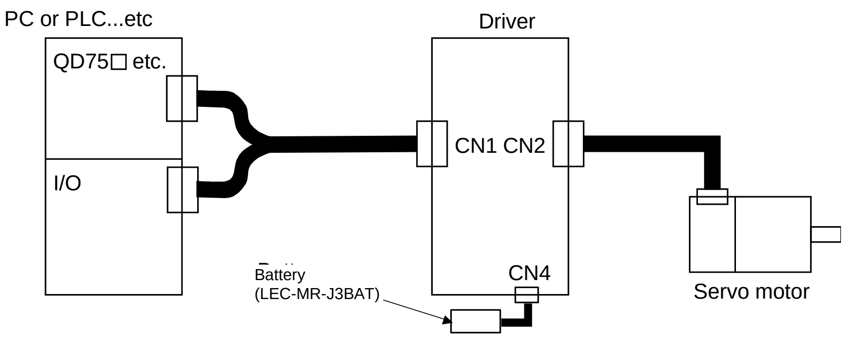
Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal＋3.6V) Type: LEC-MR-J3BAT
Maximum revolution range	Home position±32767 rev.
(Note 1) Maximum speed at power failure	3000r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
(Note 3) Battery life	5 years from date of manufacture

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.

2. Time to hold data by a battery with power off. Replace battery within three years since the operation start whether power is kept on/off. If the battery is used out of specification, the absolute position erase (AL.25) may occur.
3. Quality of battery degrades by the storage condition. It is recommended to connect and use battery in the driver within two years from the production date. The life of battery is five years from the production date regardless of the connection.

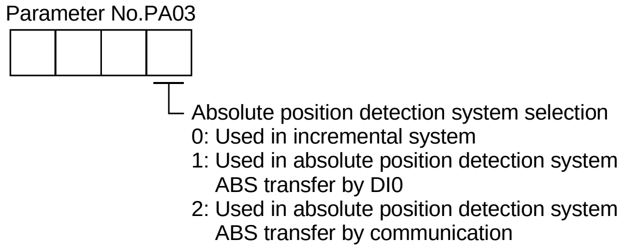
(2) Configuration

Positioning module	I/O module
QD75□	QX40・41・42 QY40・41・42・50
A1SD75□	AX40・41・42 AY40・41・42
FX_{2N}-1GP・FX_{2N}-10PG・FX_{2N}-10GM・FX_{2N}-20GM	$FX_{2N(c)}$ series・$FX_{3U(c)}$ series



(3) Parameter setting

Set "□□□1" in parameter No.PA03 to make the absolute position detection system valid. Set "□□□2" when using the communication-based ABS transfer system. Refer to section 14.11 for the communication-based ABS transfer system.



14.3 Battery replacement procedure

⚠ WARNING	・Before replacement a battery, turn off the main circuit power and wait for 15 minutes or longer (20 minutes for 30kW or higher) until the charge lamp turns off. Then, check the voltage between P(＋) and N(－) with a voltage tester or others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the driver whether the charge lamp is off or not.

POINT

・The internal circuits of the driver may be damaged by static electricity.
Always take the following precautions.
  ・Ground human body and work bench.
  ・Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

14.3.1 When replacing battery with the control circuit power ON

POINT

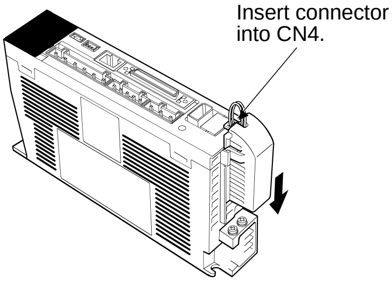
・Replacing battery with the control circuit power OFF will erase the absolute position data.

Replacing battery with the control circuit power ON will not erase the absolute position data. Refer to section 14.4 for installation procedure of battery to the driver.

14.4 Battery installation procedure

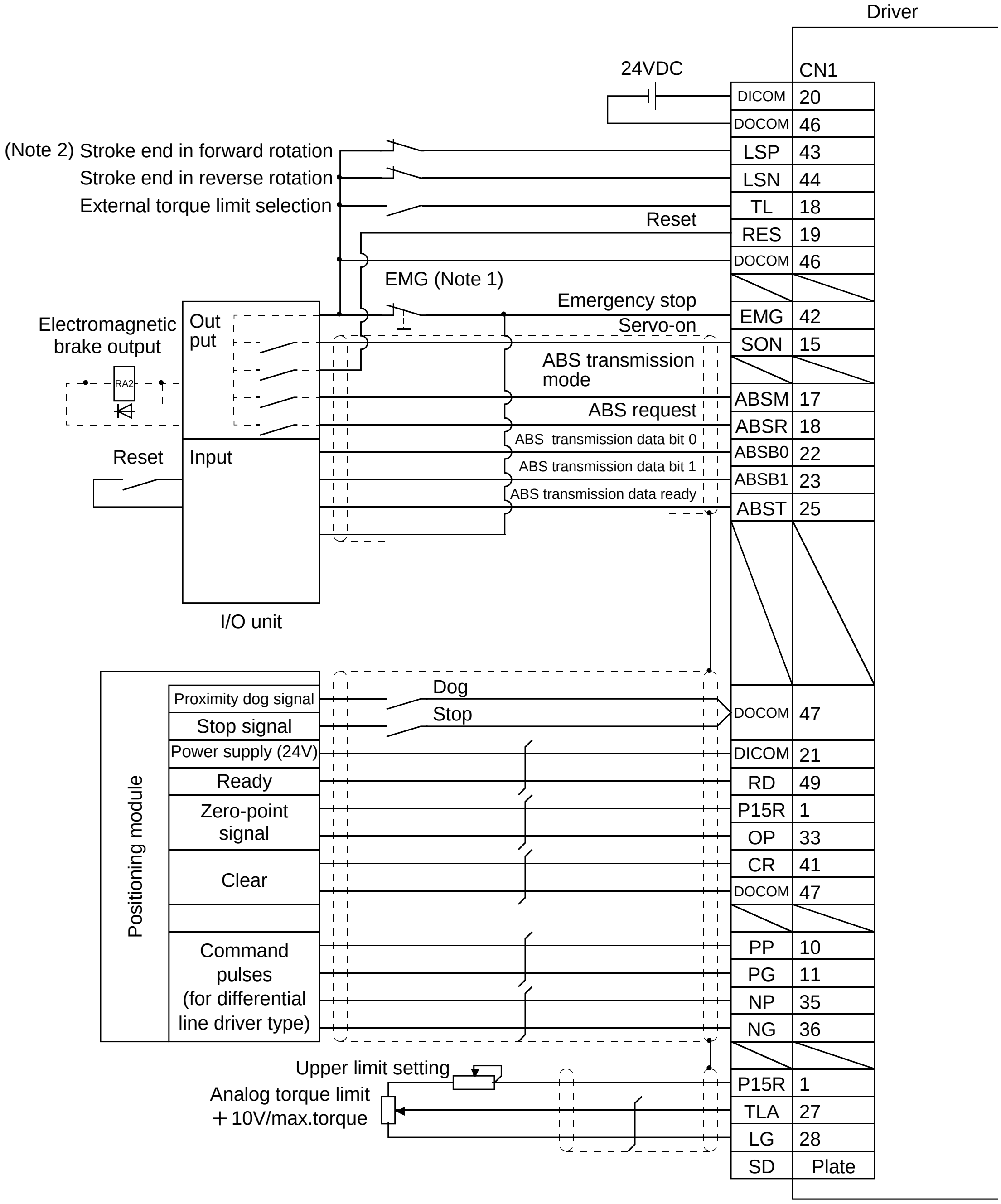
POINT

・For the driver with a battery holder on the bottom, it is not possible to wire for the earth with the battery installed. Insert the battery after executing the earth wiring of the driver.



For
LECSB□-S5
LECSB□-S7
LECSB□-S8

14.5 Standard connection diagram



Note 1. Always install the emergency stop switch.

2. For operation, always turn on forward rotation stroke end (LSP)/reverse rotation stroke end (LSN).

14.6 Signal explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in section 3.5.

For the I/O interfaces (symbols in the I/O Category column in the table), refer to section 3.8.2.

Signal name	Code	CN1 Pin No.	Function/Application	I/O category	Control mode
ABS transfer mode	ABSM	(Note) 17	While ABSM is on, the driver is in the ABS transfer mode, and the functions of ZSP, TLC, and D01 are as indicated in this table.	DI-1	P (Position control)
ABS request	ABSR	(Note) 18	Turn on ABSR to request the ABS data in the ABS transfer mode.	DI-1	
ABS transmission data bit 0	ABSB0	22	Indicates the lower bit of the ABS data (2 bits) which is sent from the servo to the programmable PC or PLC...etc in the ABS transfer mode. If there is a signal, D01 turns on.	DO-1	
ABS transmission data bit 1	ABSB1	23	Indicates the upper bit of the ABS data (2 bits) which is sent from the servo to the programmable PC or PLC...etc in the ABS transfer mode. If there is a signal, ZSP turns on.	DO-1	
ABS transmission data ready	ABST	25	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion of the ready state, TLC turns on.	DO-1	
Home position setting	CR	41	When CR is turned on, the position control counter is cleared and the home position data is stored into the non-volatile memory (backup memory).	DI-1	

Note. When "Used in absolute position detection system" is selected in parameter No.PA03, pin 17 acts as the ABS transfer mode (ABSM) and pin 18 as the ABS request (ABSR). They do not return to the original signals if data transfer ends.

14.7 Startup procedure

(1) Battery installation.

Refer to section 14.3.

(2) Parameter setting

Set "□□□1"in parameter No.PA03 of the driver and switch power off, then on.

(3) Resetting of absolute position erase (AL.25)

After connecting the encoder cable, the absolute position erase (AL.25) occurs at first power-on. Leave the alarm as it is for a few minutes, then switch power off, then on to reset the alarm.

(4) Confirmation of absolute position data transfer

When the servo-on (SON) is turned on, the absolute position data is transferred to the programmable PC or PLC...etc. When the ABS data is transferred properly.

(a) The ready output (RD) turns on.

(b) The programmable PC or PLC...etc/ABS data ready contact turns on.

(c) The MR Configurator2TM ABS data display window (refer to section 14.12) and programmable PC or PLC...etc side ABS data registers show the same value (at the home position address of 0).
If any warning such as ABS time-out warning (AL.E5) or programmable PC or PLC...etc side transfer error occurs, refer to section 14.10 or chapter 8 and take corrective action.

(5) Home position setting

The home position must be set if.

(a) System set-up is performed;

(b) The driver has been changed;

(c) The servo motor has been changed; or

(d) The absolute position erase (AL.25) occurred.

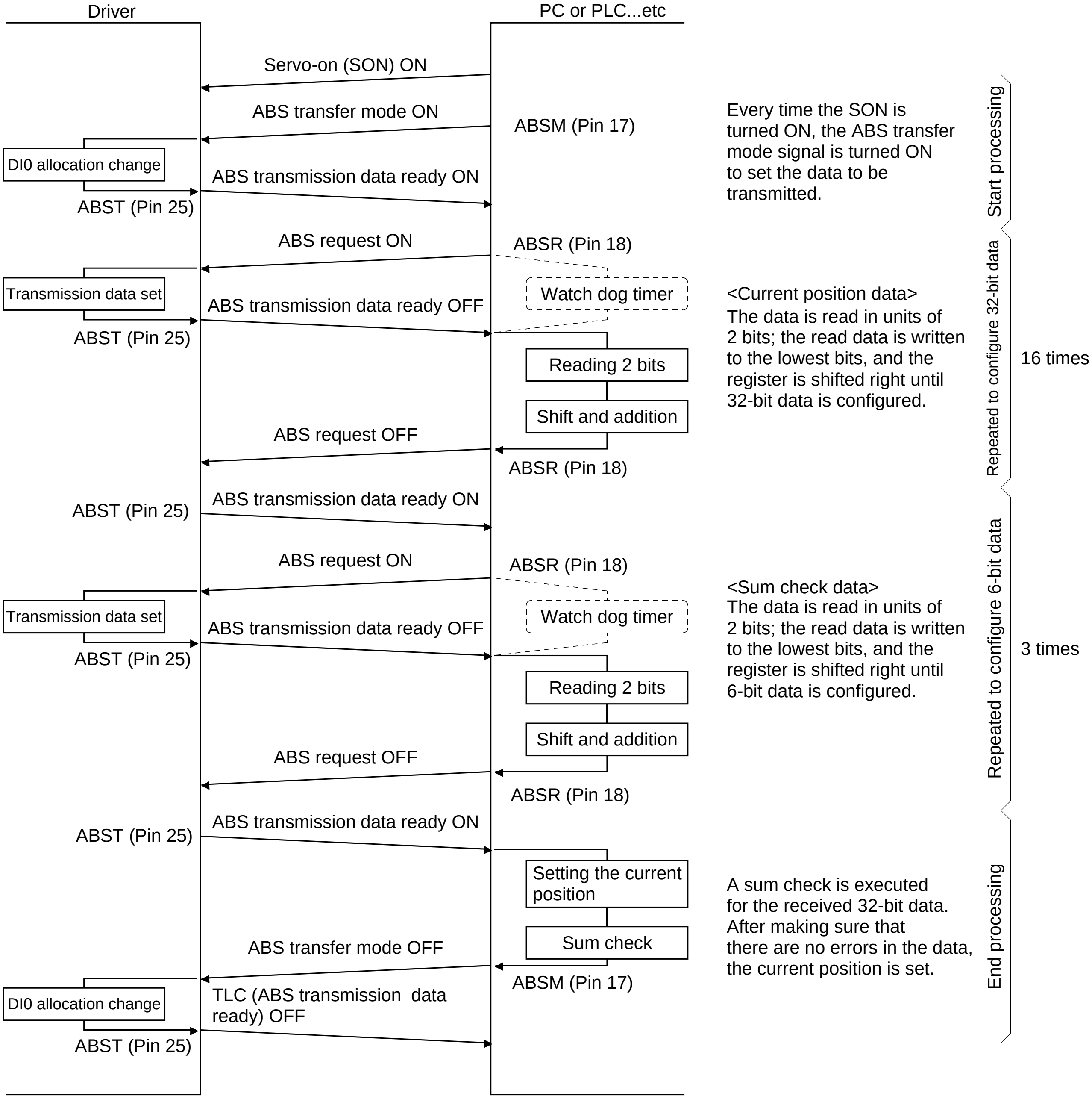
In the absolute position detection system, the absolute position coordinates are made up by making home position setting at the time of system set-up.
The motor shaft may operate unexpectedly if positioning operation is performed without home position setting.
Always make home position setting before starting operation.
For the home position setting method and types, refer to section 14.8.3.

14.8 Absolute position data transfer protocol

POINT
・After switching on the ABS transfer mode (ABSM), turn on the servo-on signal (SON). When the ABS transfer mode is off, turning on the servo-on signal (SON) does not switch on the base circuit.

14.8.1 Data transfer procedure

Each time the servo-on (SON) is turned ON (when the power is switched ON for example), the programmable PC or PLC...etc reads the position data (present position) of the driver.
Time-out monitoring is performed by the programmable PC or PLC...etc.

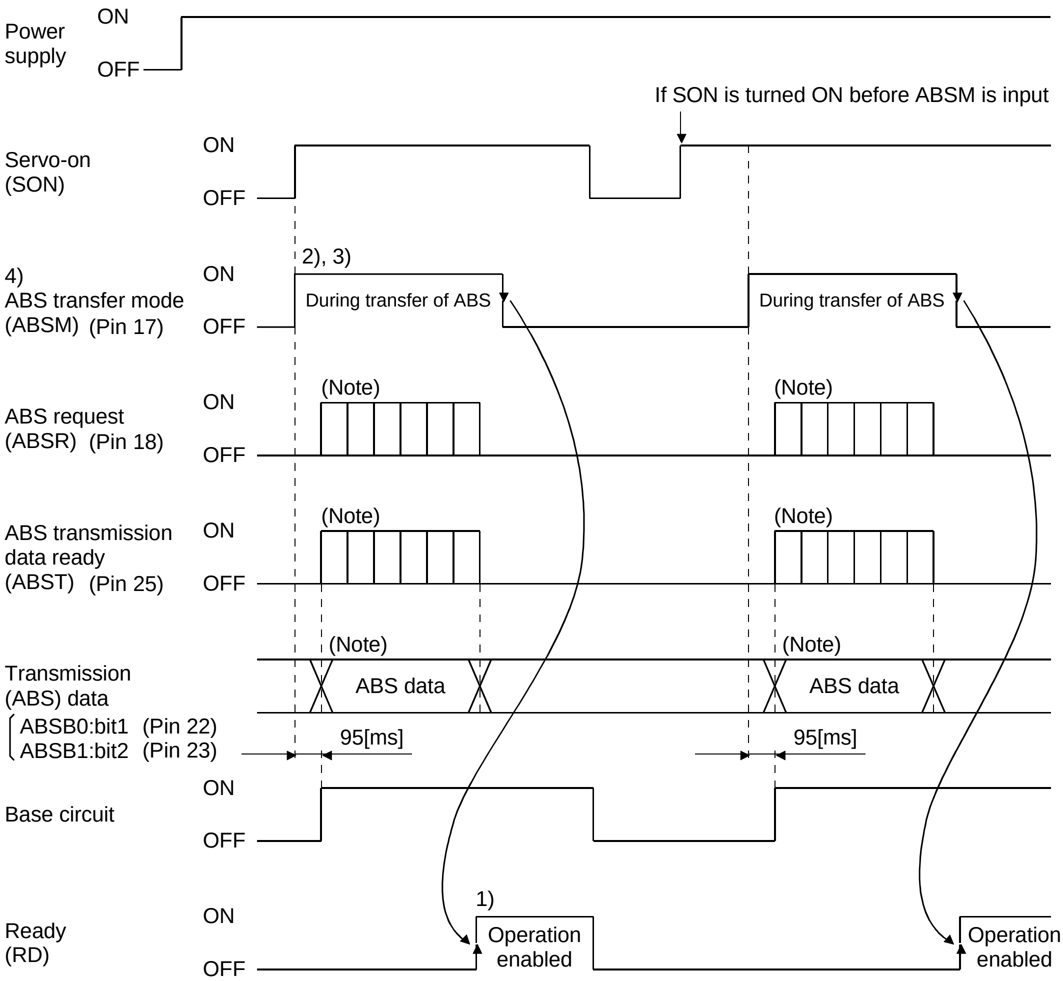


14.8.2 Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on (SON) going OFF, an emergency stop (EMG), or alarm (ALM), is explained below. In the absolute position detection system, every time the servo-on (SON) is turned on, the ABS transfer mode (ABSM) should always be turned on to read the current position in the driver to the PC or PLC...etc. The driver transmits to the PC or PLC...etc the current position latched when the ABS transfer mode (ABSM) switches from OFF to ON. At the same time, this data is set as a position command value inside the driver. Unless the ABS transfer mode (ABSM) is turned ON, the base circuit cannot be turned ON.

(1) At power-on

(a) Timing chart



Note. For details, refer to (1) (b) of this section.

1) The ready (RD) is turned ON when the ABS transfer mode (ABSM) is turned OFF after transmission of the ABS data.
While the ready (RD) is ON, the ABS transfer mode (ABSM) input is not accepted.

2) Even if the servo-on (SON) is turned ON before the ABS transfer mode (ABSM) is turned ON, the base circuit is not turned ON until the ABS transfer mode (ABSM) is turned ON.
If a servo alarm has occurred, the ABS transfer mode (ABSM) is not received.
The ABS transfer mode (ABSM) allows data transmission even while a servo warning is occurring.

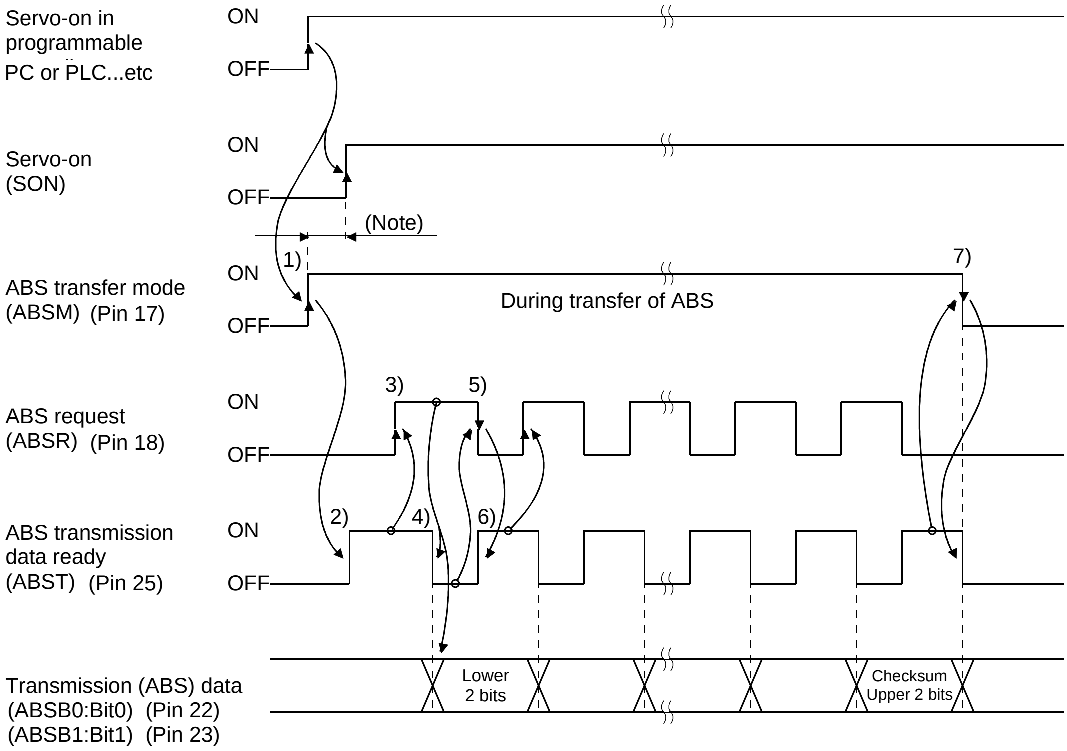
3) If the ABS transfer mode (ABSM) is turned OFF during the ABS transfer mode, the ABS transfer mode is interrupted and the time-out error (AL.E5) occurs.
If the servo-on (SON) is turned OFF, the reset (RES) is turned ON, and the emergency stop (EMG) is turned OFF during the ABS transfer mode, the ABS time-out warning (AL.E5) occurs.

4) The functions of output signals such as ABST, ABSB0, and ABSB1 change depending on the ON/OFF state of the ABS transfer mode (ABSM).
Note that if the ABS transfer mode (ABSM) is turned ON for a purpose other than ABS data transmission, the output signals will be assigned the functions of ABS data transmission.

CN1 Pin No.	Output signal	
	ABS transfer mode (ABSM): OFF	ABS transfer mode (ABSM): ON
22	Positioning completion	ABS transmission data bit 0
23	Zero speed detection	ABS transmission data bit 1
25	During torque limit control	ABS transmission data ready

5) The ABS transfer mode (ABSM) is not accepted while the base circuit is ON.
For re-transferring, turn OFF the servo-on (SON) signal and keep the base circuit in the off state for 20ms or longer.

(b) Detailed description of absolute position data transfer



Note. If the servo-on (SON) is not turned ON within 1 second after the ABS transfer mode (ABSM) is turned ON, an SON time-out warning (AL.EA) occurs. This warning, however, does not interrupt data transmission. It is automatically cleared when the servo-on (SON) is turned ON.

1) The programmable PC or PLC...etc turns ON the ABS transfer mode (ABSM) and servo-on (SON) at the leading edge of the internal servo-on (SON).

2) In response to the ABS transfer mode (ABSM), the servo detects and calculates the absolute position and turns ON the ABS transmission data ready (ABST) to notify the programmable PC or PLC...etc that the servo is ready for data transmission.

3) After acknowledging that the ready to send (ABST) has been turned ON, the programmable PC or PLC...etc turns ABS request (ABSR) ON.

4) In response to ABS request (ABSR), the servo outputs the lower 2 bits of the ABS data and the ABS transmission data ready (ABST) in the OFF state.

5) After acknowledging that the ABS transmission data ready (ABST) has been turned OFF, which implies that 2 bits of the ABS data have been transmitted, the programmable PC or PLC...etc reads the lower 2 bits of the ABS data and then turns OFF the ABS request (ABSR).

6) The servo turns ON the ABS transmission data ready (ABST) so that it can respond to the next request.
   Steps 3) to 6) are repeated until 32-bit data and the 6-bit checksum have been transmitted.

7) After receiving of the checksum, the programmable PC or PLC...etc confirms that the 19th ABS transmission data ready (ABST) is turned ON, and then turns OFF the ABS transfer mode (ABSM). If the ABS transfer mode (ABSM) is turned OFF during data transmission, the ABS transfer mode (ABSM) is interrupted and the ABS time-out warning (AL.E5) occurs.

(c) Checksum

The checksum is the code which is used by the programmable PC or PLC...etc to check for errors in the received ABS data. The 6-bit checksum is transmitted following the 32-bit ABS data.

At the programmable PC or PLC...etc, calculate the sum of the received ABS data using the ladder program and compare it with the checksum code sent from the servo.

The method of calculating the checksum is shown. Every time the programmable PC or PLC...etc receives 2 bits of ABS data, it adds the data to obtain the sum of the received data. The checksum is 6-bit data.

Example: ABS data: −10 (FFFFFFF6H)

$$
\begin{array}{rr}
 & 10^{b} \\
 & 01^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
+) & 11^{b} \\
\hline
 & 101101^{b}
\end{array}
$$

<Appendix>

Decimal	−10
	↓
Hexadecimal	FFFF FFF6
	↓
Binary	1111 1111 1111··········0110

When the binary data of each 2bits of the ABS data is added up, "10 1101^{b}" is obtained.

Therefore, the checksum of "−10" (ABS data) is "2Db"

(2) Transmission error

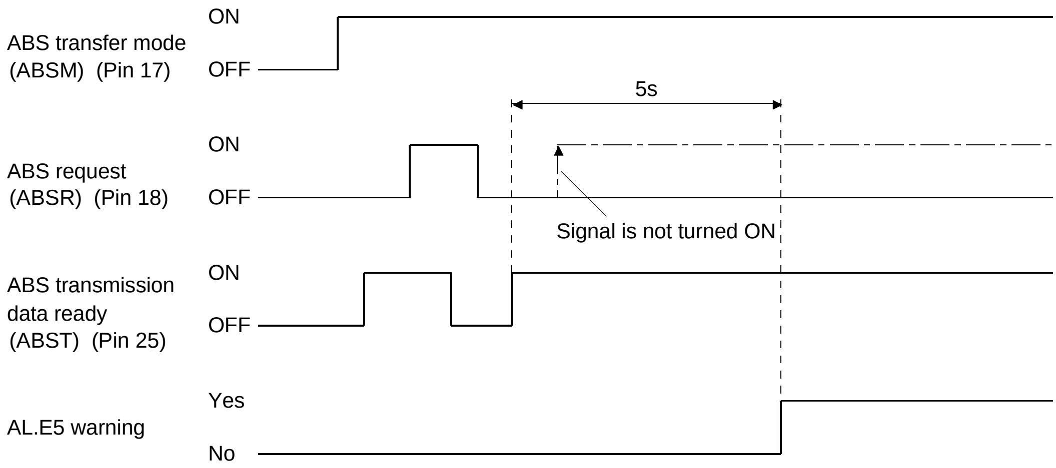
(a) Time-out warning(AL.E5)

In the ABS transfer mode, the time-out processing shown below is executed at the servo. If a time-out error occurs, an ABS time-out warning (AL.E5) is output.

The ABS time-out warning (AL.E5) is cleared when the ABS transfer mode (ABSM) changes from OFF to ON.

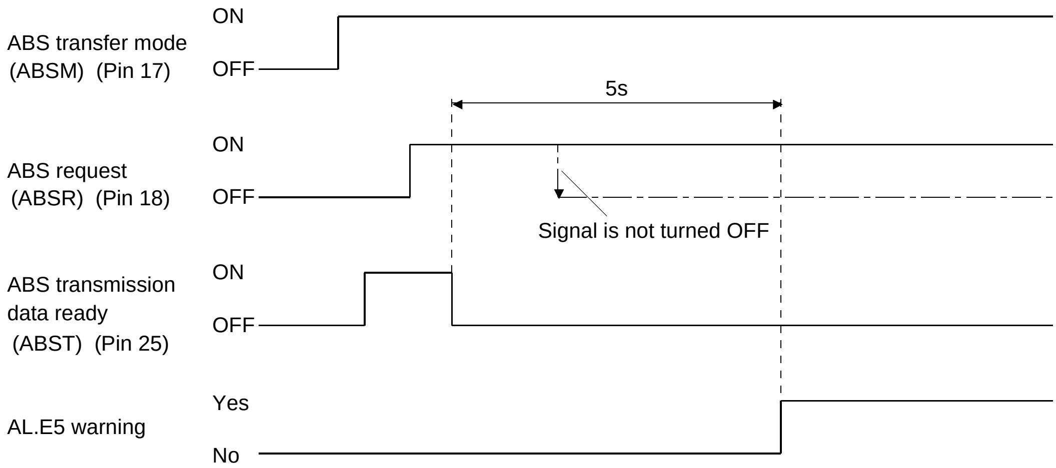
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + checksum)

If the ABS request signal is not turned ON by the programmable PC or PLC...etc within 5s after the ABS transmission data ready (ABST) is turned ON, this is regarded as a transmission error and the ABS time-out warning (AL.E5) is output.

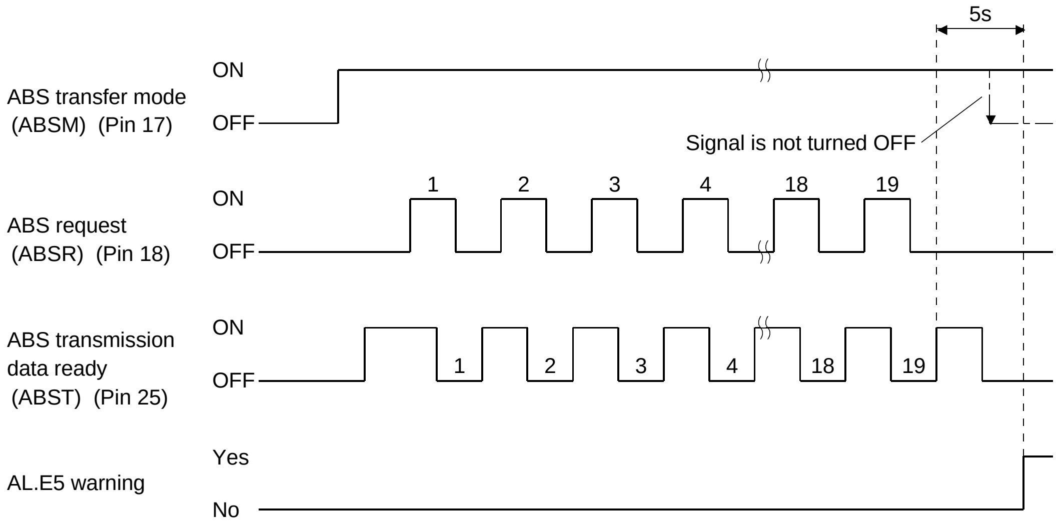


2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + checksum)

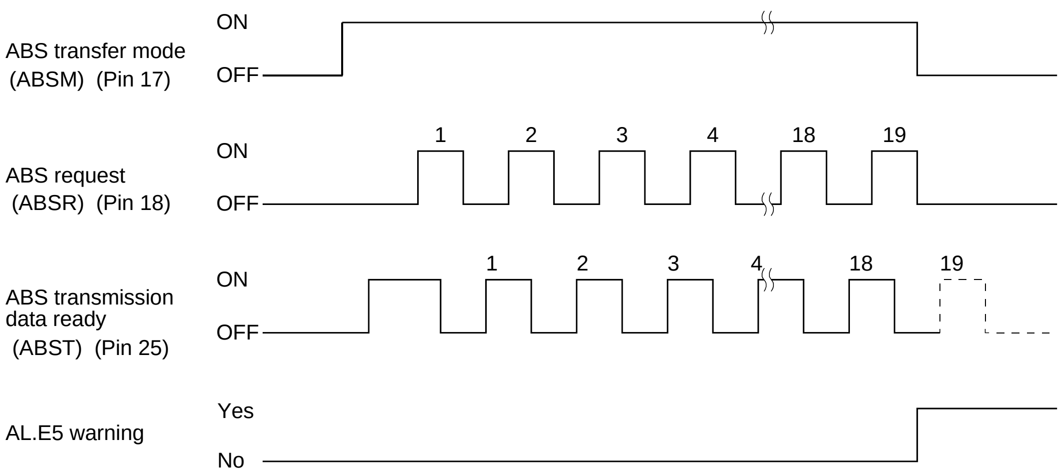
If the ABS request signal is not turned OFF by the programmable PC or PLC...etc within 5s after the ABS transmission data ready (ABST) is turned OFF, this is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.



3) ABS transfer mode finish-time time-out check
If the ABS transfer mode (ABSM) is not turned OFF within 5s after the last ABS transmission data ready (19th signal for ABS data transmission) is turned ON, it is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.

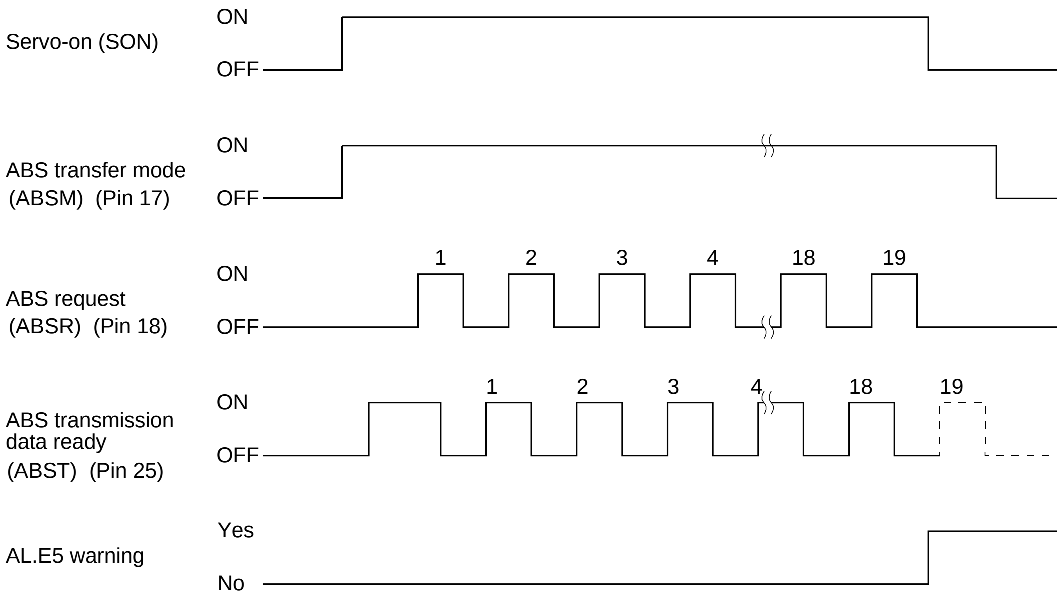


4) ABS transfer mode (ABSM) OFF check during the ABS transfer
When the ABS transfer mode is turned ON to start transferring and then the ABS transfer mode is turned OFF before the 19th ABS transmission data ready is turned ON, the ABS time-out warning (AL.E5) occurs, regarding it as a transfer error.



5) Servo-on (SON) OFF, Reset (RES) ON, Emergency stop (EMG) OFF check during the ABS transfer

When the ABS transfer mode is turned ON to start transferring and then the servo-on (SON) is turned OFF, the reset (RES) is turned ON, or the emergency stop (EMG) is turned ON before the 19th ABS transmission data ready signal is turned ON, the ABS time-out warning (AL.E5) occurs, regarding it as a transfer error.



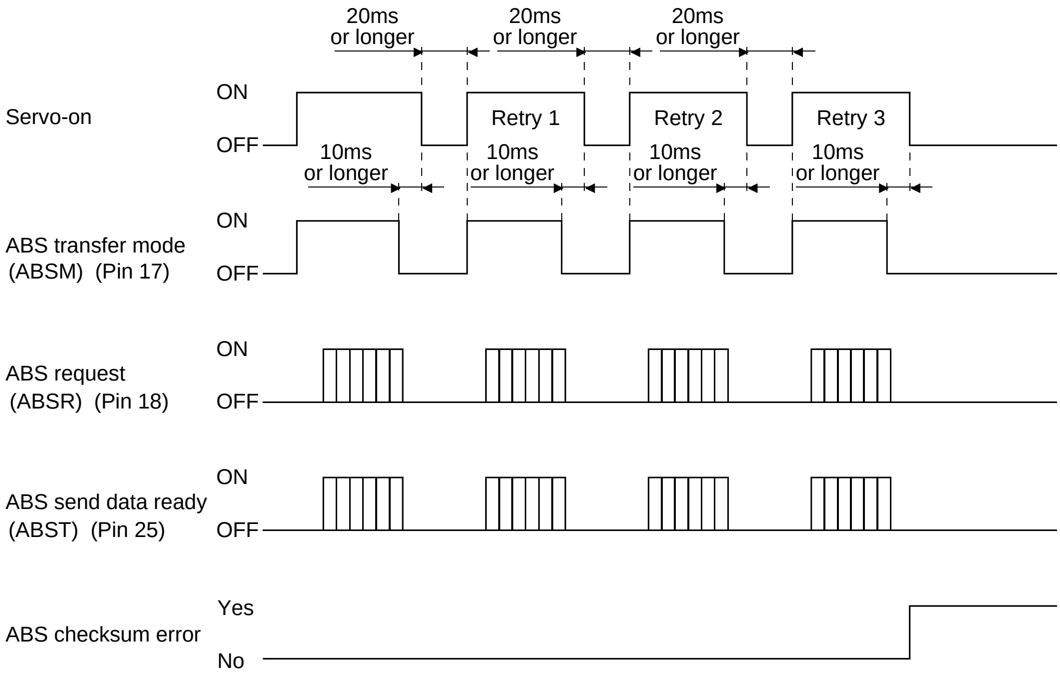
(b) Checksum error

If the checksum error occurs, the programmable PC or PLC...etc should retry transmission of the ABS data.

Using the ladder check program of the programmable PC or PLC...etc, turn OFF the ABS transfer mode (ABSM). After a lapse of 10ms or longer, turn OFF the servo-on (SON) (OFF time should be longer than 20ms) and then turn it ON again.

If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS checksum error and execute error processing.

The start command should be interlocked with the ABS data ready signal to disable positioning operation when an checksum error occurs.

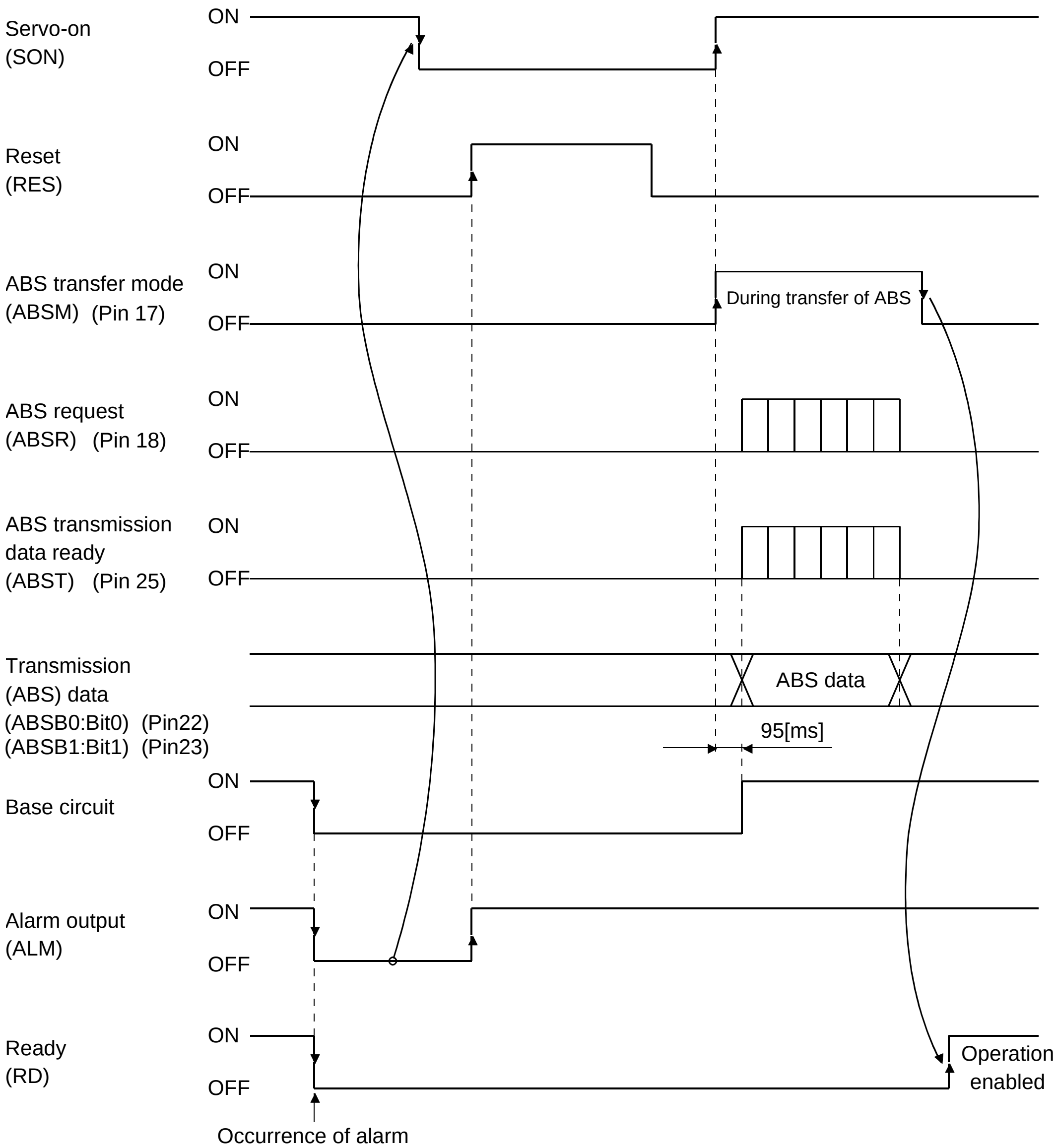


(3) At the time of alarm reset

If an alarm occurs, turn OFF the servo-on (SON) by detecting the alarm output (ALM).

If an alarm has occurred, the ABS transfer mode (ABSM) cannot be accepted.

In the reset state, the ABS transfer mode (ABSM) can be input.



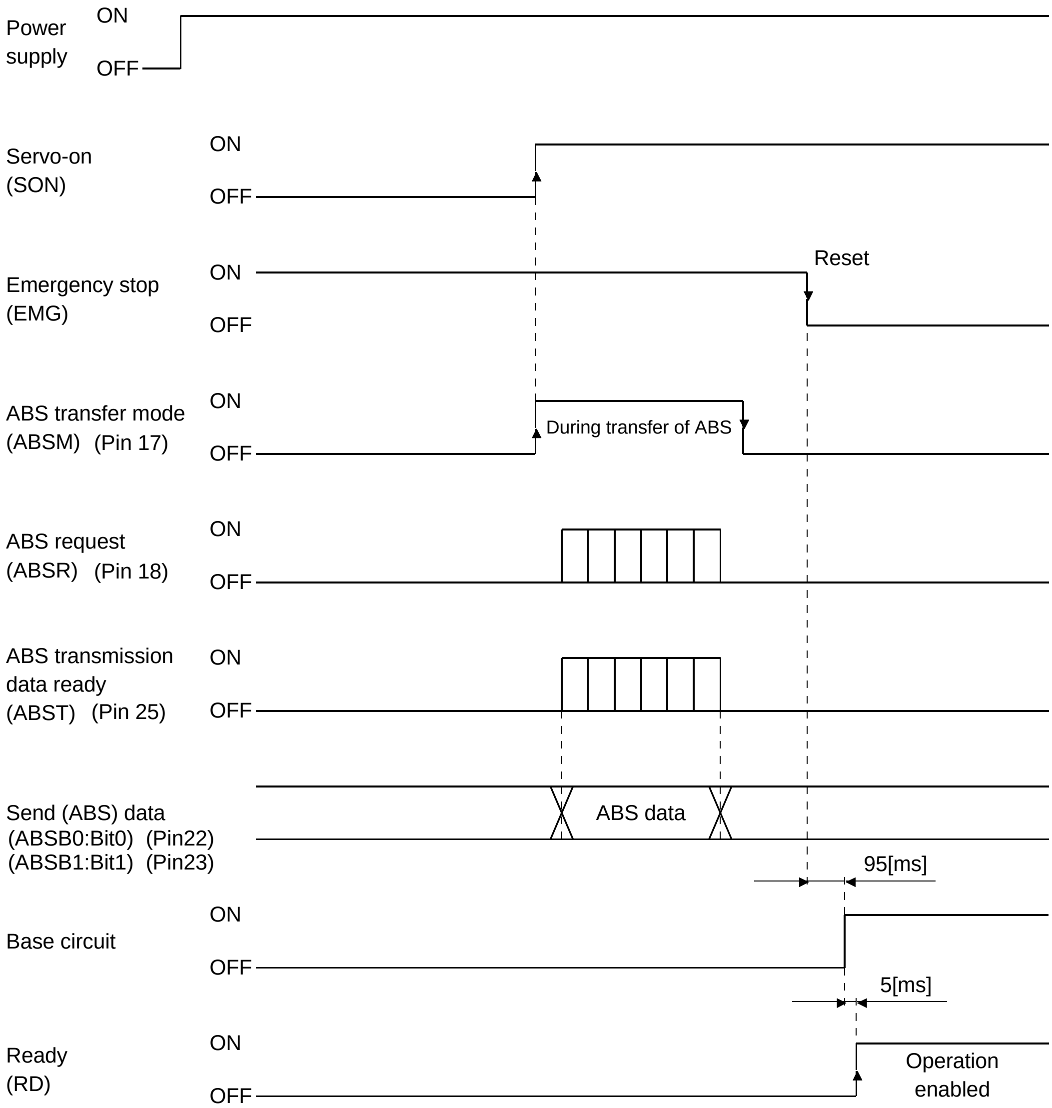
(4) At the time of emergency stop reset

(a) If the power is switched ON in the emergency stop state

The emergency stop state can be reset while the ABS data is being transferred.

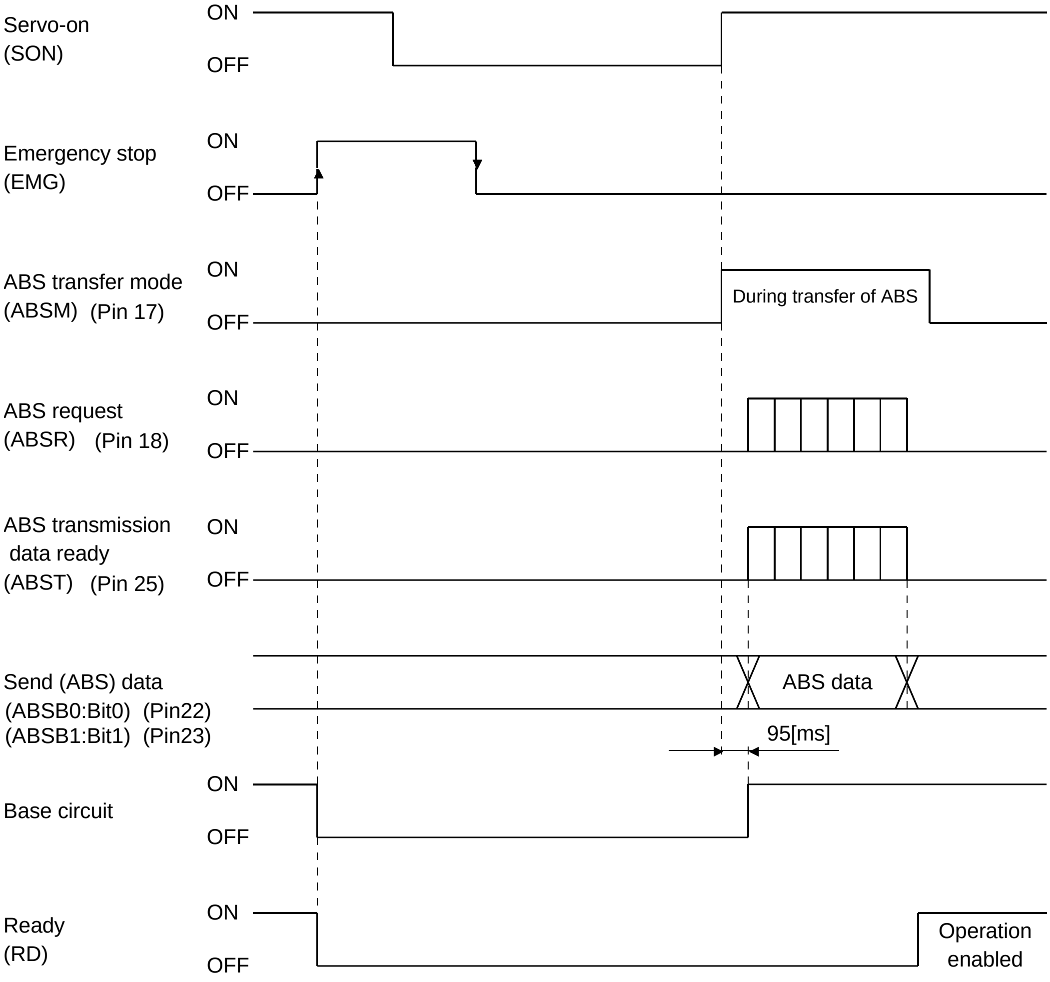
If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 95[ms] after resetting. If the ABS transfer mode (ABSM) is OFF when the base circuit is turned ON, the ready (RD) is turned ON 5[ms] after the turning ON of the base circuit. If the ABS transfer mode (ABSM) is ON when the base circuit is turned ON, it is turned OFF and then the ready (RD) is turned ON. The ABS data can be transmitted after the emergency stop state is reset.

The current position in the driver is updated even during an emergency stop. When servo-on (SON) and ABS transfer mode (ABSM) are turned ON during an emergency stop as shown below, the driver transmits to the PC or PLC...etc the current position latched when the ABS transfer mode (ABSM) switches from OFF to ON, and at the same time, the driver sets this data as a position command value. However, since the base circuit is OFF during an emergency stop, the servo-lock status is not encountered. Therefore, if the servo motor is rotated by external force or the like after the ABS transfer mode (ABSM) is turned ON, this travel distance is accumulated in the driver as droop pulses. If the emergency stop is cleared in this status, the base circuit turns ON and the motor returns to the original position rapidly to compensate for the droop pulses. To avoid this status, reread the ABS data before clearing the emergency stop.



(b) If emergency stop is activated during servo-on

The ABS transfer mode (ABSM) is permissible while in the emergency stop state. In this case, the base circuit and the ready (RD) are turned ON after the emergency stop state is reset.



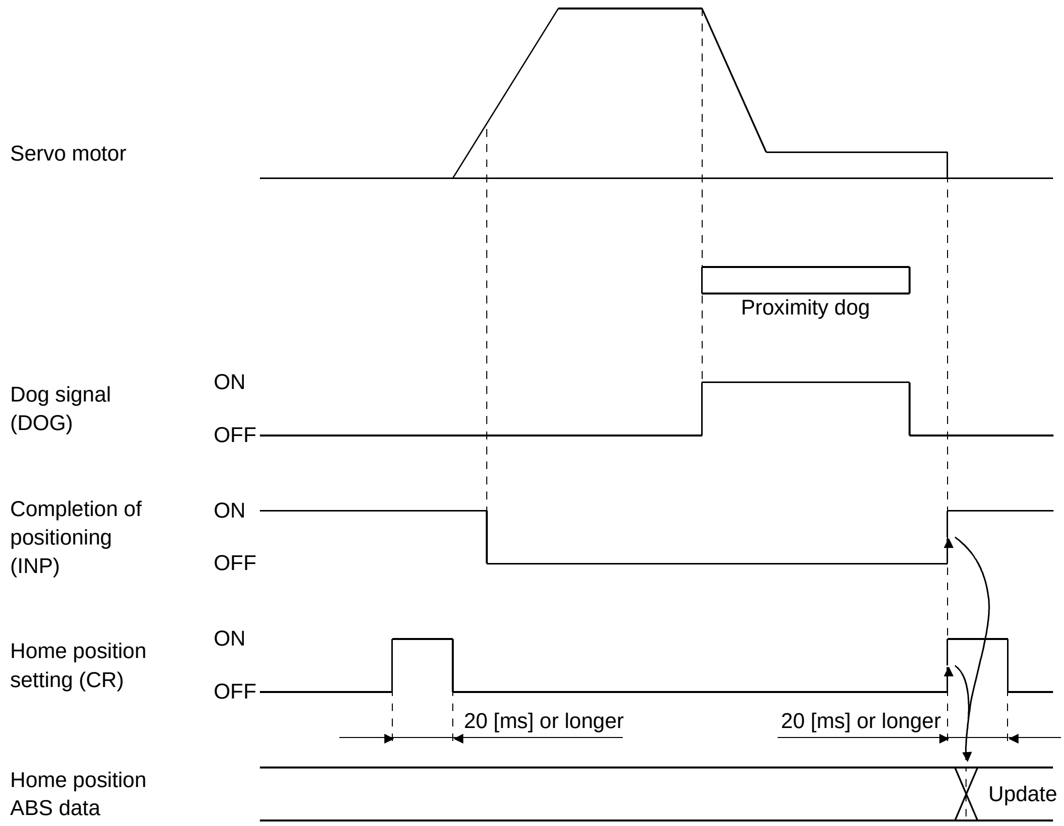
14.8.3 Home position setting

(1) Dog type home position return

Preset a home position return creep speed at which the machine will not be given impact. On detection of a zero pulse, the home position setting (CR) is turned from off to on. At the same time, the driver clears the droop pulses, comes to a sudden stop, and stores the stop position into the non-volatile memory as the home position ABS data.

The home position setting (CR) should be turned on after it has been confirmed that the in-position (INP) is on. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.

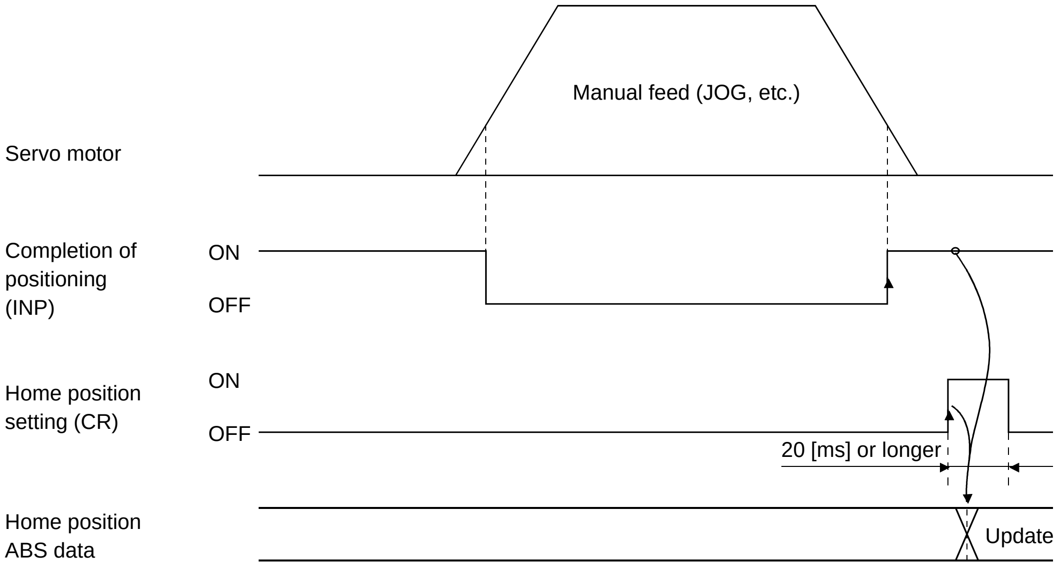
The number of home position setting times is limited to 1,000,000 times.



(2) Data set type home position return

POINT
· Never make home position setting during command operation or servo motor rotation. It may cause home position sift. · It is possible to execute data set type home position return when the servo off.

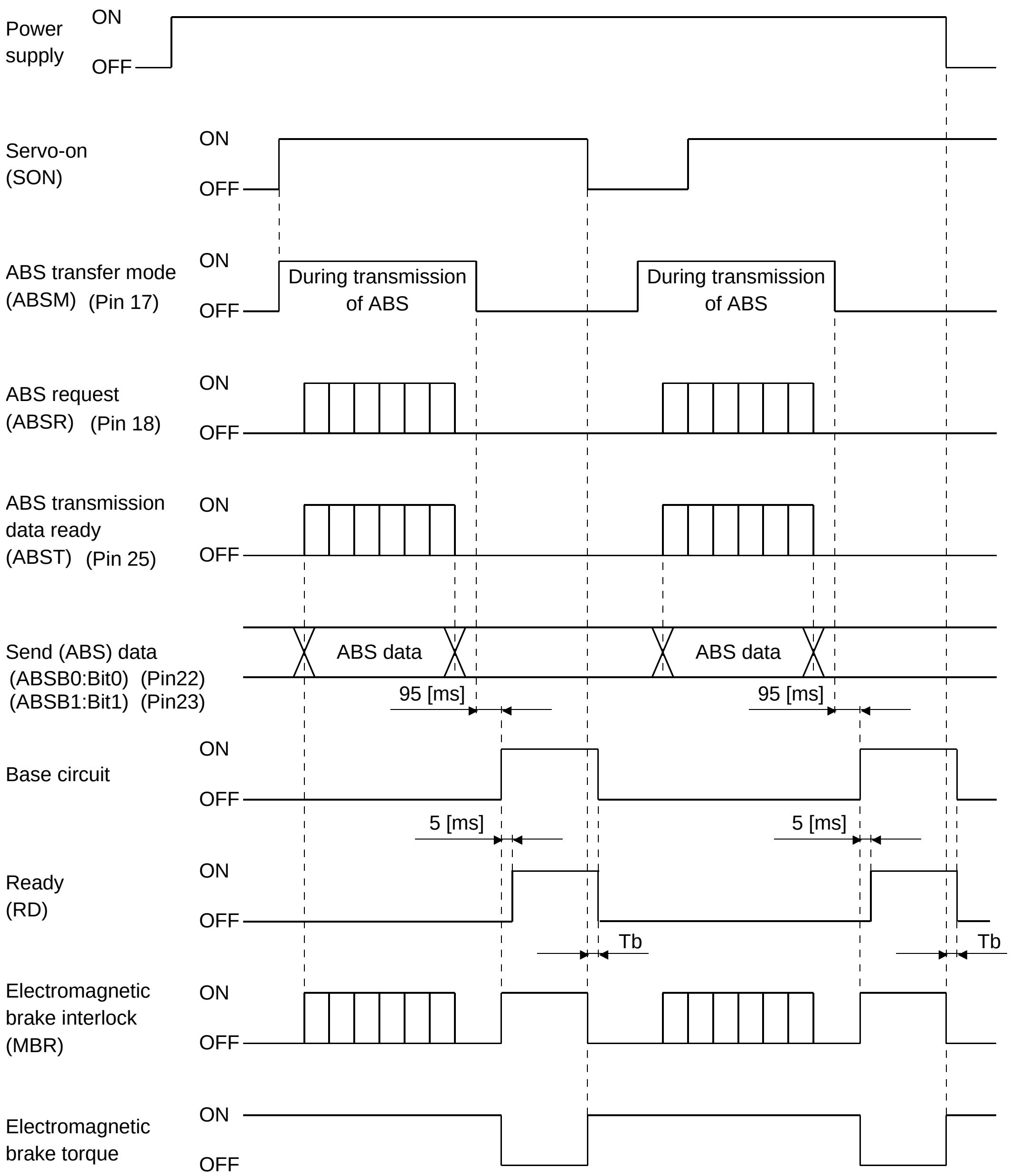
Move the machine to the position where the home position is to be set by performing manual operation such as JOG operation. When the home position setting (CR) is on for longer than 20ms, the stop position is stored into the non-volatile memory as the home position ABS data.
When the servo on, set home position setting (CR) to ON after confirming that the in-position (INP) is ON. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.
The number of home position setting times is limited to 1,000,000 times.



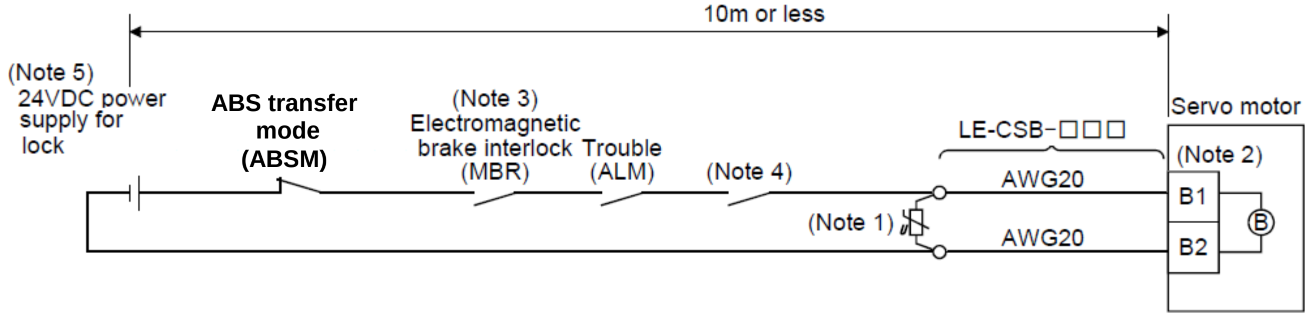
14.8.4 Use of servo motor with a lock

The timing charts at power on/off and servo-on (SON) on/off are given below.
Preset parameter No.PA04/PD13 to PD16/PD18 of the driver to make the electromagnetic brake interlock (MBR) valid. When the ABS transfer mode is ON, the electromagnetic brake interlock (MBR) set in parameter No.PA04 is used as the ABS data bit 1.
Hence, make up an external wiring and sequence program which will cause the electromagnetic brake torque to be generated by the ABS mode (ABSM) and electromagnetic brake interlock (MBR).

Refer to section 14.8.4 (1) for the external wiring example.
Refer to section 14.9.1 (2) (e), section 14.9.2 (2) (g), section 14.9.3 (2) (g) for the sequence program example.



(1) External wiring example (Absolute position detection system)



Note 1. Connect a surge absorber as close to the servo motor as possible.
2. There is no polarity in lock terminals (B1 and B2).
3. When using a servo motor with a lock, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.PA04, PD13 to PD16 and PD18.
4. Shut off the circuit by interlocking with the emergency stop switch.
5. Do not use the 24VDC interface power supply for the lock.

14.8.5 How to process the absolute position data at detection of stroke end

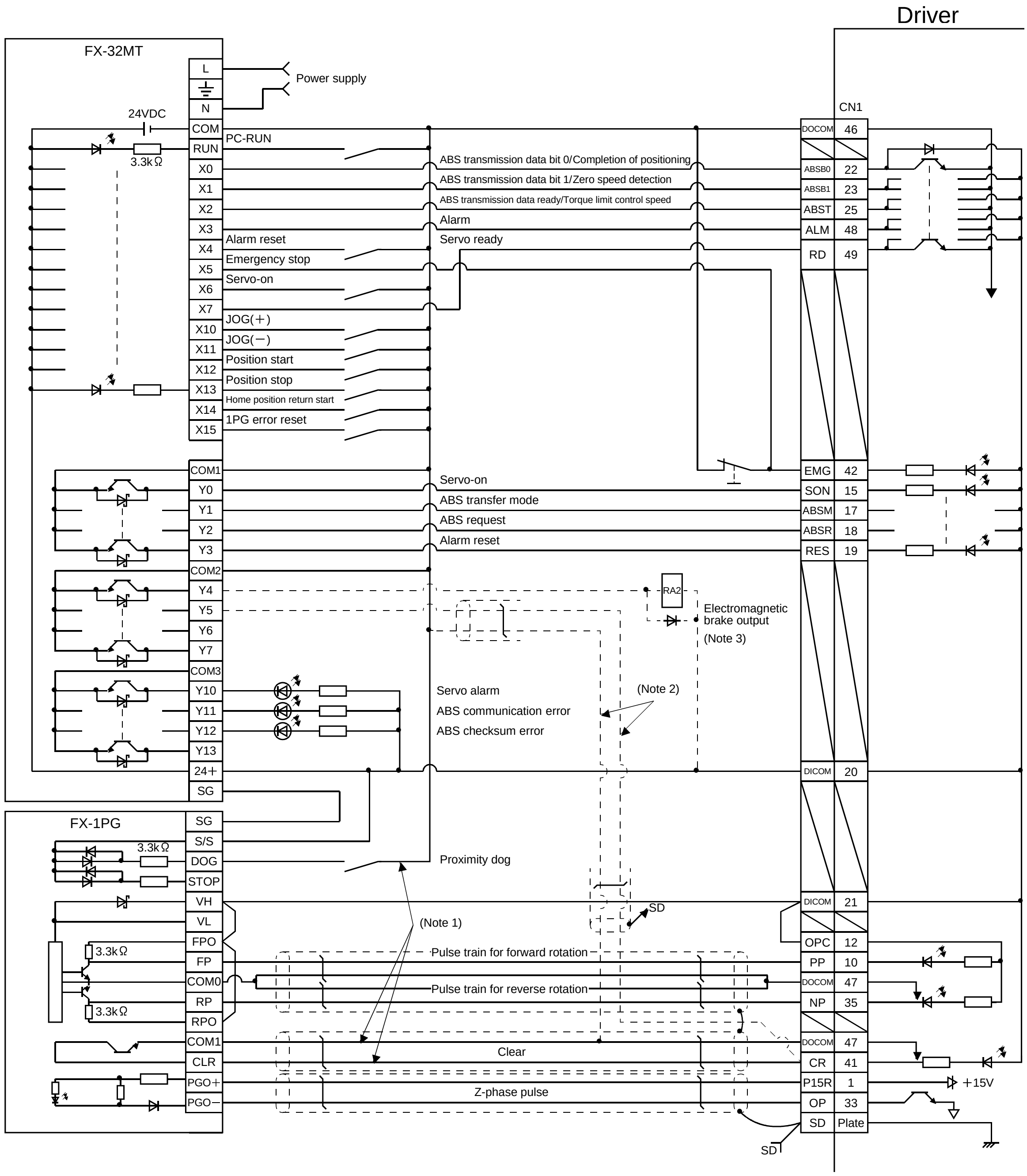
The driver stops the acceptance of the command pulse when stroke end (LSP・LSN) is detected, clears the droop pulses to 0 at the same time, and stops the servo motor rapidly.
At this time, the programmable PC or PLC...etc keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the driver and the programmable PC or PLC...etc, a difference will occur between the position data of the driver and that of the programmable PC or PLC...etc.
To prevent this difference in position data from occurring, do as described below. When the driver has detected the stroke end, perform JOG operation or the like to clear the stroke end. After that, switch the servo-on (SON) off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the driver to be transferred to the programmable PC or PLC...etc, restoring the normal data.

14.9 Examples of use

14.9.1 MELSEC FX(2N)-32MT (FX(2N)-1PG)

(1) Connection diagram

(a) FX-32MT (FX-1PG)

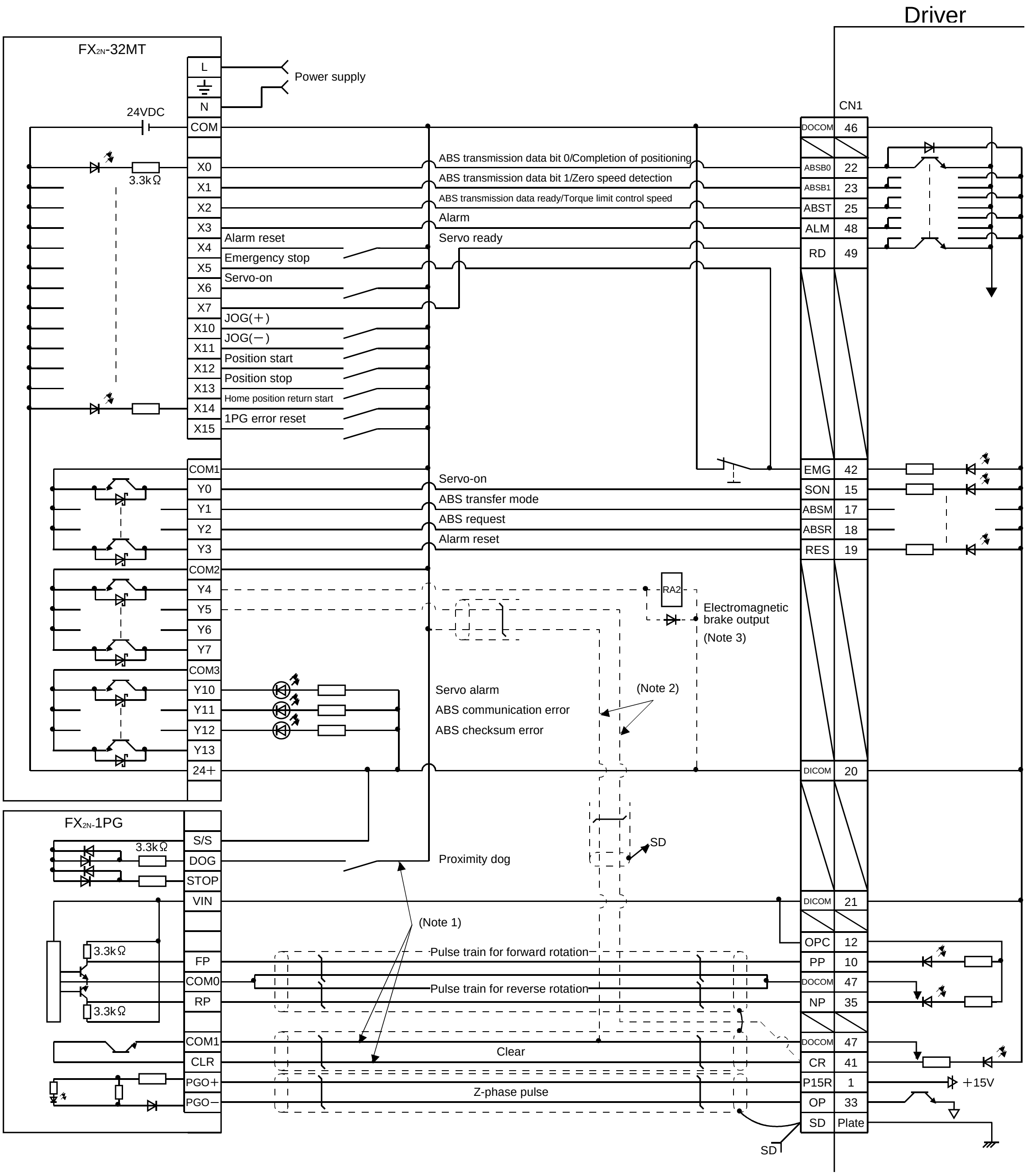


Note 1. To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2. To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

3. The electromagnetic brake interlock (MBR) should be controlled by connecting the programmable PC or PLC...etc output to a relay.

(b) FX2N-32MT (FX2N-1PG)



Note 1. To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2. To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

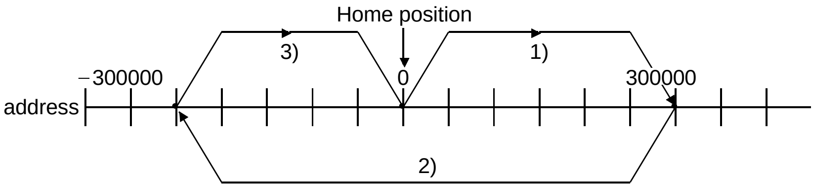
3. The electromagnetic brake interlock (MBR) should be controlled by connecting the programmable PC or PLC...etc output to a relay.

(2) Sequence program example

(a) Conditions

1) Operation pattern

ABS data transfer is made as soon as the servo-on switch is turned on. After that, positioning operation is performed as shown below.



After the completion of ABS data transmission, JOG operation is possible using the JOG+ or JOG− switch, and dog type home position return is possible using the home position return switch.

2) Buffer memory assignment

For BFM#26 and later, refer to the FX2(N)-1PG User's Manual.

BMF No.		Name and symbol		Set value	Remark
Upper 16 bits	Lower 16 bits				
-	#0	Pulse rate	A	2000	
#2	#1	Feed rate	B	1000	
-	#3	Parameter		H0000	Command unit: Pulses
#5	#4	Max. speed	Vmax	100000PPS	
-	#6	Bias speed	Vbia	0PPS	
#8	#7	JOG operation	Vjog	10000PPS	
#10	#9	Home position return speed (high speed)	V_{RT}	50000PPS	
-	#11	Home position return speed (creep)	V_{CL}	1000PPS	
-	#12	Home position return zero-point signal count	N	2 pulses	Initial value: 10
#14	#13	Home position address	HP	0	
-	#15	Acceleration/deceleration time	Ta	200ms	Initial value: 100
-	#16	Not usable			
#18	#17	Target address (I)	P(I)	0	
#20	#19	Operation speed (I)	V(I)	100000	Initial value: 10
#22	#21	Target address (II)	P(II)	0	
#24	#23	Operation speed (II)	V(II)	10	
-	#25	Operation command		H0000	

3) Instructions

When the servo-on switch and the COM of the power supply are shorted, the ABS data is transmitted when the driver power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

If checksum discrepancy is detected in the transmitted data, the ABS data transmission is retried up to three times. If the checksum discrepancy is still detected after retrying, the ABS checksum error is generated (Y12 ON).

The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y11 ON).

ON period of ABS transfer mode (Y1)

ON period of ABS request (Y2)

OFF period of ready to send the ABS data (X2).

(b) Device list

X input contact		Y output contact	
X0	Transmission data bit 0 / completion of positioning	Y0	Servo-on
X1	Transmission data bit 1 / zero speed detection	Y1	ABS transfer mode
X2	Send ABS transmission data ready/ torque limit control	Y2	ABS request
X3	Servo alarm	Y3	Alarm reset
X4	Alarm reset switch	Y4 (Note 2)	Electromagnetic brake output
X5	Servo emergency stop	Y5 (Note 1)	Clear
X6	Servo-on switch	Y10	Servo alarm
X7	Servo ready	Y11	ABS communication error
X10	JOG (+) switch	Y12	ABS checksum error
X11	JOG (−) switch		
X12	Position start switch		
X13	Position stop switch		
X14	Home position return start switch		
X15	1PG error reset		

D register	
D0	ABS data: Lower 16 bits
D1	ABS data: Upper 16 bits
D2	Checksum addition counter
D3	Check data in case of checksum error
D4	Transmission retry count in checksum discrepancy
D24	Home position address: Lower 16 bits
D25	Home position address: Upper 16 bits
D106	1PG present position address: Lower 16 bits
D107	1PG present position address: Upper 16 bits

T timer	
T200	Retry wait timer
T201	ABS transfer mode timer
T202	ABS request response timer
T203	Ready to send response timer
T204	ABS data waiting timer
T210 (Note 1)	Clear (CR) ON timer
T211	Retry ABS transfer mode OFF wait timer 20ms set

M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Servo-on request reset permission
M5	Servo-on request
M6	Retry flag
M10 M11 M12 M13	ABS data 2 bit receiving buffer
M20 ↓ M51	ABS data 32 bit buffer
M52 ↓ M57	Checksum 6 bit buffer
M58 M59	For checksum comparison
M62	Sum check discrepancy (greater) >
M63	Sum check discrepancy =
M64	Sum check discrepancy (less) <
M70 (Note 1)	Clear (CR) ON timer request
M71 (Note 1)	Data set type home position return request
M99	ABS data ready

C counter	
C0	All data reception frequency counter (19 times)
C1	Checksum reception frequency counter
C2	ABS data reception frequency counter (16 times)

Note 1. Necessary when data set type home position return is executed.

2. Necessary in the event of electromagnetic brake output.

(c) ABS data transfer program for X-axis

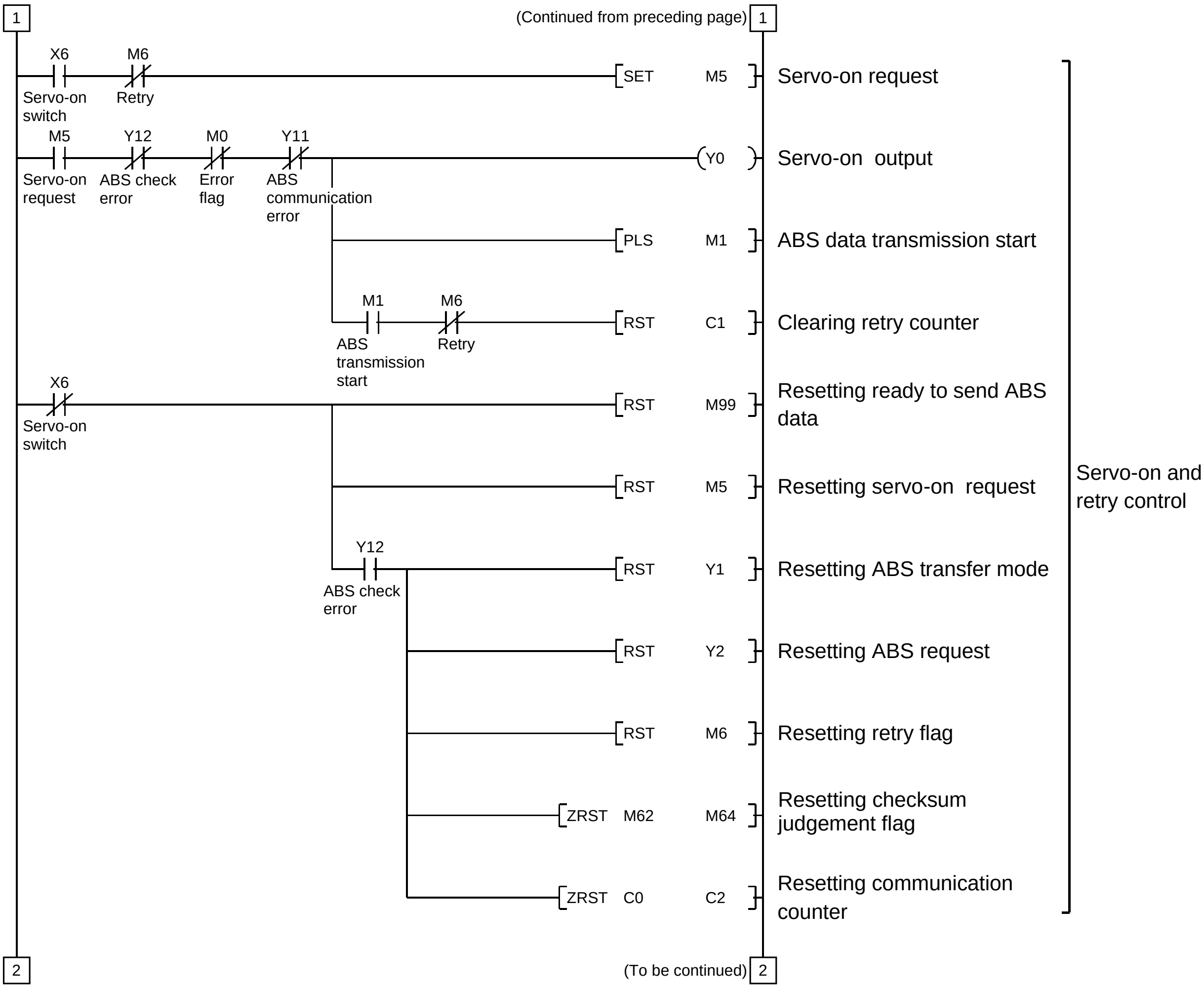
M8002 Initial pulse	DMOV K0 D24	Setting home position address to 0
	TO K0 K3 K0 K1	Setting 1PG pulse command unit
	DTO K0 K4 K100000 K1	1PG max. speed: 100 kpps
	DTO K0 K7 K10000 K1	1PG JOG speed: 10 kpps
	DTO K0 K9 K50000 K1	1PG home position return speed: 50 kpps
	TO K0 K11 K1000 K1	1PG creep speed: 1 kpps
	TO K0 K12 K2 K1	1PG home position return zero-point count: twice
	DTO K0 K13 D24 K1	1PG home position address setting
	TO K0 K15 K200 K1	1PG acceleration/deceleration time: 200ms
	DTO K0 K19 K100000 K1	1PG operation speed: 100kpps
	DMOV K300000 D100	Position move account 1: 300000 pulses
	DMOV K−250000 D102	Position move account 2: −250000 pulses
	DMOV K0 D104	Position move account 3: 0 pulses
	DMOV K0 Z	Clearing index registers V, Z
	DMOV K4 D4	Setting "4 times" for check sum error transmission frequency

Initial setting

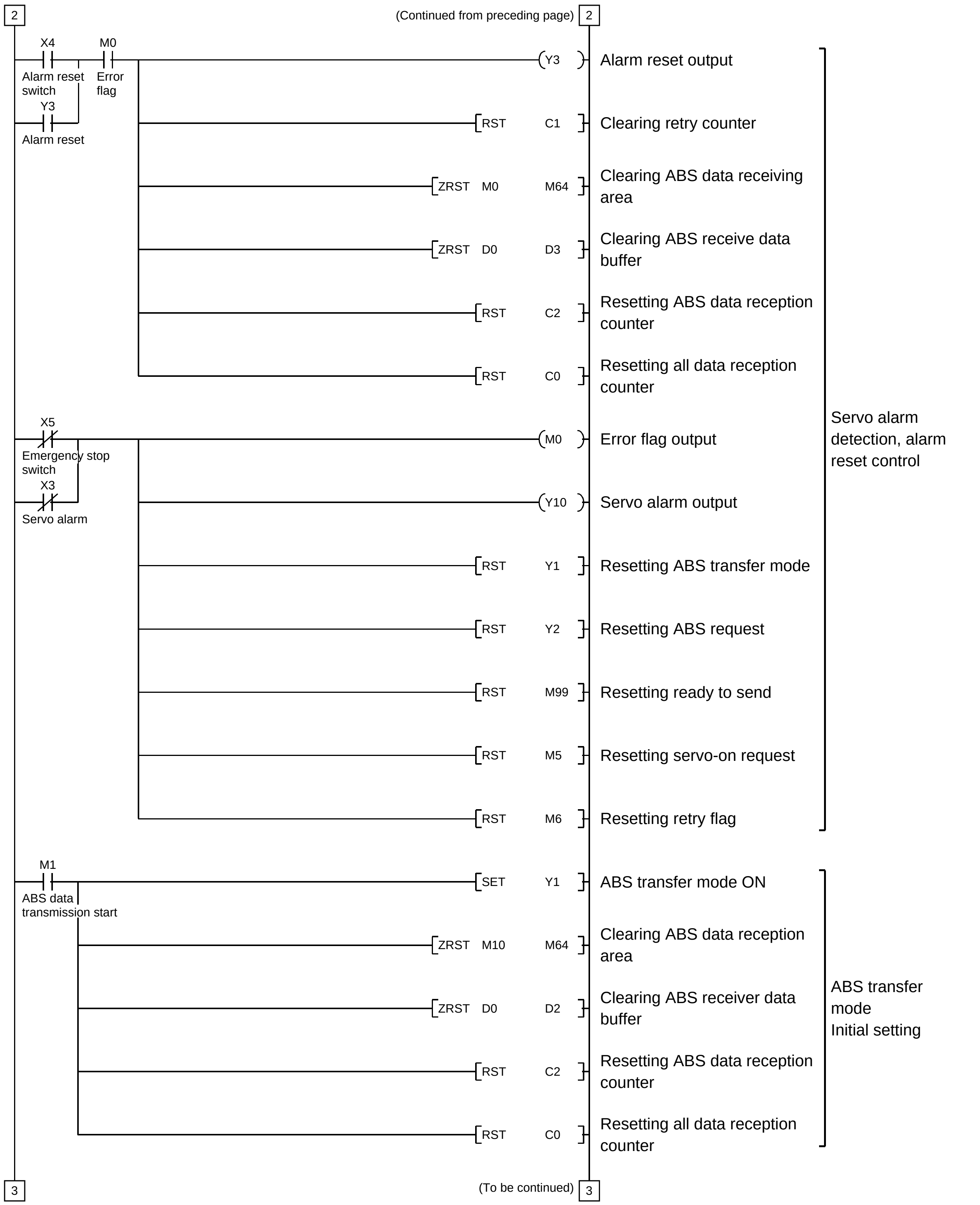
1

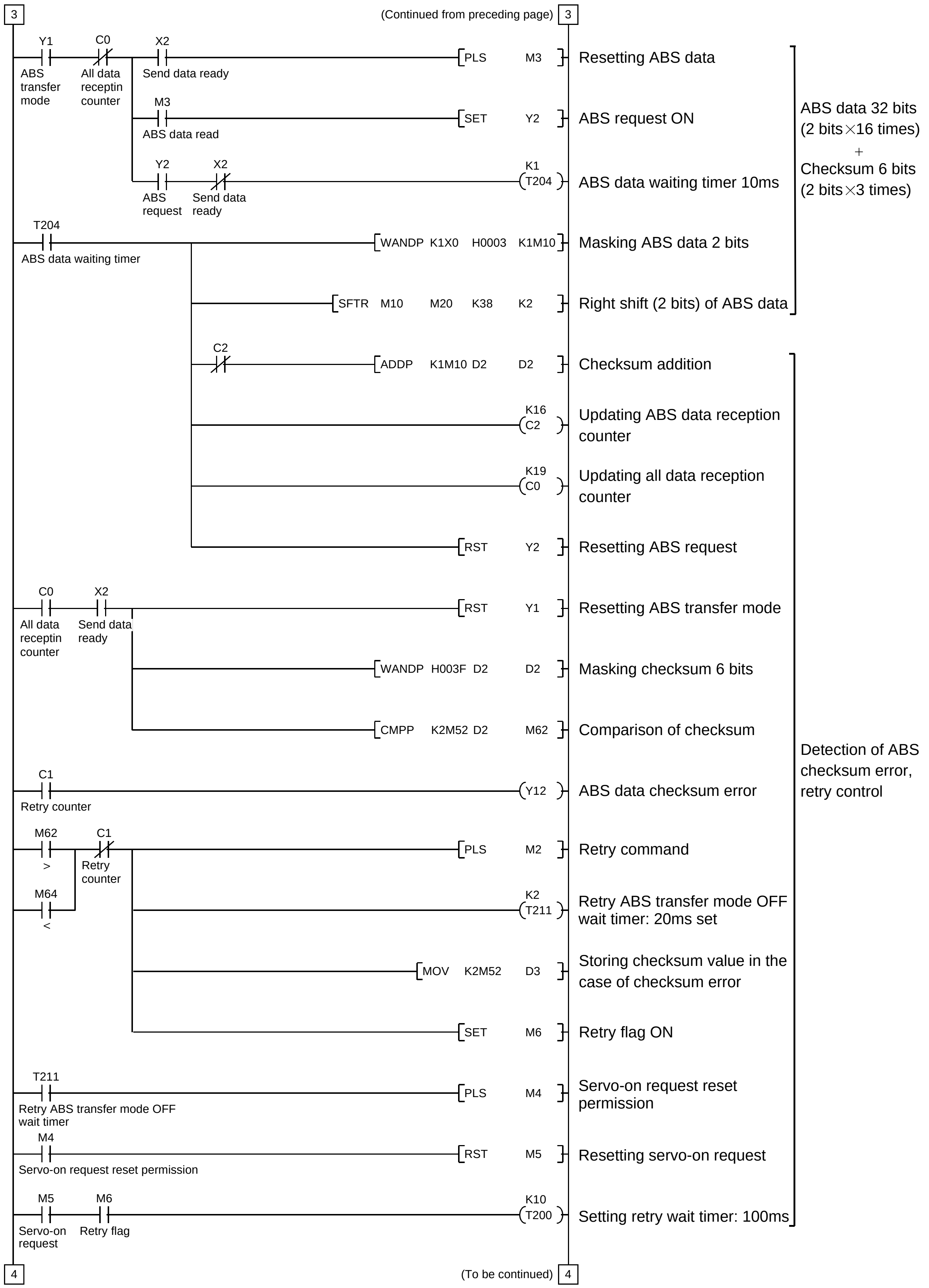
(To be continued) 1

(Continued from preceding page)



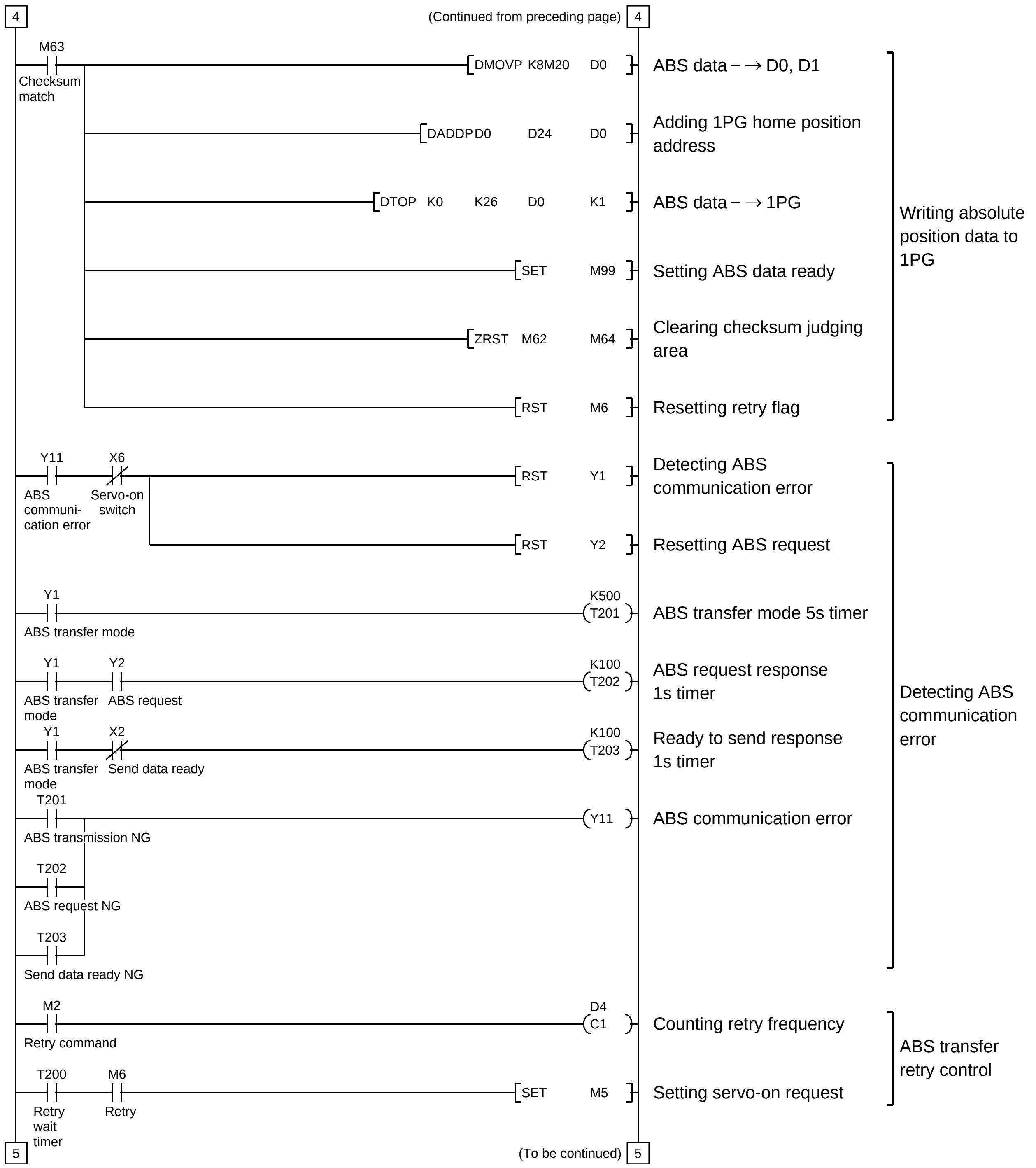
(To be continued)


2
(Continued from preceding page)
X4
M0
Alarm reset switch
Error flag
Y3
Alarm reset
Y3
Alarm reset output
RST C1
Clearing retry counter
ZRST M0 M64
Clearing ABS data receiving area
ZRST D0 D3
Clearing ABS receive data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
X5
Emergency stop switch
X3
Servo alarm
M0
Error flag output
Y10
Servo alarm output
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M99
Resetting ready to send
RST M5
Resetting servo-on request
RST M6
Resetting retry flag
Servo alarm detection, alarm reset control
M1
ABS data transmission start
SET Y1
ABS transfer mode ON
ZRST M10 M64
Clearing ABS data reception area
ZRST D0 D2
Clearing ABS receiver data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
ABS transfer mode Initial setting
3
(To be continued)

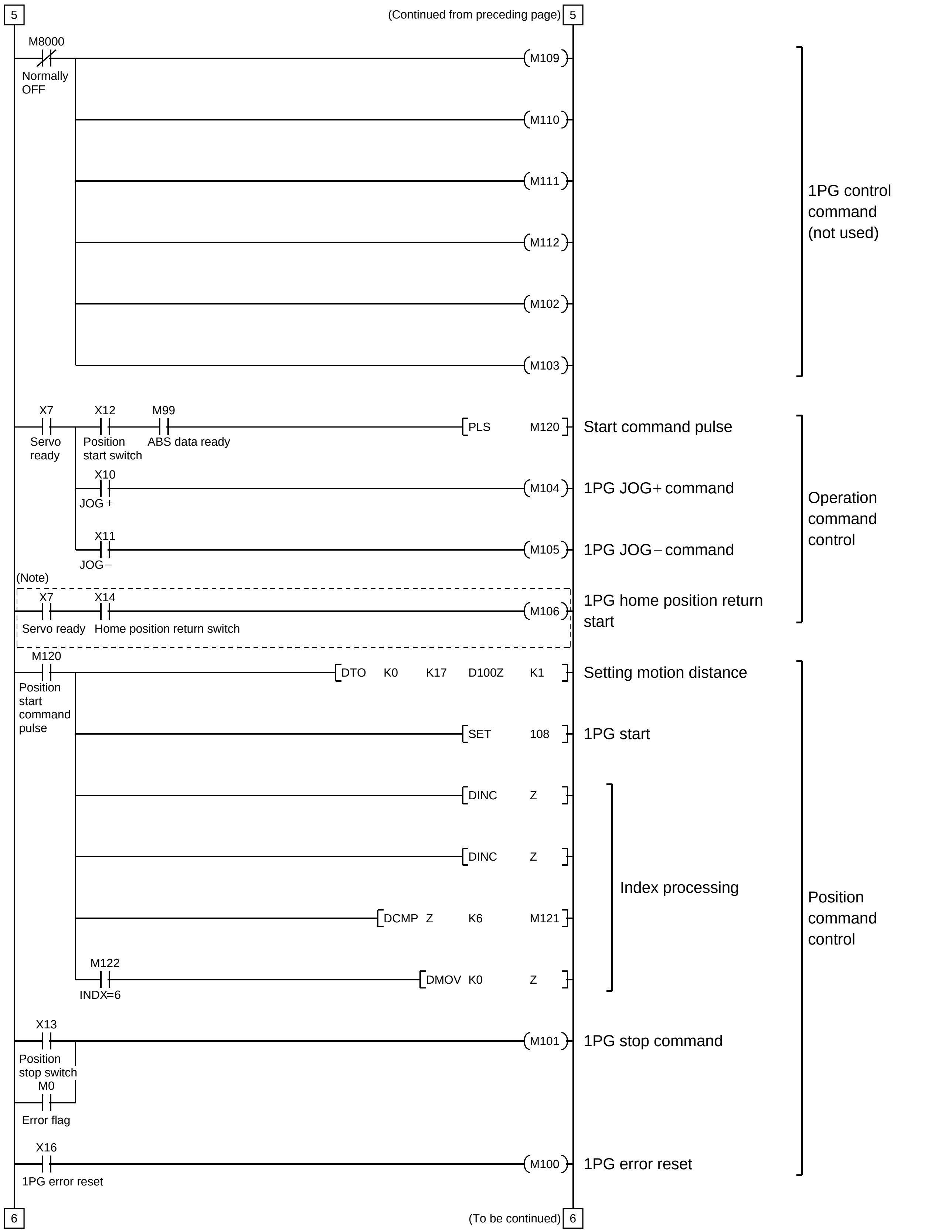


3
(Continued from preceding page) 3
Y1 C0 X2
ABS transfer mode
All data receptin counter
Send data ready
PLS M3
Resetting ABS data
M3
ABS data read
SET Y2
ABS request ON
Y2 X2
ABS request
Send data ready
K1
T204
ABS data waiting timer 10ms
ABS data 32 bits (2 bits×16 times)
+
Checksum 6 bits (2 bits×3 times)
T204
ABS data waiting timer
WANDP K1X0 H0003 K1M10
Masking ABS data 2 bits
SFTR M10 M20 K38 K2
Right shift (2 bits) of ABS data
C2
ADDP K1M10 D2 D2
Checksum addition
K16
C2
Updating ABS data reception counter
K19
C0
Updating all data reception counter
RST Y2
Resetting ABS request
C0 X2
All data receptin counter
Send data ready
RST Y1
Resetting ABS transfer mode
WANDP H003F D2 D2
Masking checksum 6 bits
CMPP K2M52 D2 M62
Comparison of checksum
C1
Retry counter
Y12
ABS data checksum error
Detection of ABS checksum error, retry control
M62 C1
>
Retry counter
M64
<
PLS M2
Retry command
K2
T211
Retry ABS transfer mode OFF wait timer: 20ms set
MOV K2M52 D3
Storing checksum value in the case of checksum error
SET M6
Retry flag ON
T211
Retry ABS transfer mode OFF wait timer
PLS M4
Servo-on request reset permission
M4
Servo-on request reset permission
RST M5
Resetting servo-on request
M5 M6
Servo-on request
Retry flag
K10
T200
Setting retry wait timer: 100ms
4
(To be continued) 4

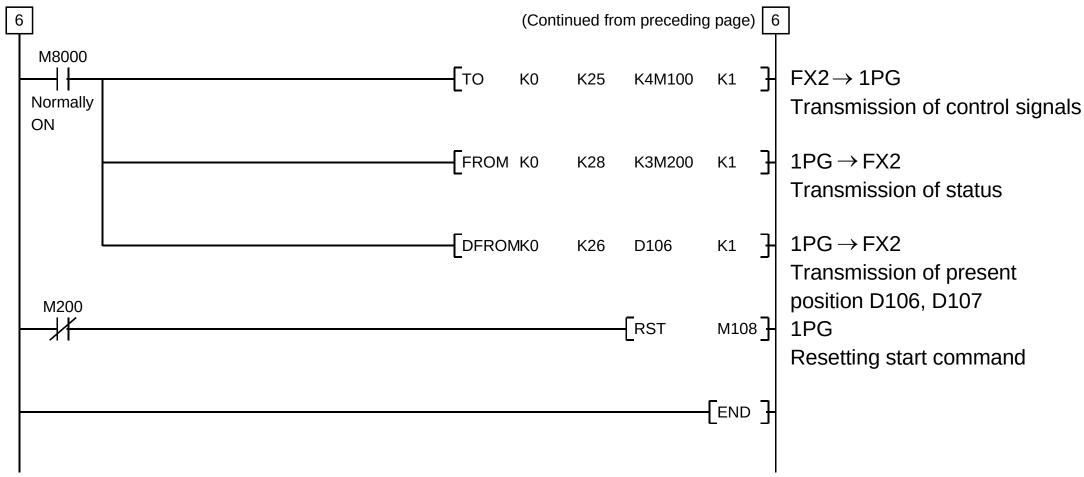
(Continued from preceding page)



(To be continued)

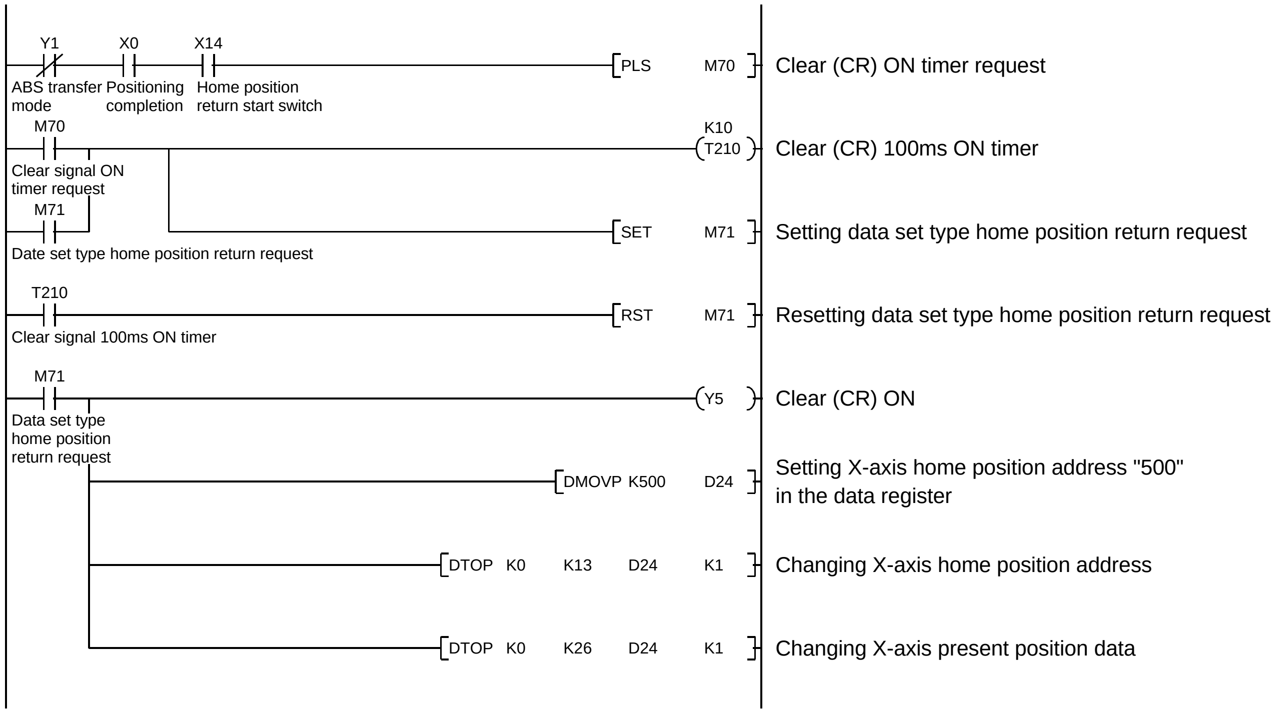


Note. Program example for the dog type home position return. For the data set type home position return, refer to the program example in (2), (d) of this section.



(d) Data set type home position return

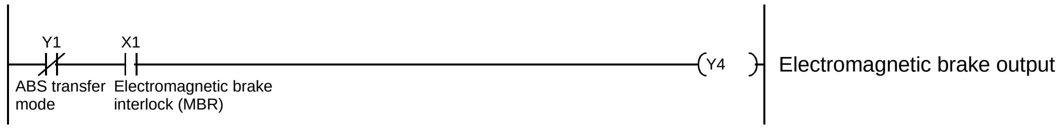
After jogging the machine to the position where the home position (e.g.500) is to be set, choose the home position return mode set the home position with the home position return start switch (X14) ON. After switching power on, rotate the servo motor more than 1 revolution before starting home position return. Do not turn ON the clear (CR) (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(e) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

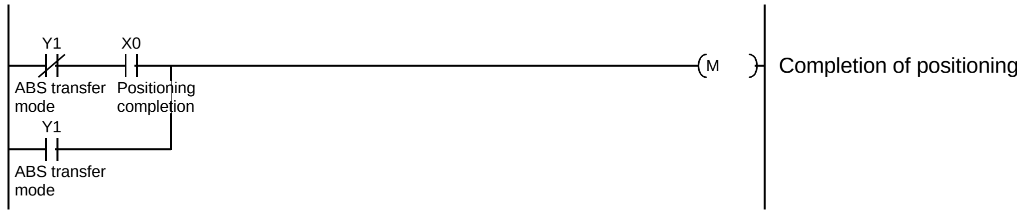
Set "□□□1" in parameter No.PA04 of the driver to make the electromagnetic brake interlock (MBR) valid.



(f) Positioning completion

To create the status information for positioning completion.

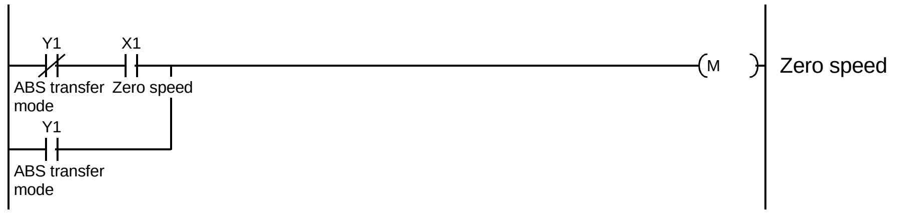
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(g) Zero speed

To create the status information for zero speed.

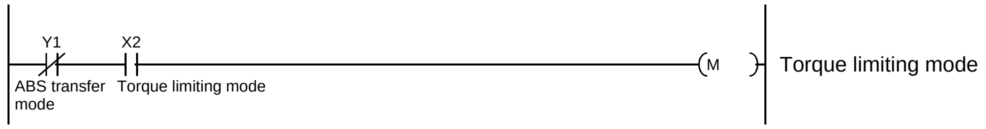
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(h) Torque limiting

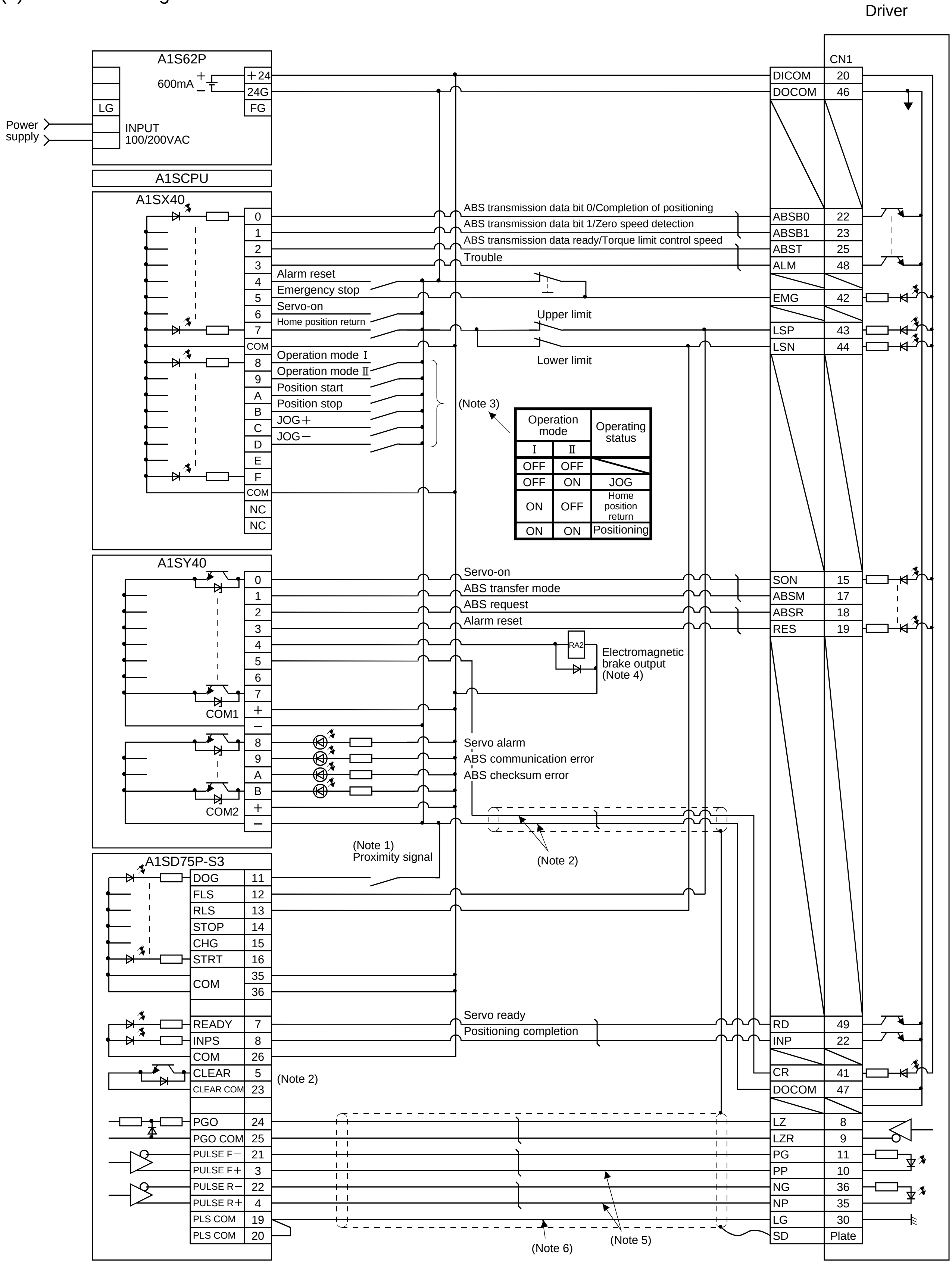
To create the status information for the torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



14.9.2 MELSEC A1SD75

(1) Connection diagram



Operation mode		Operating status
Ⅰ	Ⅱ	
OFF	OFF	
OFF	ON	JOG
ON	OFF	Home position return
ON	ON	Positioning

Note 1. For the dog type home position return. Need not be connected for the data set type home position return.
2. If the servo motor provided with the zero point signal is started, the A1SD75 will output the deviation counter clear (CR). Therefore, do not connect the clear (CR) of the LECSB□-□ to the A1SD75 but connect it to the output module of the programmable PC or PLC...etc.
3. This circuit is provided for your reference.
4. The electromagnetic brake output should be controlled via a relay connected to the programmable PC or PLC...etc output.
5. This connection diagram applies to the differential line driver system as a pulse input system. Refer to section 3.8.2 (3)(b) and A1SD75P□-S3 Positioning Module User’s Manual (IB(NA)66716) for the open collector system.
6. To enhance noise immunity, connect LG and pulse output COM.

(2) Sequence program example

(a) Conditions

The ABS data is transmitted using the leading edge of the servo-on switch as a trigger.

1) When the servo-on switch and power supply GND are shorted, the ABS data is transmitted at power-on of the driver or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset. Before starting the ABS data transfer, confirm that it is the servo-on (SON) ON state (refer to section 3.3.2).

2) If a checksum mismatch is detected in the transmitted data, data transmission is retried up to three times. If the checksum mismatch still persists after the retries, the ABS checksum error occurs (Y3A ON).

3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON).
ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of reading to send ABS data (X22)

(b) Device list

X input contact	
X20	ABS Transmission data bit 0 / positioning completion
X21	ABS Transmission data bit 1 / zero speed detection
X22	Reading to send ABS data / limiting torque
X23	Servo alarm
X24	Alarm reset switch
X25	Servo emergency stop
X26	Servo-on switch
X27	Home position return start switch
X28	Operation mode I
X29	Operation mode II

D register	
D0	ABS data transmission counter
D1	Checksum transmission counter
D2	Checksum addition register
D3	ABS data: Lower 16 bits
D4	ABS data: Upper 16 bits
D5	ABS data 2-bit receiving buffer
D6	Check data in case of checksum error
D7	Number of retries
D8	Forward rotation direction
D9	Home position address: Lower 16 bits
D10	Home position address: Upper 16 bits
D11	Drive unit ready data
D12	Home position return completion data
D110	Received shift data: Lower 16 bits
D111	Received shift data: Upper 16 bits

T timer	
T0	ABS transmission mode timer
T1	ABS request response timer
T2	Retry wait timer
T3	ABS data send reading response timer
T10 (Note 1)	Clear (CR) ON timer
T200	Transmitted data read 10ms delay timer
T211	Retry ABS transfer mode OFF wait timer 20ms set

Y output contact	
Y30	Servo-on
Y31	ABS transfer mode
Y32	ABS request
Y33	Alarm reset
Y34 (Note 2)	Electromagnetic brake output
Y35 (Note 1)	Clear
Y38	Servo alarm
Y39	ABS communication error
Y3A	ABS checksum error

M contact	
M5	ABS data transmission start
M6	Sum check completion
M7	Sum check mismatch
M8	ABS data ready
M9	Transmission data read enabled
M10	Checksum 2 bits read completion
M11	ABS 2 bits read completion
M12	ABS 2 bits request
M13	Servo-on request
M14	Servo alarm
M15	ABS data transfer retry start flag set
M16	Retry flag set
M17	Retry flag reset
M18	PLS processing command
M20 (Note 1)	Clear (CR) ON timer request
M21 (Note 1)	Data set type home position return request
M22	Home position return processing instruction
M23	Current position change processing instruction
M24	Current position change flag
M26	ABS transfer mode OFF permission

C counter	
C0	ABS data receive times counter
C1	Checksum receive times counter
C2	Retry counter

Note 1. Required for data set type home position return.

2. Required for electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions.

・Parameters of the A1SD75P1-S3 positioning module

1) Unit setting :3 = pulse (PLS)

2) Travel per pulse :1 = 1 pulse

To select the unit other than the pulse, conversion into the unit of the feed value per pulse is required. Hence, add the following program to the area marked (Note) in the sequence program.

<Additional program>

[D * P K □□ D3 D3]

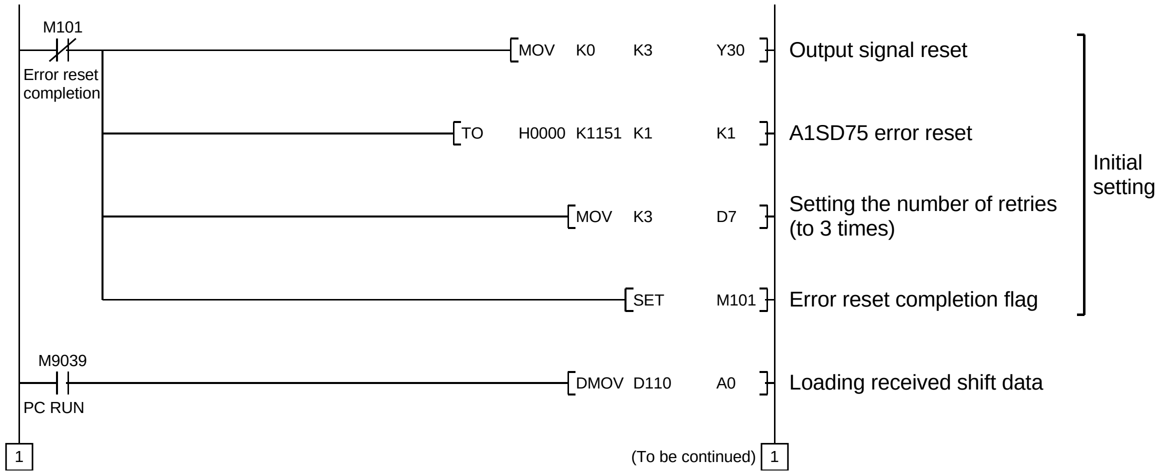
Item	mm				inch				degree				pulse
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.00001 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	μm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	None

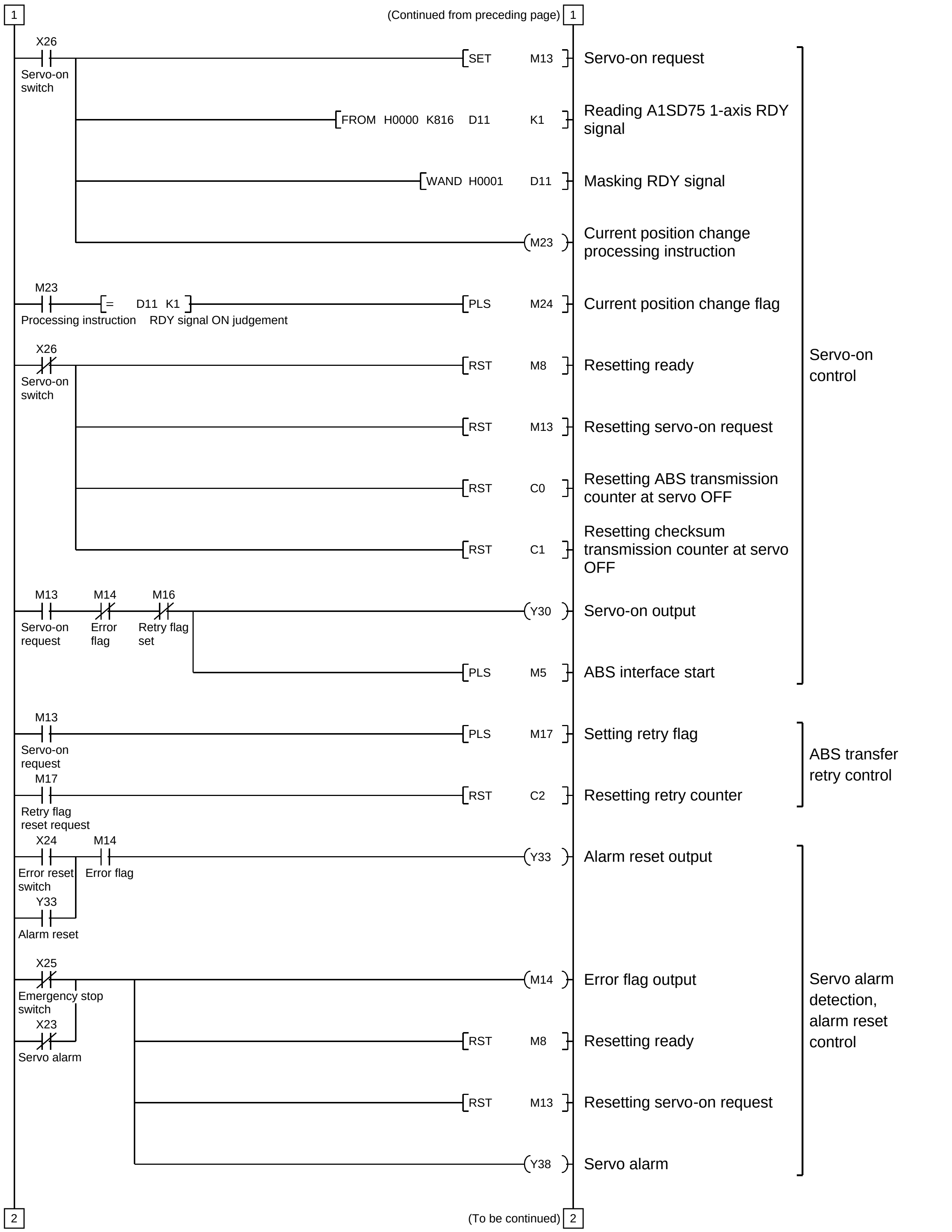
Reference

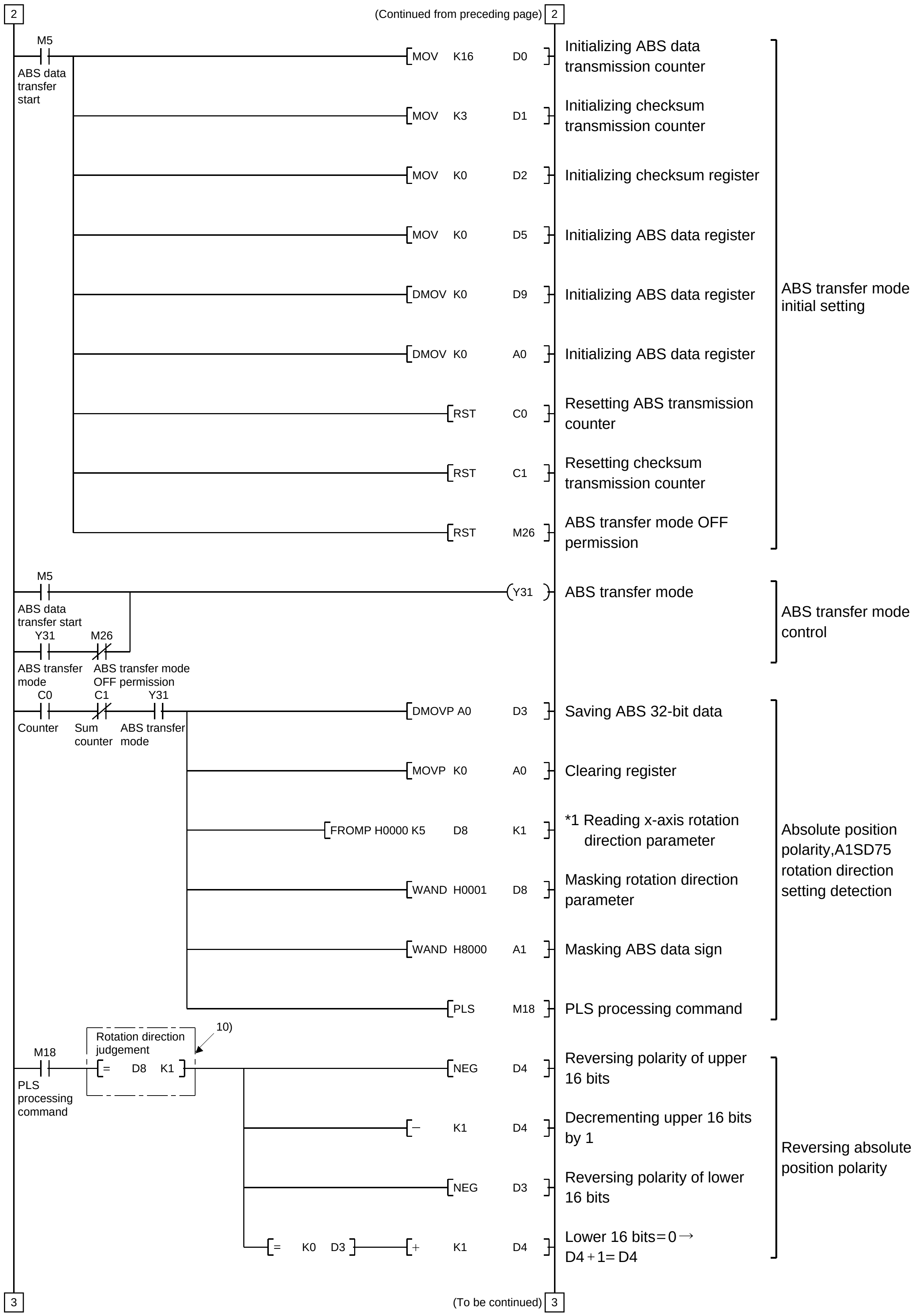
・For 1μm/PLS, set constant K to 10

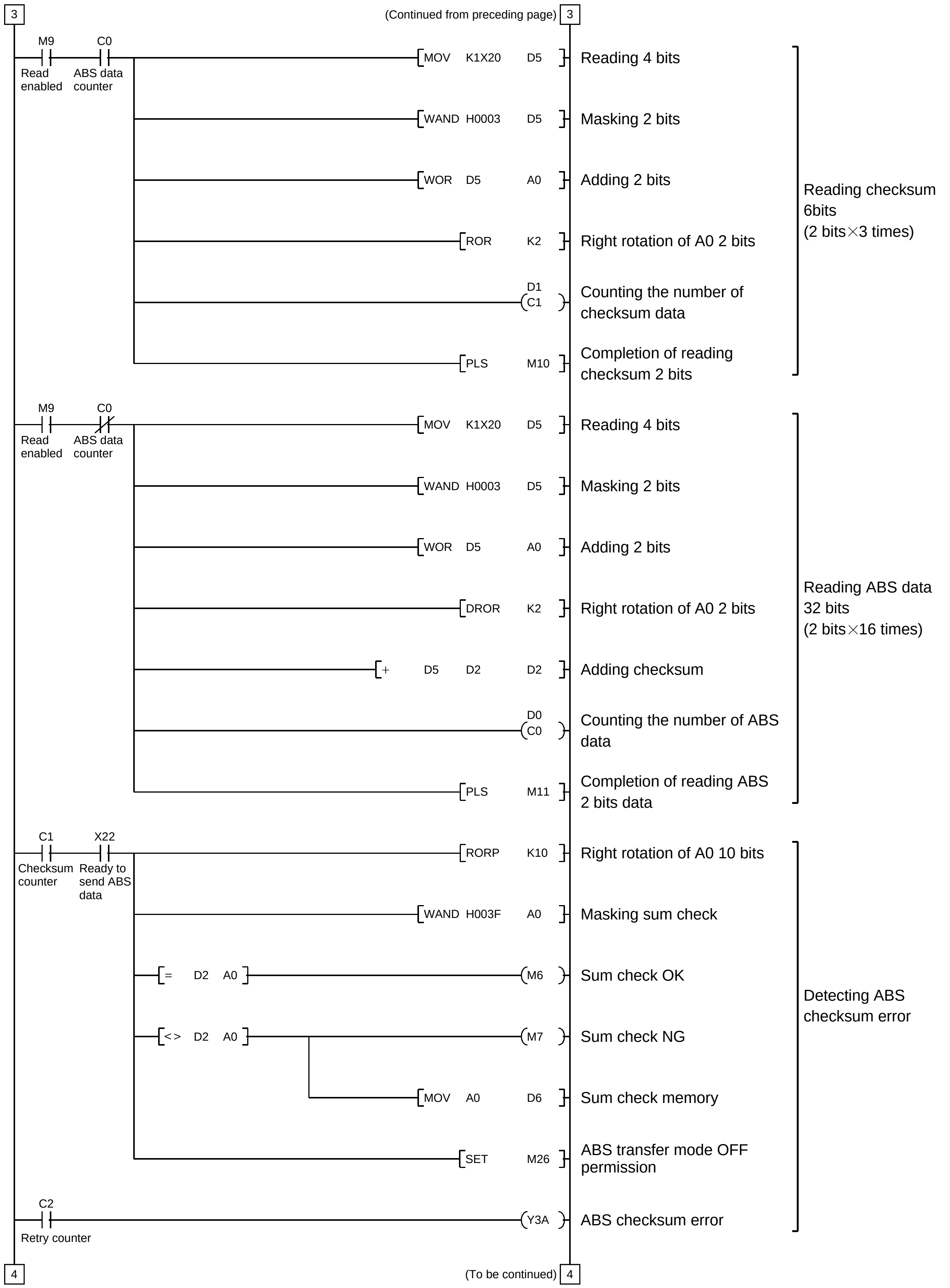
・For 5μm/PLS, set constant K to 50

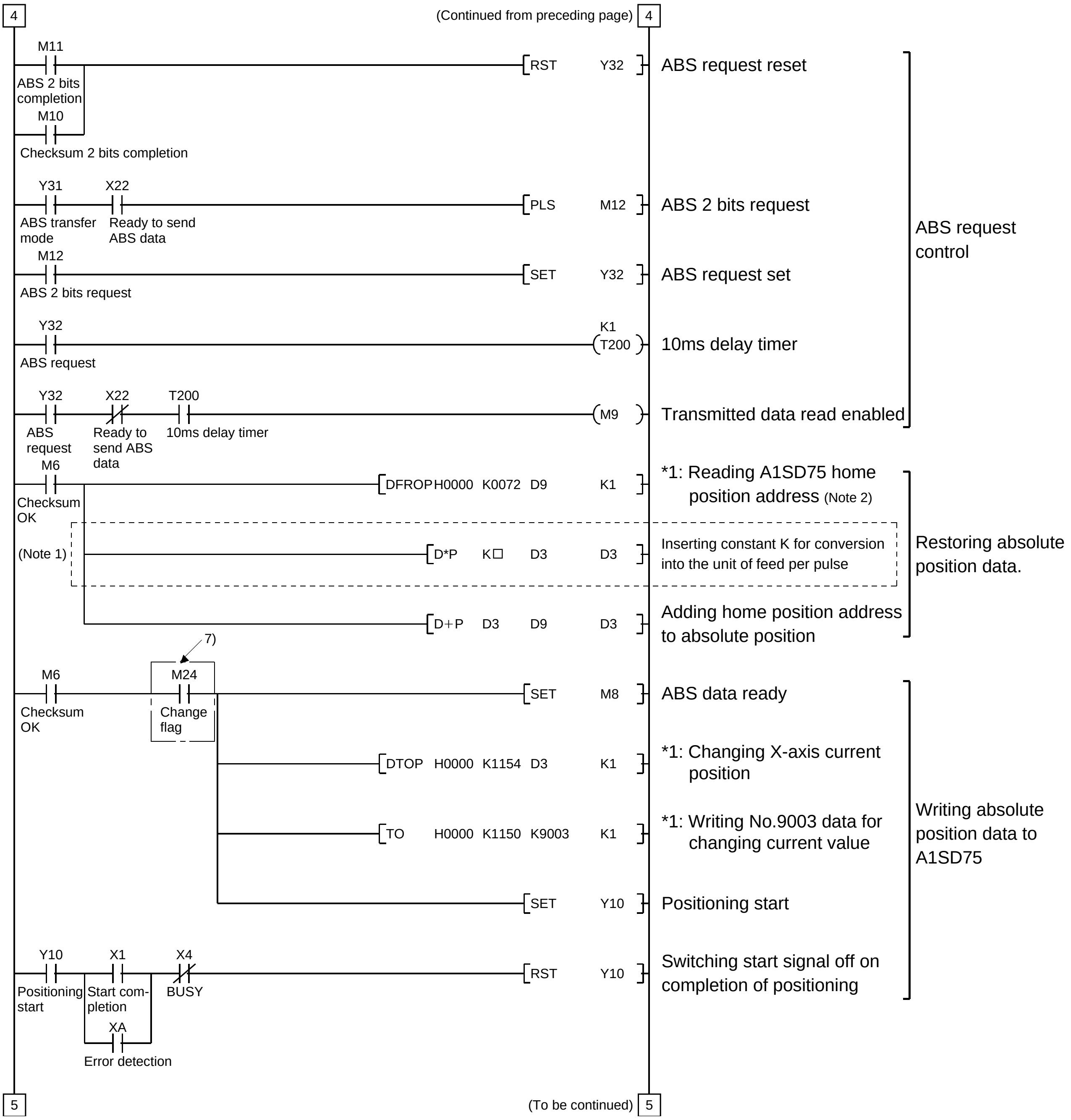
・The additional program is not required for the unit setting is PLS.




1
(Continued from preceding page) 1
X26
Servo-on switch
SET M13
Servo-on request
FROM H0000 K816 D11 K1
Reading A1SD75 1-axis RDY signal
WAND H0001 D11
Masking RDY signal
M23
Current position change processing instruction
M23
Processing instruction
= D11 K1
RDY signal ON judgement
PLS M24
Current position change flag
X26
Servo-on switch
RST M8
Resetting ready
RST M13
Resetting servo-on request
RST C0
Resetting ABS transmission counter at servo OFF
RST C1
Resetting checksum transmission counter at servo OFF
M13
Servo-on request
M14
Error flag
M16
Retry flag set
Y30
Servo-on output
PLS M5
ABS interface start
Servo-on control
M13
Servo-on request
PLS M17
Setting retry flag
M17
Retry flag reset request
RST C2
Resetting retry counter
ABS transfer retry control
X24
Error reset switch
M14
Error flag
Y33
Alarm reset
Y33
Alarm reset output
X25
Emergency stop switch
X23
Servo alarm
M14
Error flag output
RST M8
Resetting ready
RST M13
Resetting servo-on request
Y38
Servo alarm
Servo alarm detection, alarm reset control
2
(To be continued) 2

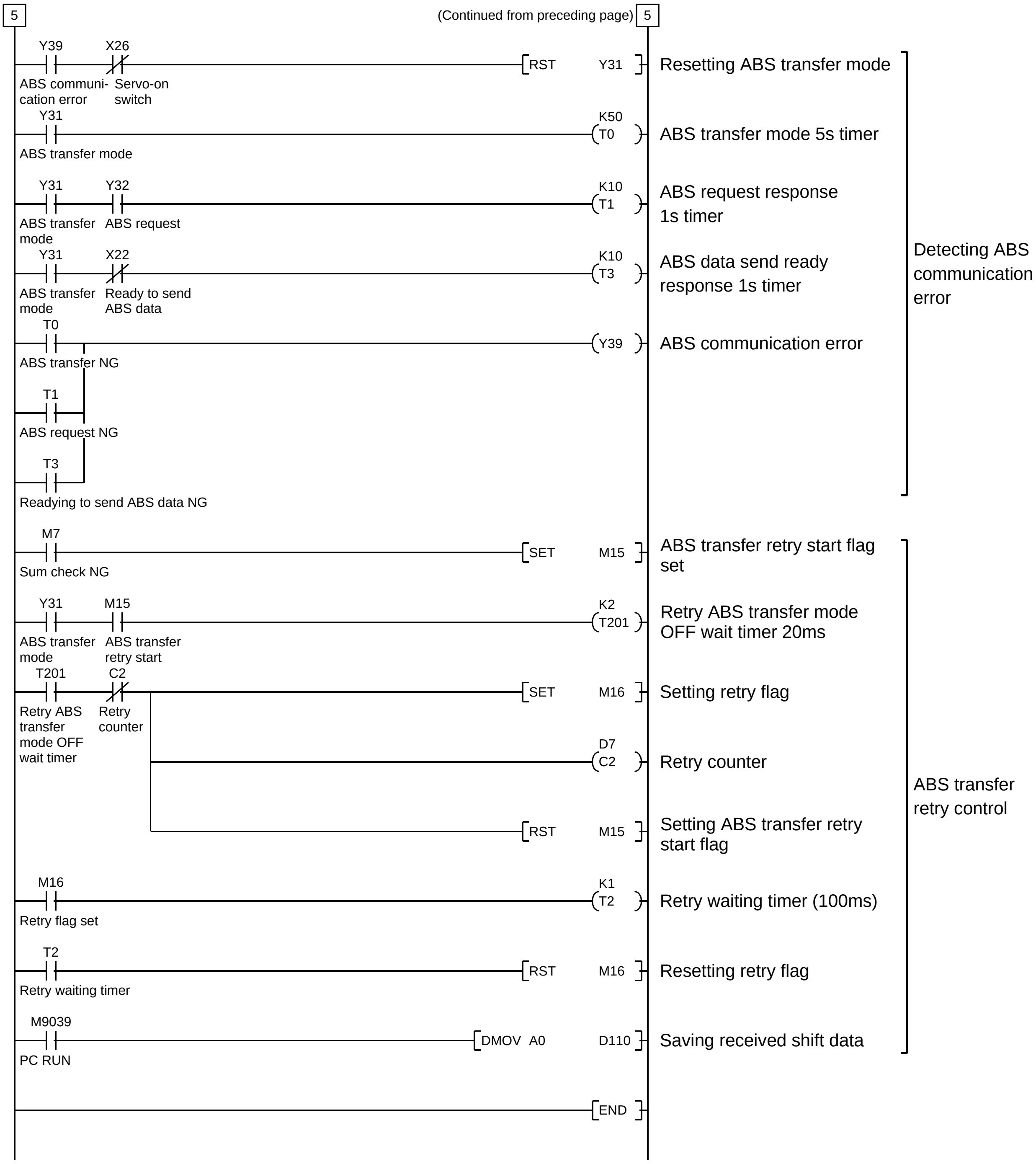

2
(Continued from preceding page) 2
M5
ABS data transfer start
MOV K16 D0
Initializing ABS data transmission counter
MOV K3 D1
Initializing checksum transmission counter
MOV K0 D2
Initializing checksum register
MOV K0 D5
Initializing ABS data register
DMOV K0 D9
Initializing ABS data register
DMOV K0 A0
Initializing ABS data register
RST C0
Resetting ABS transmission counter
RST C1
Resetting checksum transmission counter
RST M26
ABS transfer mode OFF permission
ABS transfer mode initial setting
M5
ABS data transfer start
Y31
M26
ABS transfer mode
ABS transfer mode OFF permission
Y31
ABS transfer mode
ABS transfer mode control
C0
C1
Y31
Counter
Sum counter
ABS transfer mode
DMOVP A0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
FROMP H0000 K5 D8 K1
*1 Reading x-axis rotation direction parameter
WAND H0001 D8
Masking rotation direction parameter
WAND H8000 A1
Masking ABS data sign
PLS M18
PLS processing command
Absolute position polarity,A1SD75 rotation direction setting detection
10)
Rotation direction judgement
M18
PLS processing command
= D8 K1
NEG D4
Reversing polarity of upper 16 bits
– K1 D4
Decrementing upper 16 bits by 1
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits=0→ D4+1=D4
Reversing absolute position polarity
3
(To be continued) 3


3
(Continued from preceding page) 3
M9
C0
Read enabled
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
ROR K2
Right rotation of A0 2 bits
D1
C1
Counting the number of checksum data
PLS M10
Completion of reading checksum 2 bits
Reading checksum 6bits (2 bits×3 times)
M9
C0
Read enabled
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding checksum
D0
C0
Counting the number of ABS data
PLS M11
Completion of reading ABS 2 bits data
Reading ABS data 32 bits (2 bits×16 times)
C1
X22
Checksum counter
Ready to send ABS data
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking sum check
= D2 A0
M6
Sum check OK
<> D2 A0
M7
Sum check NG
MOV A0 D6
Sum check memory
SET M26
ABS transfer mode OFF permission
C2
Retry counter
Y3A
ABS checksum error
Detecting ABS checksum error
4
(To be continued) 4



Note 1. When the unit setting parameter value of the A1SD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To set the unit to × 1μm, add this program to multiple the feed value by 10.

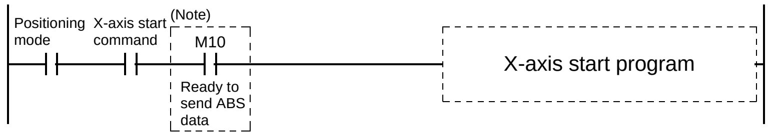
2. The home position address loaded from flash ROM of normal positioning module can be obtained.
For updating the home position address by the home position setting, refer to (2) (f) Data set type home position return in this Section.



5
(Continued from preceding page) 5
Y39
X26
RST Y31
ABS communi-cation error
Servo-on switch
Resetting ABS transfer mode
Y31
K50
T0
ABS transfer mode
ABS transfer mode 5s timer
Y31
Y32
K10
T1
ABS transfer mode
ABS request
ABS request response 1s timer
Y31
X22
K10
T3
ABS transfer mode
Ready to send ABS data
ABS data send ready response 1s timer
Detecting ABS communication error
T0
Y39
ABS transfer NG
ABS communication error
T1
ABS request NG
T3
Readying to send ABS data NG
M7
SET M15
Sum check NG
ABS transfer retry start flag set
Y31
M15
K2
T201
ABS transfer mode
ABS transfer retry start
Retry ABS transfer mode OFF wait timer 20ms
T201
C2
SET M16
Retry ABS transfer mode OFF wait timer
Retry counter
Setting retry flag
D7
C2
Retry counter
ABS transfer retry control
RST M15
Setting ABS transfer retry start flag
M16
K1
T2
Retry flag set
Retry waiting timer (100ms)
T2
RST M16
Retry waiting timer
Resetting retry flag
M9039
DMOV A0 D110
PC RUN
Saving received shift data
END

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.



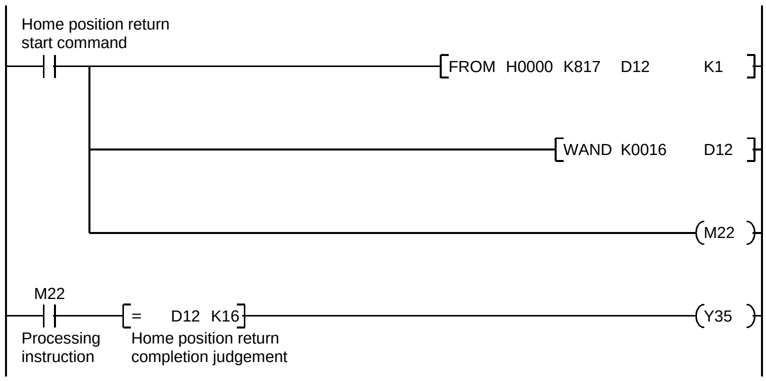
When "M10" (ready to send ABS data) switches on, the X-axis start program is executed by the X-axis start command.

(e) Dog type home position return

Refer to the home position return program in the A1SD75 User's Manual.

Note that this program requires a program which outputs the clear (CR) (Y35) after completion of home position return.

Add the following program.



Reading 1-axis home position return completion signal

Masking home position return completion

Home position return processing instruction

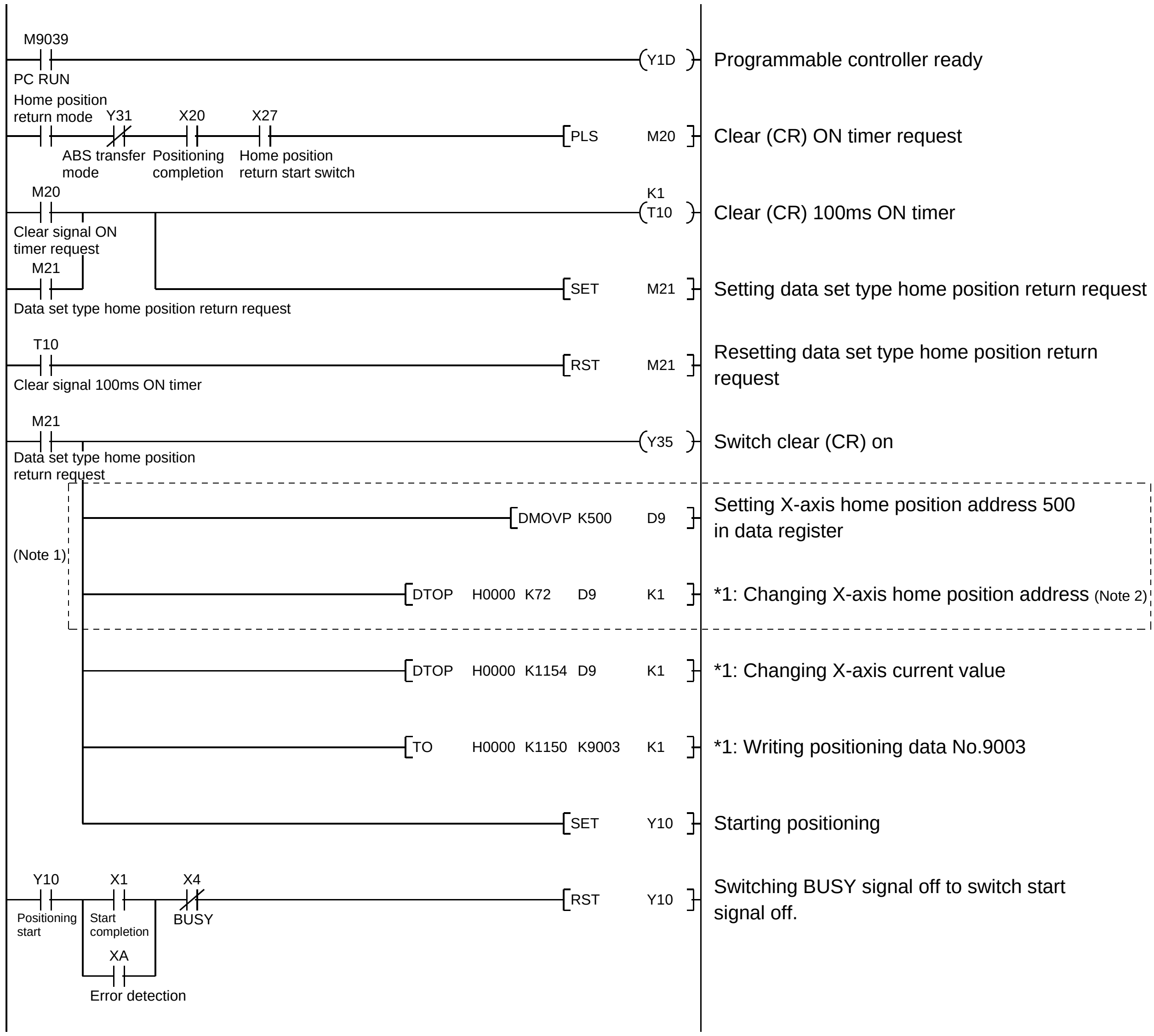
Switching clear (CR) on

(f) Data set type home position return

After jogging the machine to the position where the home position (e.g. 500) is to be set, choose the home position return mode and set the home position with the home position return start switch (X27) ON.

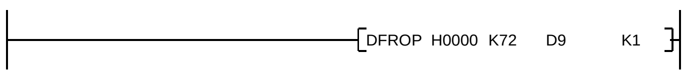
After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear (CR) (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



Note 1. When the data of the home position address parameter is not written from GX Developer or the like before starting the data set type home position return program, this sequence circuit is required.
When the home position address is written in the home position address parameter, change to the following circuit.

(Note 2)

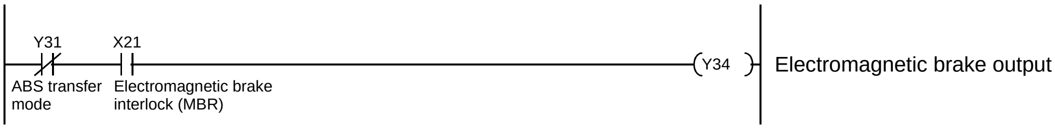


2. Changes are stored temporarily to buffer memory at this time. An additional processing is required when changes should be reflected to memory for OS or flash ROM. For details, refer to the positioning module user's manual.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

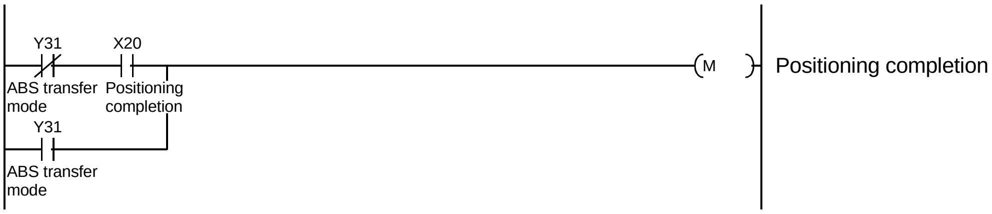
Set "□□□1" in parameter No.PA04 of the driver to make the electromagnetic brake interlock (MBR) valid.



(h) Positioning completion

To create the status information for positioning completion.

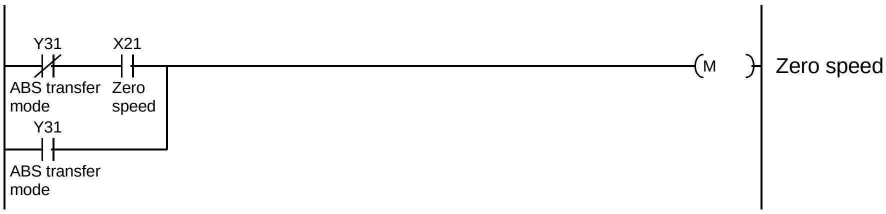
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for zero speed.

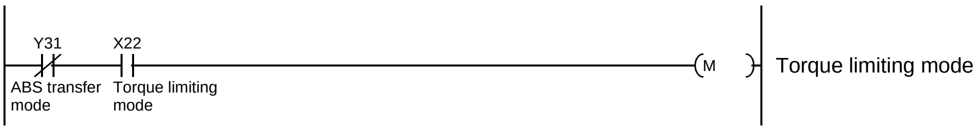
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single A1SD75 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

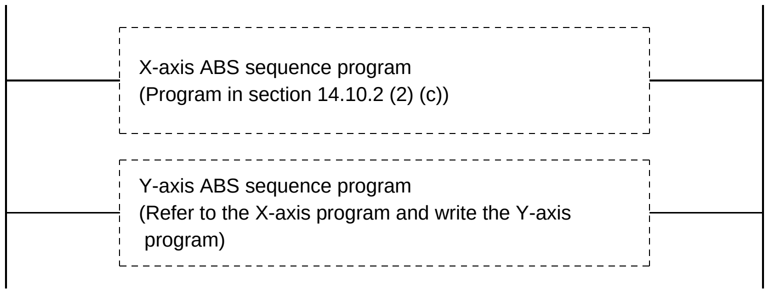
Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.9.2 (2) (c) should be changed as indicated below for use with the Y axis.

```
[FROMP  H0000  K5     D8     K1]  →  [FROMP  H0000  K155   D8     K1]
[DFROP  H0000  K0072  D9     K1]  →  [DFROP  H0000  K222   D9     K1]
[DTOP   H0000  K1154  D3     K1]  →  [DTOP   H0000  K1204  D3     K1]
[TO     H0000  K1150  K9003  K1]  →  [TO     H0000  K1200  K9003  K1]
```

[Program configuration]



(b) Data set type home position return

Arrange the data set type home position return programs given in section 14.9.2 (2) (f) in series to control two axes.

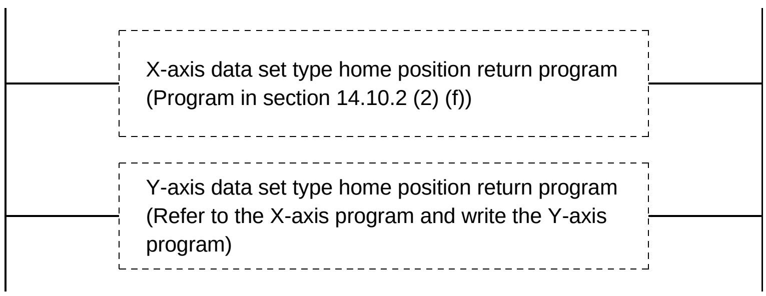
Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.9.2 (2) (f) should be changed as indicated below for use with the Y axis.

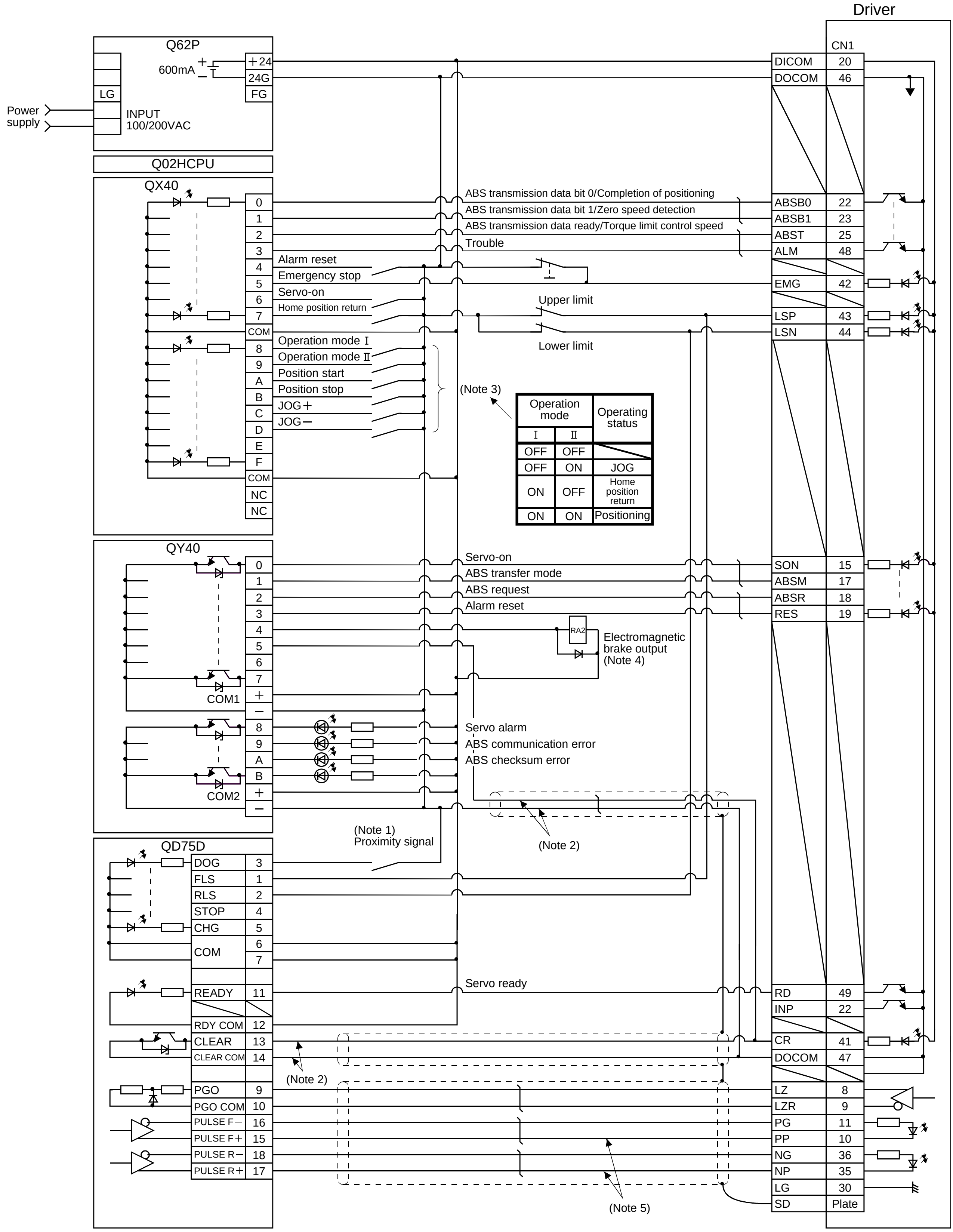
```
[DTOP  H0000  K72    D9     K1]  →  [DTOP  H0000  K222   D9     K1]
[DTOP  H0000  K1154  D9     K1]  →  [DTOP  H0000  K1204  D3     K1]
[TO    H0000  K1150  K9003  K1]  →  [TO    H0000  K1200  K9003  K1]
```

[Program configuration]



14.9.3 MELSEC QD75

(1) Connection diagram



Note 1. For the dog type home position return. Need not be connected for the data set type home position return.
2. For the dog type home position return, connect a QD75 deviation counter clearing signal cable. For the data set type home position return, connect a cable to the output module of the programmable PC or PLC...etc.
3. This circuit is provided for your reference.
4. The electromagnetic brake output should be controlled via a relay connected to the programmable PC or PLC...etc output.
5. Refer to section 3.8.2 (3)(b) and Type QD75P/QD75D Positioning Module User's Manual when connecting to QD75P.

(2) Sequence program example

(a) Conditions

The ABS data is transmitted using the leading edge of the servo-on switch as a trigger.

1) When the servo-on switch and power supply GND are shorted, the ABS data is transmitted at power-on of the driver or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.

2) An ABS checksum error is caused (Y3AON) if checksum inconsistency is found in transferred data.

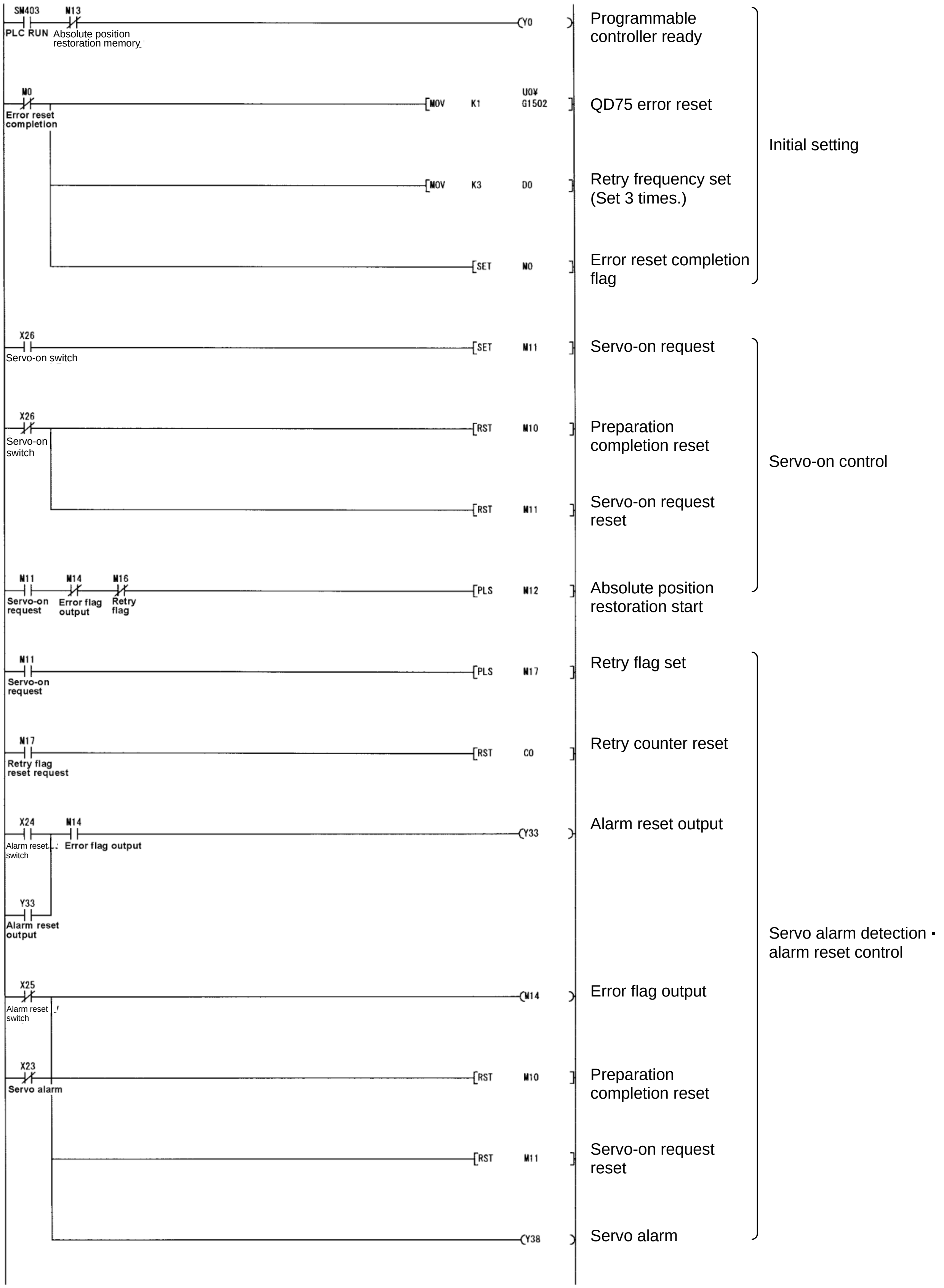
3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON).
ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of reading to send ABS data (X22)

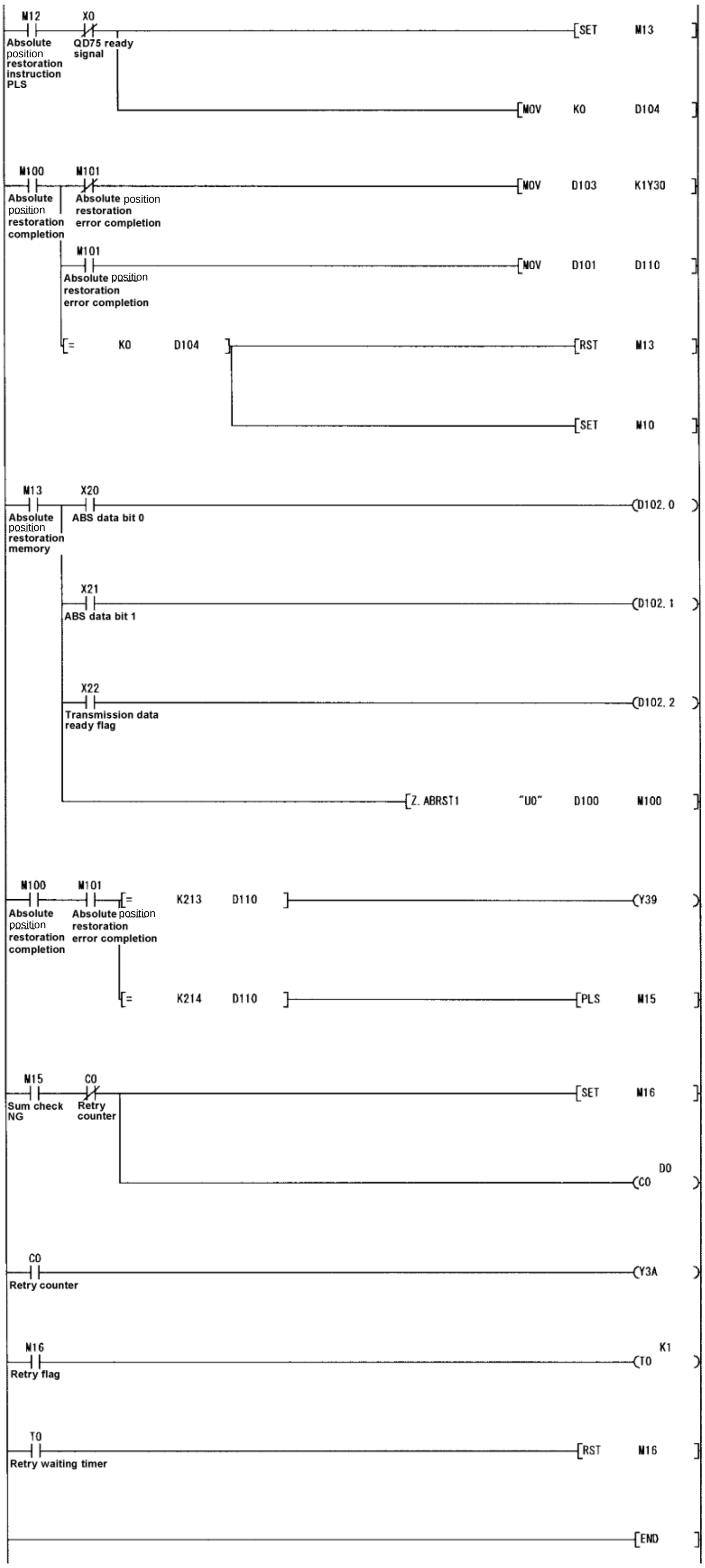
(b) Device list

X input contact		Y output contact	
X20	ABS transmission data bit 0/Positioning completion	Y30	Servo-on
X21	ABS transmission data bit 1/zero speed detection	Y31	ABS transfer mode
X22	ABS transmission data ready/Torque limiting	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset switch	Y34 (Note 2)	Electromagnetic brake output
X25	Servo emergency stop	Y35 (Note 1)	Clear
X26	Servo-on switch	Y38	Servo alarm
X27	Home position return start switch	Y39	ABS communication error
X28	Operation mode I	Y3A	ABS checksum error
X29	Operation mode II		
D register		**M contact**	
D0	Number of retries	M0	End of error reset
D9	Home position address: Lower 16 bits	M10	Preparation completion
D10	Home position address: Upper 16 bits	M11	Servo-on request
D100 to D104	For absolute position restoration dedicated instruction	M12	Absolute position restoration instruction PLS
		M13	Absolute position restoration memory
T timer		M14	Error flag output
T0	Retry wait timer	M15	Sum check NG
T10 (Note 1)	Clear (CR) ON timer	M16	Retry flag
		M17	Retry flag reset request
		M20 (Note 1)	Clear (CR) ON timer request
		M21 (Note 1)	Data set type home position return request
		M100 to M101	For absolute position restoration dedicated instruction
		C counter	
		C0	Retry counter

Note 1. Required for data set type home position return.
2. Required for electromagnetic brake output.

(c) ABS data transfer program for X axis





Absolute position restoration start flag

Absolute position restoration status reset

Absolute position restoration output

Error code storage

Absolute position restoration start flag reset

Preparation completion

Absolute position restoration data reception

Absolute position restoration data reception

Absolute position restoration data reception

Absolute position restoration dedicated instruction execution

Absolute position restoration

ABS communication error

Sum check error detection

Retry flag set

Retry counter

ABS checksum error

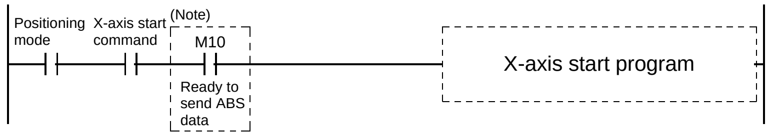
Retry wait timer

Retry flag reset

Error detection・retry control

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M10) is off.



When "M10" (ready to send ABS data) switches on, the X-axis start program is executed by the X-axis start command.

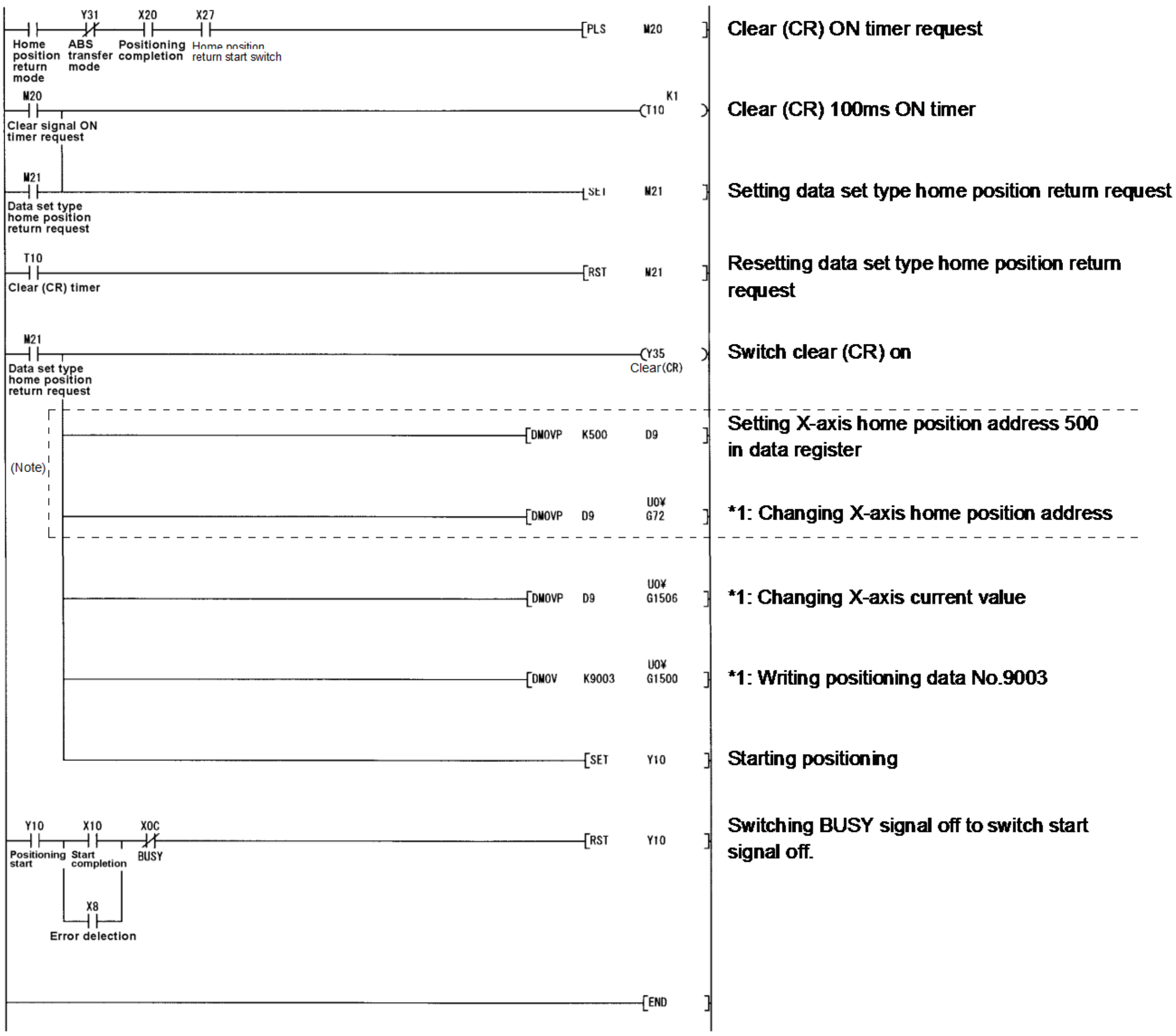
(e) Dog type home position return

Refer to the home position return program in the QD75 User's Manual.

(f) Data set type home position return

After jogging the machine to the position where the home position (e.g. 500) is to be set, choose the home position return mode and set the home position with the home position return start switch (X27) ON. After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear (CR) (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



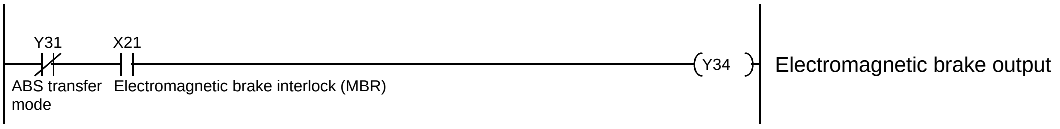
Note. When the data of the home position address parameter is not written from GX Developer or the like before starting the data set type home position return program, this sequence circuit is required.

When the home position address is written in the home position address parameter, change to the following circuit.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

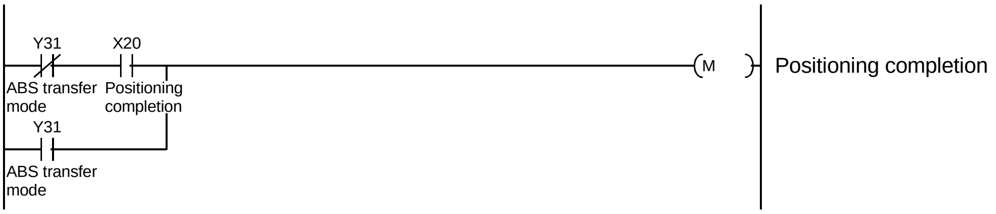
Set "□□□1" in parameter No.PA04 of the driver to make the electromagnetic brake interlock (MBR) valid.



(h) Positioning completion

To create the status information for positioning completion.

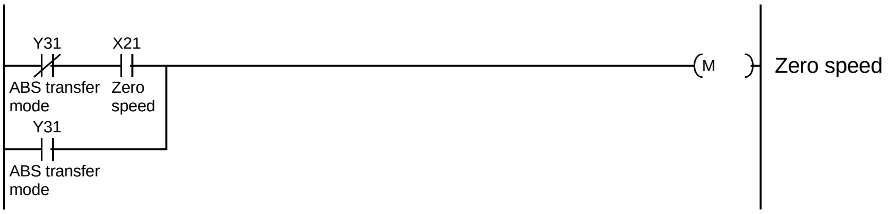
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for zero speed.

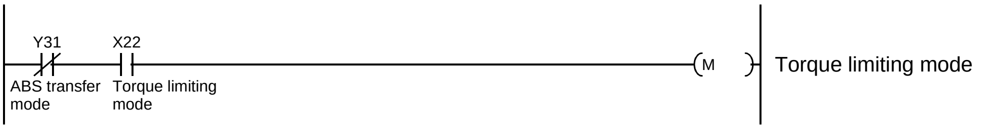
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single QD75 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

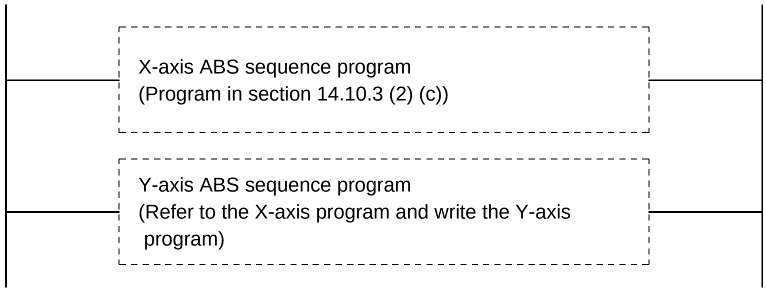
Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the QD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.9.3 (2) (c) should be changed as indicated below for use with the Y axis.

[Z. ABRST1 "U0" D100 M100] → [Z. ABRST2 "U0" D100 M100]

[Program configuration]



(b) Data set type home position return

Arrange the data set type home position return programs given in section 14.9.3 (2) (f) in series to control two axes.

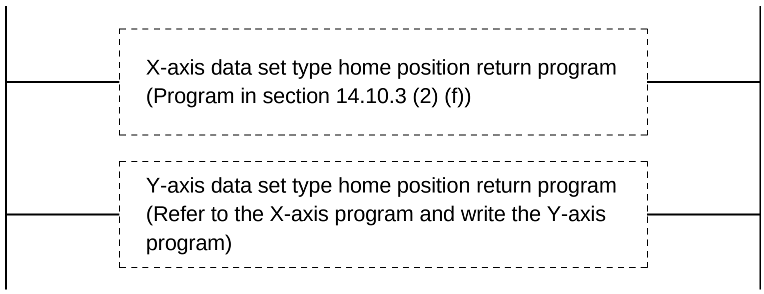
Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the QD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.9.2 (2) (f) should be changed as indicated below for use with the Y axis.

[DMOVP D9 U0¥G72] → [DMOVP D9 U0¥G222]
[DMOVP U0¥G72 D9] → [DMOVP U0¥G222 D9]
[DMOVP D9 U0¥1506] → [DMOVP D9 U0¥1606]
[DMOVP K9003 U0¥1500] → [DMOVP D9 U0¥1600]

[Program configuration]



14.10 Absolute position data transfer errors

14.10.1 Corrective actions

(1) Error list

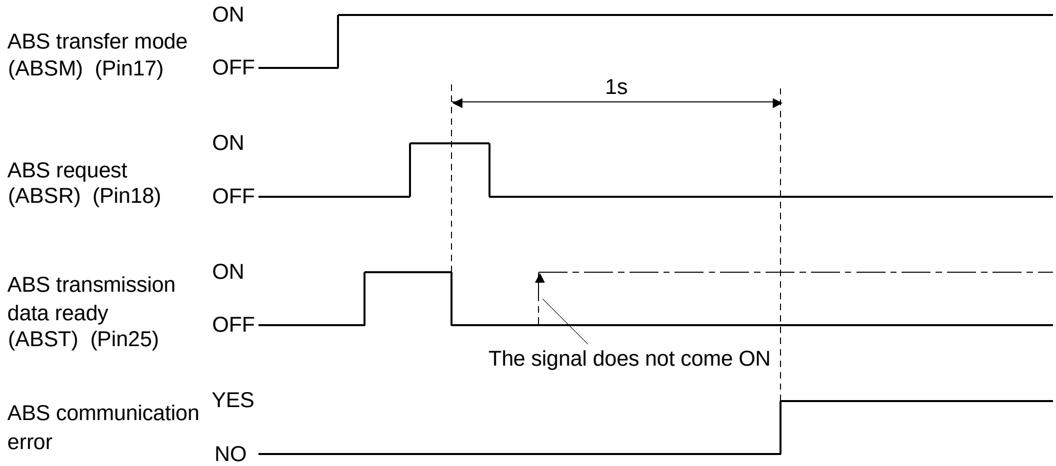
The number within parentheses in the table indicates the output coil or input contact number of the A1SD75.

Name	Output coil		Description	Cause	Action
	AD75	1PG			
(Note) ABS communication error	Y39	Y11	1. The ABS data transfer mode signal (Y41) is not completed within 5s. 2. The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON. 3. The ready to send signal (X32) remains OFF for longer than 1s.	1. Wiring for ABS transfer mode signal, ABS data request signal, or ready to send signal is disconnected or connected to the DOCOM terminal.	Correct the wiring.
				2. Programmable PC or PLC...etc program incorrect.	Correct the ladder.
				3. Faulty programmable PC or PLC...etc output or input module.	Change the input or output module.
				4. Faulty printed board in the driver.	Change the driver
				5. Power supply to the driver is OFF.	Turn on the power to the driver.
ABS data checksum error	Y3A	Y12	・ABS data sumcheck resulted in mismatch four times consecutively.	1. Wiring for the ABS data signal (ABS bit 0 (PF), bit 1 (ZSP)) is disconnected or connected to the SG terminal.	Correct the wiring.
				2. Programmable PC or PLC...etc program incorrect.	Correct the ladder.
				3. Faulty Programmable PC or PLC...etc input module.	Change the input module.
				4. Faulty printed board in the driver.	Change the driver
Servo alarm	Y38	Y10	・Alarm occurred in the driver.	1. Emergency stop (EMG) of the driver was turned off.	After ensuring safety, turn EMG on.
				2. Trouble (ALM) of the driver was turned on.	Refer to chapter 9 and take action.

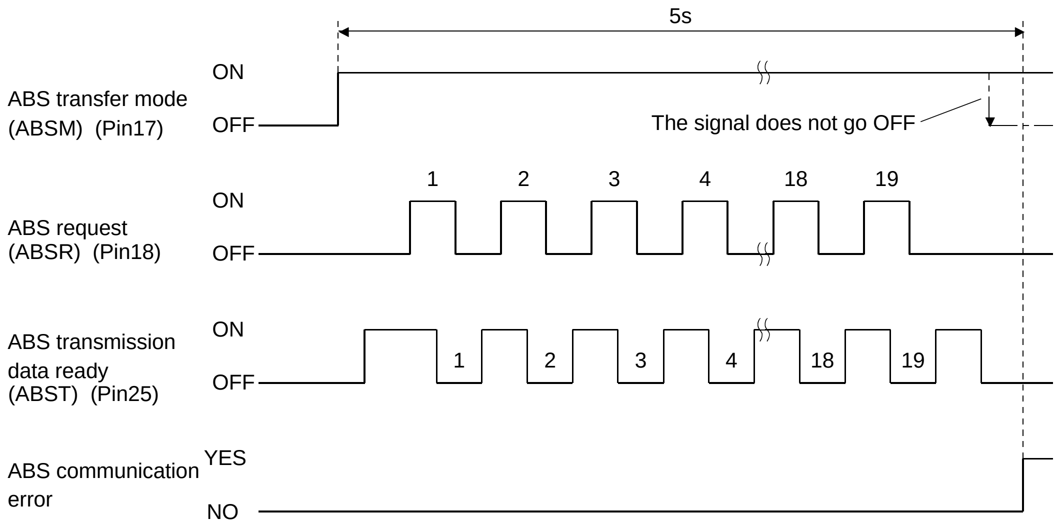
Note. Refer to (2) of this section for details of error occurrence definitions.

(2) ABS communication error

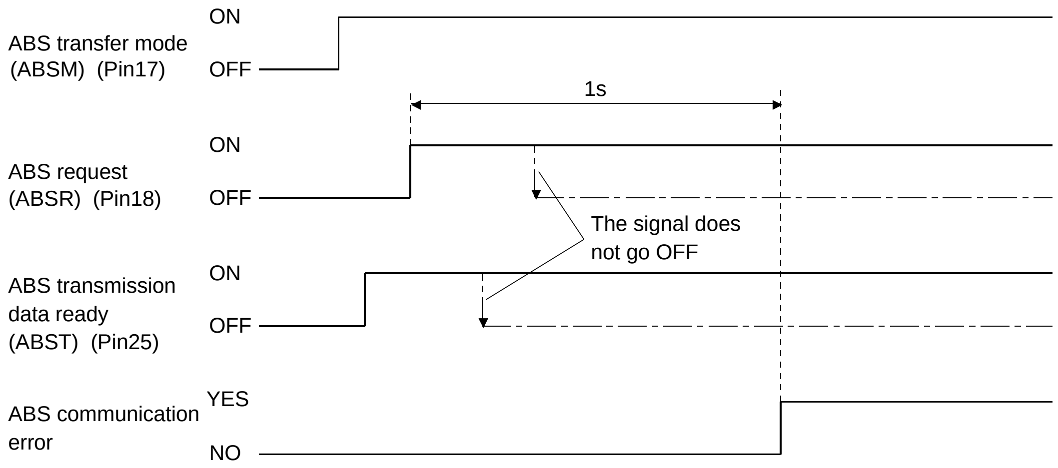
(a) The OFF period of the ABS transmission data ready signal output from the driver is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the driver due to an ABS request ON time time-out.



(b) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked.
If the ABS transfer time is longer than 5s, this is communication error occurs if the ABS time-out warning (AL.E5) is generated at the driver due to an ABS transfer mode completion time time-out.



(c) To detect the ABS time-out warning (AL.E5) at the driver, the time required for the ABS request signal to go OFF after it has been turned ON (ABS request time) is checked. If the ABS request remains ON for longer than 1s, it is regarded that an fault relating to the ABS request signal or the ABS transmission data ready (ABST) has occurred, and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the driver due to an ABS request OFF time time-out.



14.10.2 Error resetting conditions

Always remove the cause of the error before resetting the error.

Name	Output coil		Servo status	Resetting condition
	A1SD75	1PG		
ABS communication error	Y39	Y11	Ready (RD) off	Reset when servo-on (SON) switch (X26) signal turns off.
ABS checksum error	Y3A	Y12	Ready (RD) on	For A1SD75 Reset when servo-on (SON) switch (X26) signal turns from off to on.
				For FX-1PG Reset when servo-on (SON) switch (X26) signal turns off.
Servo alarm	Y38	Y10	Ready (RD) on	Reset when alarm reset switch turns on or power switches from off to on.

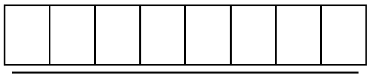
14.11 Communication-based ABS transfer system

14.11.1 Serial communication command

The following commands are available for reading absolute position data using the serial communication function. When reading data, take care to specify the correct station number of the drive unit from where the data will be read.
When the master station sends the data No. to the slave station (driver), the slave station returns the data value to the master station.

(1) Transmission
Transmit command [0][2] and data No. [9][1].

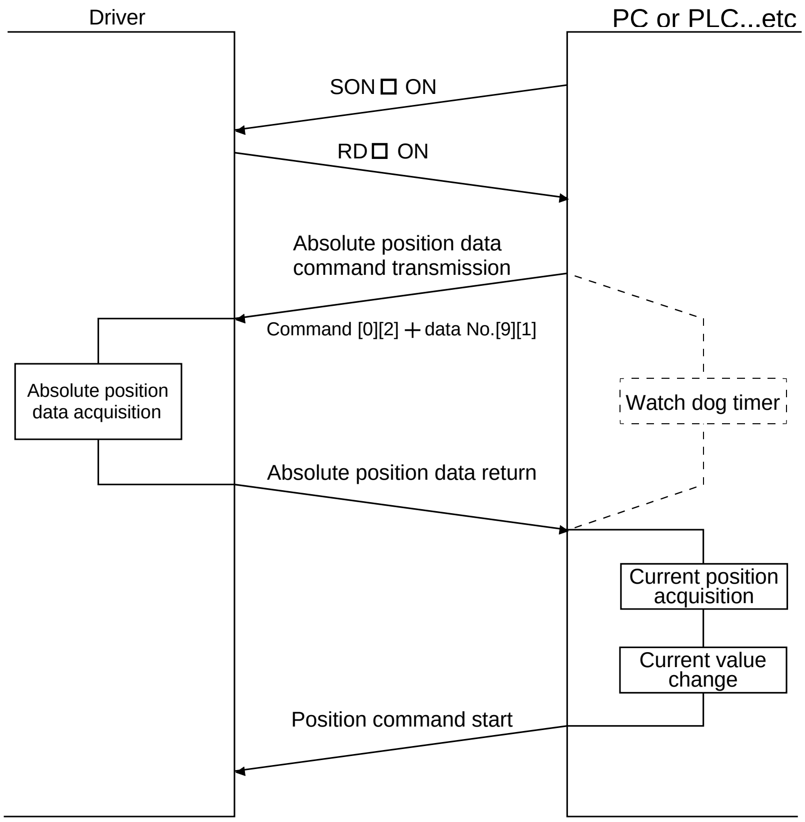
(2) Reply
The absolute position data in the command pulse unit is returned in hexadecimal.



Data 32-bit length (hexadecimal representation)

14.11.2 Absolute position data transfer protocol

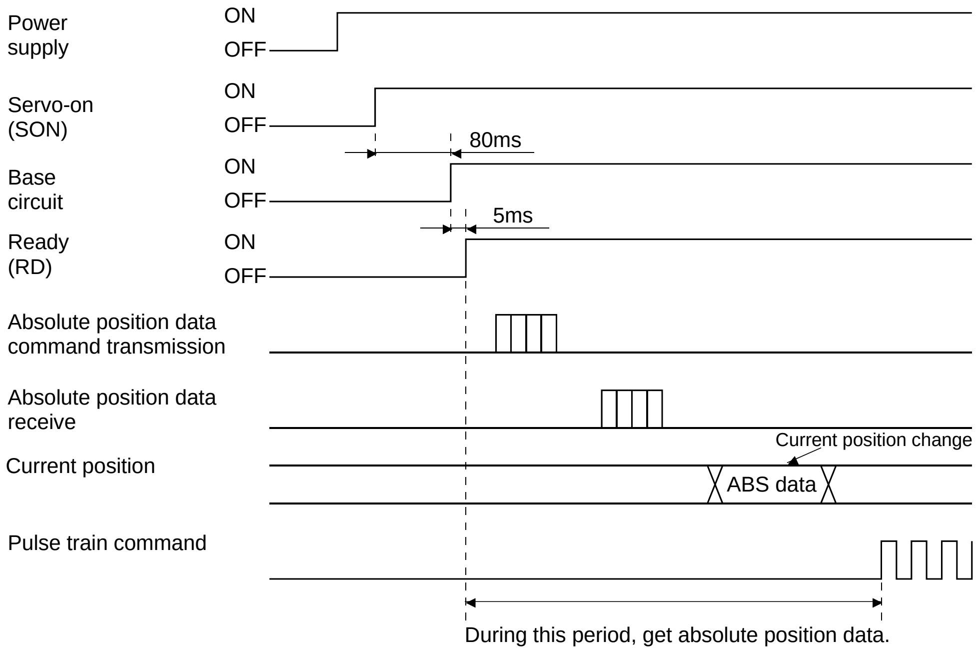
(1) Data transfer procedure
Every time the servo-on (SON) turns on at power-on or like, the PC or PLC...etc must read the current position data in the driver. Not performing this operation will cause a position shift.
Time-out monitoring is performed by the PC or PLC...etc.



(2) Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on (SON) going OFF, an emergency stop, or alarm, is explained below. In the absolute position detection system, always give the serial communication command to read the current position in the driver to the PC or PLC...etc every time the ready (RD) turns on. The driver sends the current position to the PC or PLC...etc on receipt of the command. At the same time, this data is set as a position command value in the driver.

(a) Sequence processing at power-on



1) 95ms after the servo-on (SON) has turned on, the base circuit turns on.

2) After the base circuit has turned on, the ready (RD) turns on.

3) After the ready (RD) turned on and the PC or PLC...etc acquired the absolute position data, give command pulses to the drive unit. Providing command pulses before the acquisition of the absolute position data can cause a position shift.

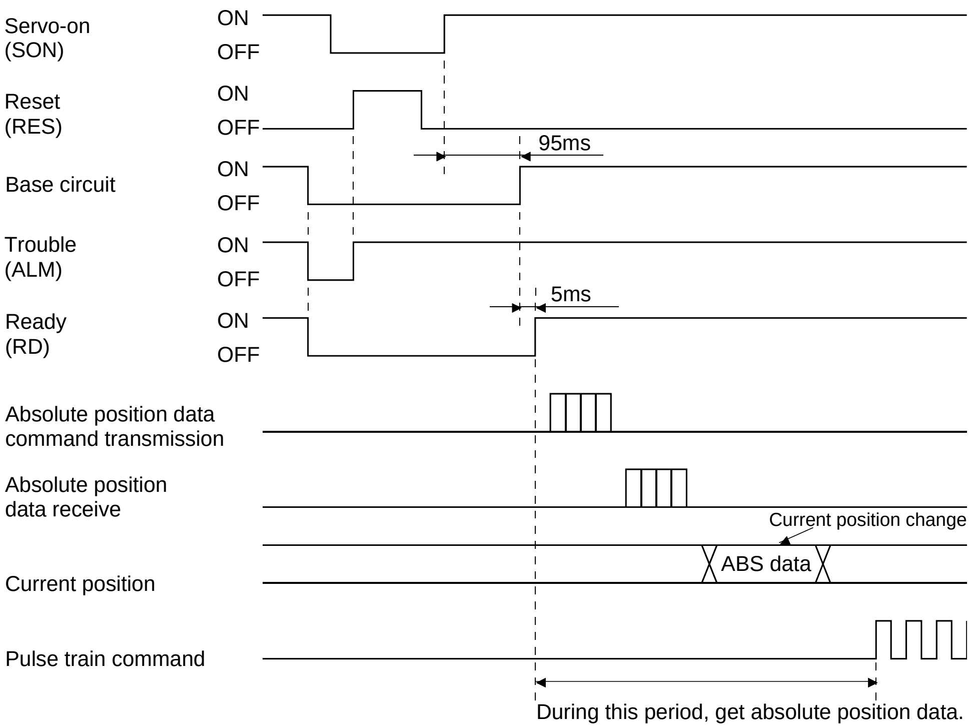
(b) Communication error

If a communication error occurs between the PC or PLC...etc and driver, the driver sends the error code. The definition of the error code is the same as that of the communication function. Refer to section 13.3.3 for details.

If a communication error has occurred, perform retry operation. If several retries do not result in a normal termination, perform error processing.

(c) At the time of alarm reset

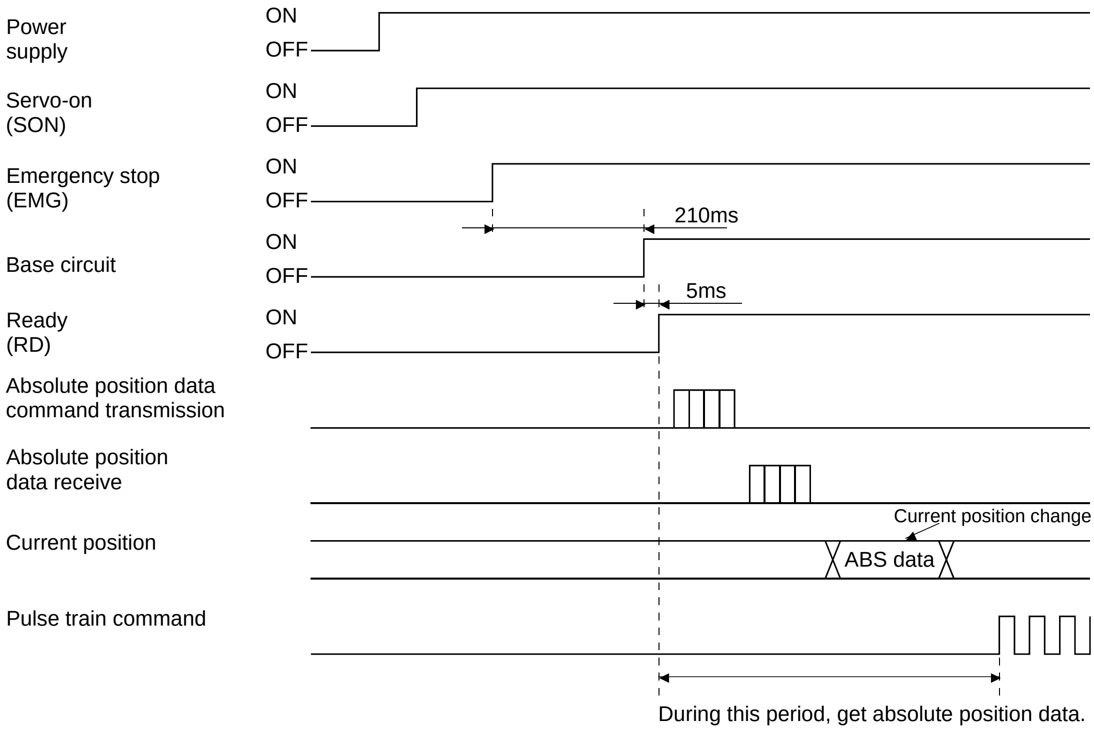
If an alarm has occurred, detect the trouble (ALM) and turn off the servo-on (SON). After removing the alarm occurrence factor and deactivating the alarm, get the absolute position data again from the driver in accordance with the procedure in (a) of this section.



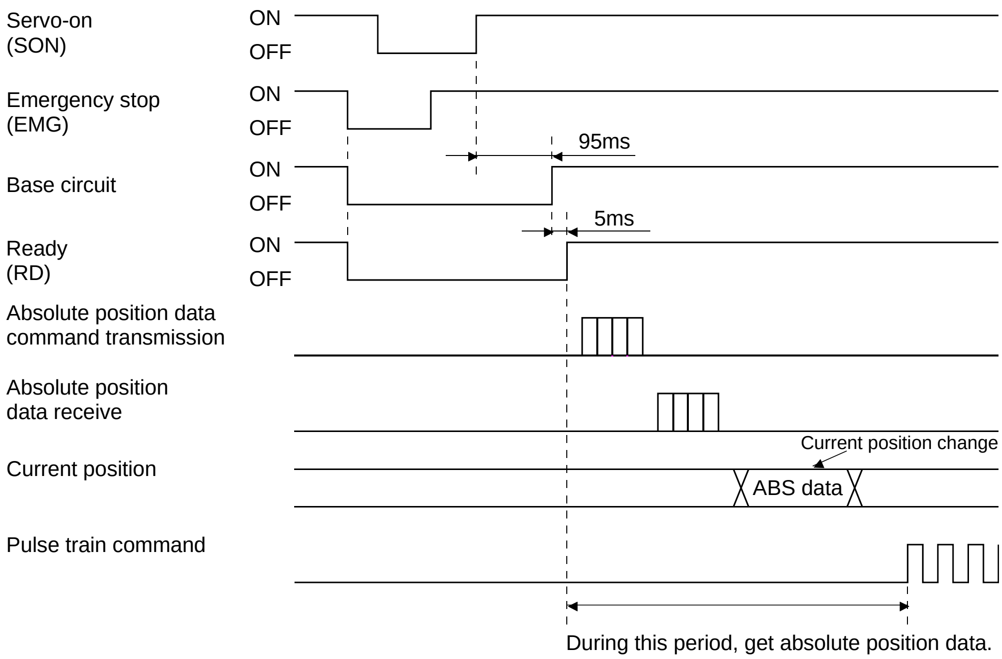
(d) At the time of forced stop reset

210ms after the forced stop is deactivated, the base circuit turns on, and further 5ms after that, the ready (RD) turns on. Always get the current position data from when the ready (RD) is triggered until before the position command is issued.

1) When power is switched on in a forced stop status



2) When a emergency stop is activated during servo on

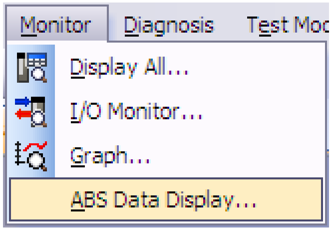


14.12 Confirmation of absolute position detection data

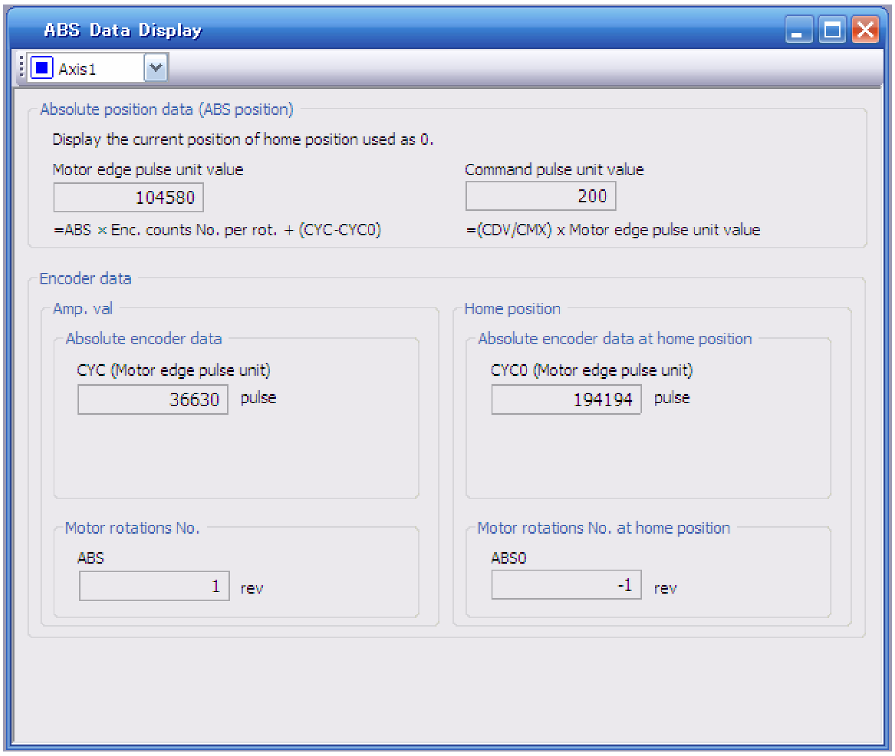
You can confirm the absolute position data with MR Configurator2TM.

Choose "Diagnostics" and "Absolute Encoder Data" to open the absolute position data display screen.

(1) Choosing "Monitor" in the menu opens the sub-menu as shown below.



(2) By choosing "Absolute Encoder Data" in the sub-menu, the absolute encoder data display window appears.



(3) Press the "Close" button to close the absolute encoder data display window.

15. SERVO MOTOR

15. SERVO MOTOR

15.1 Servo motor with a lock

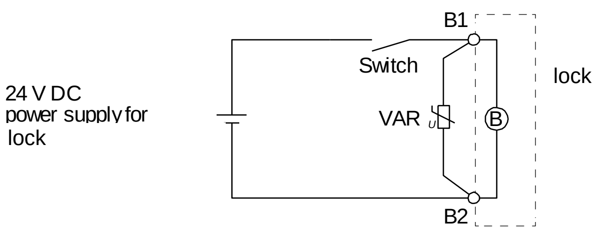
15.1.1 Features

⚠CAUTION	● The lock is provided to prevent a drop at a power failure or servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not use it for normal braking (including braking at servo-lock). ● The lock has a time lag. Use the lock so that servo motor control starts after the lock has completely opened. Be sure to check the time lag of the locking with a real machine. ● Configure a lock circuit so that it is activated also by an external EMG stop switch. ● While the lock is opened, the motor may be raised to high temperature regardless of driving. ● The life will be shorten under sudden acceleration/deceleration conditions.

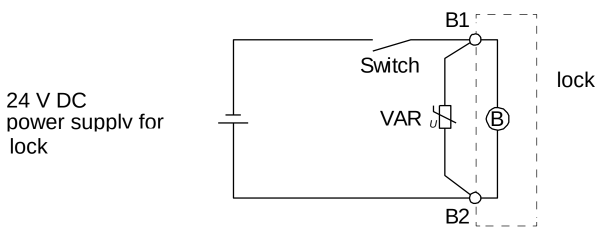
The servo motor with a lock can be used to prevent a drop in vertical lift applications or to ensure double safety at an emergency stop, for example. When operating the servo motor, supply power to the lock to release the lock. Switching power off enables the lock.

(1) Lock power supply

Prepare the following power supply for use with the lock only. The lock terminals (B1 and B2) have no polarity.



or



The surge absorber (VAR) must be installed between B1 and B2. When you use a diode for a surge absorber, the locking time will be longer.

(2) Sound generation

Though the brake lining may rattle during operation, it poses no functional problem.
If braking sounds, it may be improved by setting the machine resonance suppression filter in the driver parameters.

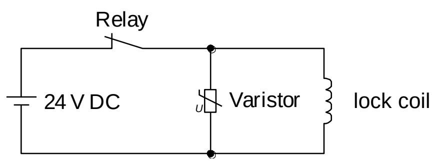
(3) Selection of surge absorbers for lock circuit

The following shows an example how to select a varistor with a surge absorber.

(a) Selection conditions

Item	Condition
Lock specification	R [Ω]: Resistance (Note) L [H]: Inductance (Note) Vb [V]: Power supply voltage
Desired suppression voltage	Vs [V] or less
Durable surge application time	N times

Note. Refer to section 15.1.2



(b) Tentative selection and verification of surge absorber

1) Maximum allowable circuit voltage of varistor

Tentatively select a varistor whose maximum allowable voltage is larger than Vb [V].

2) Lock current (Ib)

$$Ib = \frac{Vb}{R} \text{ [A]}$$

3) Energy (E) generated by lock coil

$$E = \frac{L \times Ib^2}{2} \text{ [J]}$$

4) Varistor limit voltage (Vi)

From the energy (E) generated in the lock coil and the varister characteristic diagram, calculate the varistor limit voltage (Vi) when the lock current (Ib) flows into the tentatively selected varistor during opening of the circuit. Please refer to the varistor characteristic diagram to the varistor manufacturer.

The desired suppressed voltage (Vs) is the sum of the 24 VDC ± 10% used and the other devices (relays etc.) used by the user.

Please confirm the specification of the equipment to be used.

Vi is favorable when the varistor limit voltage (Vi) [V] is smaller than the desired suppressed voltage (Vs) [V].

If Vi is not smaller than Vs, reselect a varistor or improve the withstand voltage of devices.

Regarding the characteristics characteristic diagram, specification, selection of the varistor, it is necessary to check with the varistor manufacturer.

5) Surge current width (τ)

Given that the varistor absorbs all energies, the surge current width (τ) will be as follows.

$$\tau = \frac{E}{Vi \times Ib} \text{ [S]}$$

6) Examining surge life of varister

From the varistor characteristic diagram, the guaranteed current value (Ip) in which the number of the surge application life is N at the surge current width (τ). Calculate the guaranteed current value (Ip) ratio to lock current (Ib).

If an enough margin is ensured for Ip/Ib, the number of the surge application life N [time] can be considered as favorable.

(4) Others

A leakage magnetic flux will occur at the shaft end of the servo motor equipped with a lock. Note that chips, screws, etc. are attracted.

15.1.2 Characteristics of servo motor with a lock

⚠CAUTION

- The lock is provided to prevent a drop at a power failure or servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not use it for normal braking (including braking at servo-lock).
- Before performing the operation, be sure to confirm that the lock operates properly.
- The operation time of the lock differs depending on the power supply circuit you use. Be sure to check the operation delay time with a real machine.

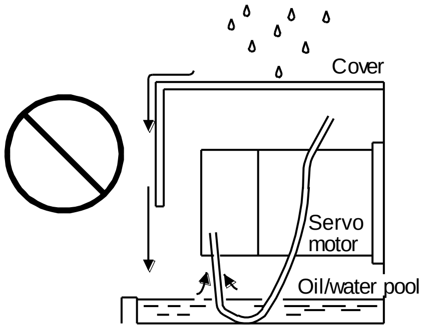
The characteristics (reference value) of the lock provided for the servo motor with a lock are indicated below.

Item / Servo motor		LE-□-B			
		S5 (50W)	S6 (100W)	S7 (200W)	S8 (400W)
Type (Note 1)		Spring actuated type safety lock			
Rated voltage (Note 4)		24 V DC $^{0}_{-10\%}$			
Power consumption [W] at 20 °C		6.3		7.9	
Coil resistance (Note 6) [Ω]		91.0		73.0	
Inductance (Note 6) [H]		0.15		0.18	
Lock static friction torque [N•m]		0.32		1.3	
Release delay time (Note 2) [s]		0.03		0.03	
Locking delay time (Note 2) [s]	DC off	0.01		0.02	
Permissible locking work	Per locking [J]	5.6		22	
	Per hour [J]	56		220	
Lock looseness at servo motor shaft (Note 5) [degrees]		2.5		1.2	
Lock life (Note 3)	Number of lockings [times]	20000			
	Work per locking [J]	5.6		22	
Selection example of surge absorbers to be used (Note 7, 8)	For the suppressed voltage 145 V	TND20V-680KB (135[V])			
	For the suppressed voltage 370 V	TND10V-221KB (360[V])			

Note
1. There is no manual release mechanism. When it is necessary to hand-turn the servo motor shaft for machine centering, etc., use a separate 24 V DC power supply to release the lock electrically.
2. The value for initial on gap at 20 °C.
3. The lock gap will increase as the brake lining wears, but the gap is not adjustable.
   The lock life indicated is the number of locking cycles after which adjustment will be required.
4. Always prepare a power supply exclusively used for the lock.
5. These are design values. These are not guaranteed values.
6. These are measured values. These are not guaranteed values.
7. Select the lock control relay properly, considering the characteristics of the lock and surge absorber. When you use a diode for a surge absorber, the locking time will be longer.
8. Manufactured by Nippon Chemi-Con Corporation.

15.2 Protection from oil and water

(1) Do not use the servo motor with its cable soaked in oil or water.



(2) If oil such as cutting oil drops on the servo motor, the sealant, packing, cable and others may be affected depending on the oil type.

15.3 Cable

The standard motor and encoder cables routed from the servo motor should be fixed to the servo motor to keep them unmovable. Otherwise, the cable may disconnect. In addition, do not modify the connectors, terminals and others at the ends of the cables.

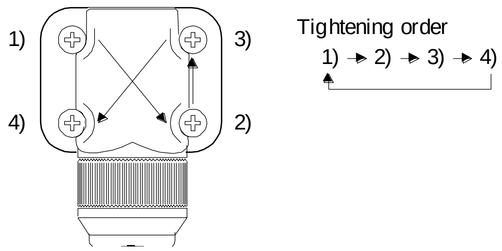
15.4 Rated speed of servo motor

The rated speed of servo motor (LE-S5-□, LE-S6-□, LE-S7-□, LE-S8-□) is 3000[r/min].

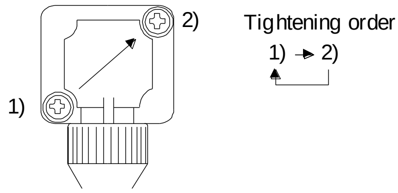
15.5 Mounting connectors

If the connector is not fixed securely, it may come off or may not produce a splash-proof effect during operation.
To achieve the IP rating IP65, pay attention to the following points and install the connectors.

(1) When screwing the connector, hold the connector still and gradually tighten the screws in a crisscross pattern.

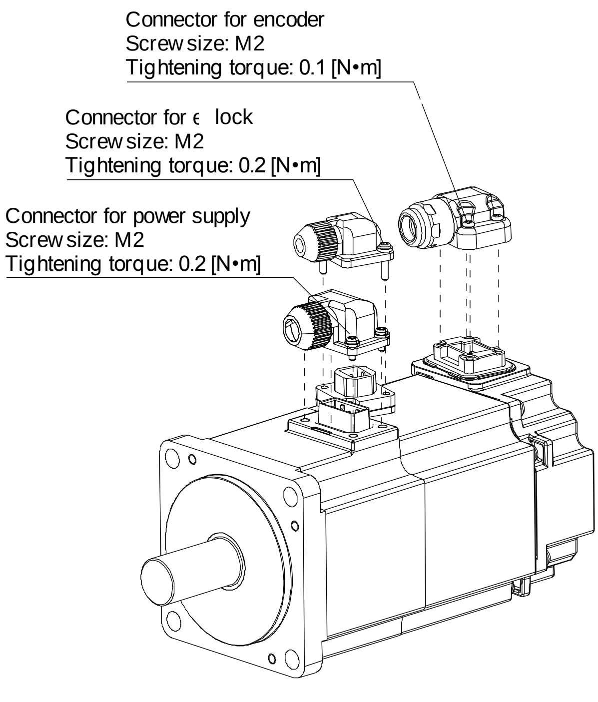


Connector for power supply, connector for encoder



Connector for lock

(2) Tighten the screws evenly. Tightening torques are as indicated below.



(3) The servo motor fitting part of each connector is provided with a splash-proof seal (O ring). When mounting a connector, use care to prevent the seal (O ring) from dropping and being pinched. If the seal (O ring) has dropped or is pinched, a splash-proof effect is not produced.

APPENDIX

App. 1 Parameter list

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

App. 1.1 Driver (drive unit)

Basic setting parameters (PA□□)			
No.	Symbol	Name	Control mode
PA01	*STY	Control mode	P・S・T
PA02	*REG	Regenerative option	P・S・T
PA03	*ABS	Absolute position detection system	P
PA04	*AOP1	Function selection A-1	P・S・T
PA05	*FBP	Number of command input pulses per revolution	P
PA06	CMX	Electronic gear numerator (Command pulse multiplying factor numerator)	P
PA07	CDV	Electronic gear denominator (Command pulse multiplying factor denominator)	P
PA08	ATU	Auto tuning mode	P・S
PA09	RSP	Auto tuning response	P・S
PA10	INP	Control mode, regenerative option selection	P
PA11	TLP	Forward rotation torque limit	P・S・T
PA12	TLN	Reverse rotation torque limit	P・S・T
PA13	*PLSS	Command pulse input form	P
PA14	*POL	Rotation direction selection	P
PA15	*ENR	Encoder output pulses	P・S・T
PA16 to PA18		For manufacturer setting	
PA19	*BLK	Parameter write inhibit	P・S・T

Gain/filter parameters (PB□□)			
No.	Symbol	Name	Control mode
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	P・S
PB02	VRFT	Vibration suppression control tuning mode (Advanced vibration suppression control)	P
PB03	PST	Position command acceleration/ deceleration time constant (Position smoothing)	P
PB04	FFC	Feed forward gain	P
PB05		For manufacturer setting	
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	P・S
PB07	PG1	Model loop gain	P
PB08	PG2	Position loop gain	P
PB09	VG2	Speed loop gain	P・S
PB10	VIC	Speed integral compensation	P・S
PB11	VDC	Speed differential compensation	P・S
PB12	OVA	Overshoot amount compensation	P・S
PB13	NH1	Machine resonance suppression filter 1	P・S
PB14	NHQ1	Notch shape selection 1	P
PB15	NH2	Machine resonance suppression filter 2	P
PB16	NHQ2	Notch shape selection 2	P
PB17		Automatic setting parameter	
PB18	LPF	Low-pass filter setting	P
PB19	VRF1	Vibration suppression control vibration frequency setting	P
PB20	VRF2	Vibration suppression control resonance frequency setting	P
PB21		For manufacturer setting	
PB22			
PB23	VFBF	Low-pass filter selection	P
PB24	*MVS	Slight vibration suppression control selection	P・S
PB25	*BOP1	Function selection B-1	P
PB26	*CDP	Gain changing selection	P・S
PB27	CDL	Gain changing condition	P・S
PB28	CDT	Gain changing time constant	P・S
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	P・S
PB30	PG2B	Gain changing position loop gain	P
PB31	VG2B	Gain changing speed loop gain	P・S
PB32	VICB	Gain changing speed integral compensation	P・S
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	P
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	P
PB35 to PB44		For manufacturer setting	
PB45	CNHF	Vibration suppression control filter 2	P

Extension setting parameters (PC□□)			
No.	Symbol	Name	Control mode
PC01	STA	Acceleration time constant	S・T
PC02	STB	Deceleration time constant	S・T
PC03	STC	S-pattern acceleration/ deceleration time constant	S・T
PC04	TQC	Torque command time constant	T
PC05	SC1	Internal speed command 1	S
		Internal speed limit 1	T
PC06	SC2	Internal speed command 2	S
		Internal speed limit 2	T
PC07	SC3	Internal speed command 3	S
		Internal speed limit 3	T
PC08	SC4	Internal speed command 4	S
		Internal speed limit 4	T
PC09	SC5	Internal speed command 5	S
		Internal speed limit 5	T
PC10	SC6	Internal speed command 6	S
		Internal speed limit 6	T
PC11	SC7	Internal speed command 7	S
		Internal speed limit 7	T
PC12	VCM	Analog speed command maximum speed	S
		Analog speed limit maximum speed	T
PC13	TLC	Analog torque command maximum output	T
PC14	MOD1	Analog monitor 1 output	P・S・T
PC15	MOD2	Analog monitor 2 output	P・S・T
PC16	MBR	Electromagnetic brake sequence output	P・S・T
PC17	ZSP	Zero speed	P・S・T
PC18	*BPS	Alarm history clear	P・S・T
PC19	*ENRS	Encoder output pulses selection	P・S・T
PC20	*SNO	Parameter block	P・S・T
PC21	*SOP	communication function selection	P・S・T
PC22	*COP1	Function selection C-1	P・S・T
PC23	*COP2	Function selection C-2	S・T
PC24	*COP3	Function selection C-3	P
PC25		For manufacturer setting	
PC26	*COP5	Function selection C-5	P・S
PC27	*COP6	Function selection C-6	P・S・T
PC28 PC29		For manufacturer setting	
PC30	STA2	Acceleration time constant 2	S・T
PC31	STB2	Deceleration time constant 2	S・T
PC32	CMX2	Command pulse multiplying factor numerator 2	P
PC33	CMX3	Command pulse multiplying factor numerator 3	P
PC34	CMX4	Command pulse multiplying factor numerator 4	P
PC35	TL2	Internal torque limit 2	P・S・T
PC36	*DMD	Status display selection	P・S・T
PC37	VCO	Analog speed command offset	S
		Analog speed limit offset	T
PC38	TPO	Analog torque command offset	T
		Analog torque limit offset	S

Extension setting parameters (PC□□)			
No.	Symbol	Name	Control mode
PC39	MO1	Analog monitor 1 offset	P・S・T
PC40	MO2	Analog monitor 2 offset	P・S・T
PC41 to PC50		For manufacturer setting	

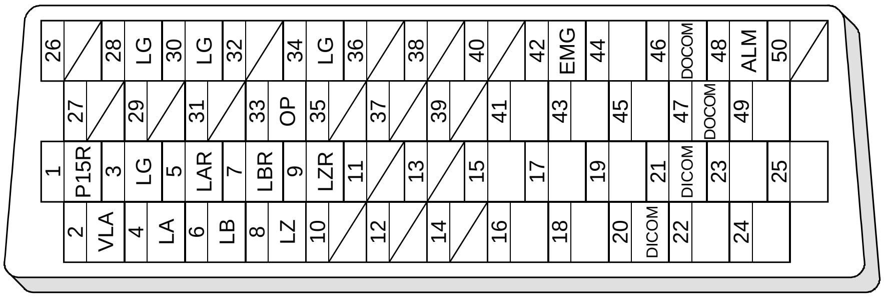
I/O setting parameters (PD□□)			
No.	Symbol	Name	Control mode
PD01	*DIA1	Input signal automatic ON selection 1	P・S・T
PD02		For manufacturer setting	
PD03	*DI1	Input signal device selection 1 (CN1-pin 15)	P・S・T
PD04	*DI2	Input signal device selection 2 (CN1-pin 16)	P・S・T
PD05	*DI3	Input signal device selection 3 (CN1-pin 17)	P・S・T
PD06	*DI4	Input signal device selection 4 (CN1-pin 18)	P・S・T
PD07	*DI5	Input signal device selection 5 (CN1-pin 19)	P・S・T
PD08	*DI6	Input signal device selection 6 (CN1-pin 41)	P・S・T
PD09		For manufacturer setting	
PD10	*DI8	Input signal device selection 8 (CN1-pin 43)	P・S・T
PD11	*DI9	Input signal device selection 9 (CN1-pin 44)	P・S・T
PD12	*DI10	Input signal device selection 10 (CN1-pin 45)	P・S・T
PD13	*DO1	Output signal device selection 1 (CN1-pin 22)	P・S・T
PD14	*DO2	Output signal device selection 2 (CN1-pin 23)	P・S・T
PD15	*DO3	Output signal device selection 3 (CN1-pin 24)	P・S・T
PD16	*DO4	Output signal device selection 4 (CN1-pin 25)	P・S・T
PD17		For manufacturer setting	
PD18	*DO6	Output signal device selection 6 (CN1-pin 49)	P・S・T
PD19	*DIF	Input filter setting	P・S・T
PD20	*DOP1	Function selection D-1	P・S・T
PD21		For manufacturer setting	
PD22	*DOP3	Function selection D-2	P
PD23		For manufacturer setting	
PD24	*DOP5	Function selection D-4	P・S・T
PD25 to PD30		For manufacturer setting	

App. 1.2 Converter unit

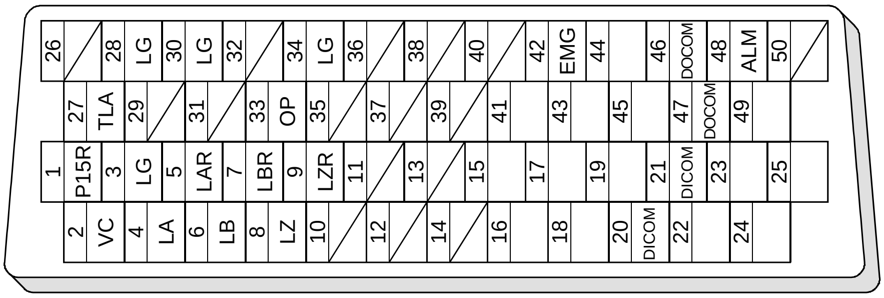
No.	Symbol	Name
PA01	*REG	Regenerative selection
PA02	*MCC	Magnetic contactor drive output selection
PA03 to PA07		For manufacturer setting
PA08	*DMD	Auto tuning mode
PA09	*BPS	Alarm history clear
PA10		For manufacturer setting
PA11		
PA12	*DIF	Input filter setting
PA13 to PA19		For manufacture setting

App. 2 Signal layout recording paper

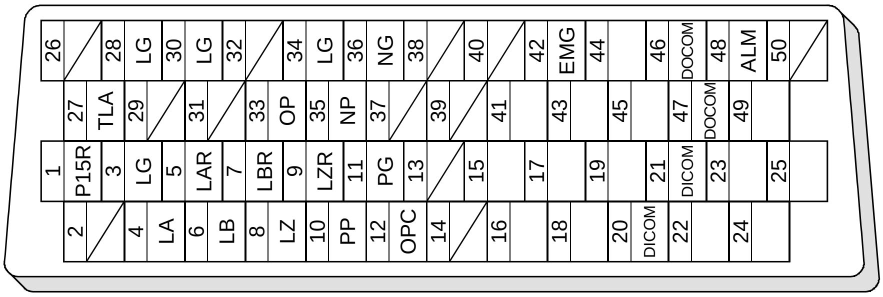
Torque control mode
CN1



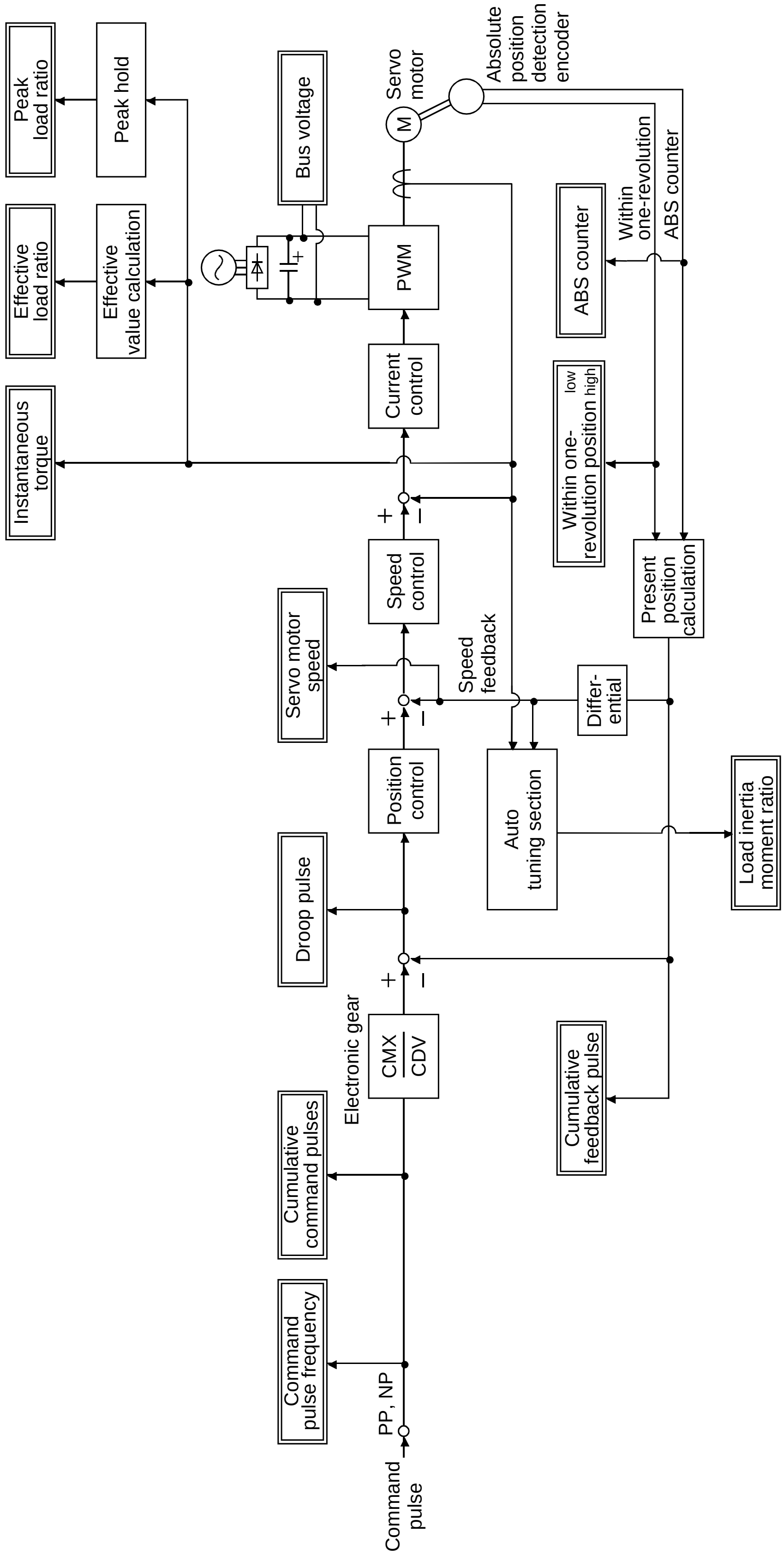
Speed control mode
CN1



Position control mode
CN1



App. 3 Status display block diagram



App. 4 Handling of AC driver batteries for the United Nations Recommendations on the Transport of Dangerous Goods

To transport lithium batteries, take action to comply with the instructions and regulations such as the United Nations (UN), the International Civil Aviation Organization (ICAO), and the International Maritime Organization (IMO).
The battery (LEC-MR-J3BAT) uses an electric cell (lithium metal battery ER6).
The IATA Dangerous Goods Regulation are revised, and the requirements are changed annually.
When customers transport lithium batteries by themselves, the responsibility for the cargo lies with the customers.
Thus, be sure to check the latest version of the IATA Dangerous Goods Regulations.

Battery (Cell) : LEC-MR-J3BAT
Lithium content : 0.65(g)

App. 5 Symbol for the new EU Battery Directive

Symbol for the new EU Battery Directive (2006/66/EC) that is plastered to general-purpose AC servo battery is explained here.

Note. This symbol mark is for EU countries only.

This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your SMC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows.
Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators.

Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

App. 6 Compliance with the European EC directives

App. 6.1 What are EC directives?

The EC directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the machinery directive (effective in January, 1995), EMC directive (effective in January, 1996) and low voltage directive (effective in January, 1997) of the EC directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies also to machines and equipment into which servos have been installed.

(1) EMC directive

The EMC directive applies to the servo units alone. This servo is designed to comply with the EMC directive. The EMC directive also applies the servo-incorporated machines and equipment. This requires the EMC filters to be used with the servo-incorporated machines and equipment to comply with the EMC directive. For specific EMC directive conforming methods, refer to the EMC Installation Guidelines (IB(NA)67310).

(2) Low voltage directive

The low voltage directive applies also to servo units alone. This servo is designed to comply with the low voltage directive.

(3) Machinery directive

Not being machines, the converter units and drivers (drive units) need not comply with this directive.

App. 6.2 For compliance

Be sure to perform an appearance inspection of every unit before installation. In addition, have a final performance inspection on the entire machine/system, and keep the inspection record.

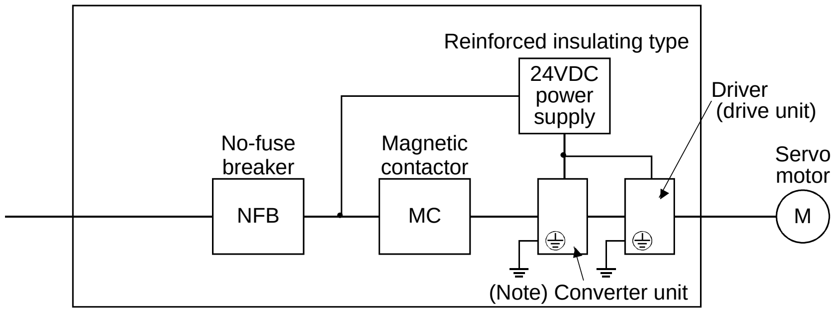
(1) Converter units, drivers (drive units) and servo motors used

Use the converter units, drivers (drive units) and servo motors which standard product.

Driver	: LECSB□-□
Servo motor series	: LE-S5-□,LE-S6-□,LE-S7-□,LE-S8-□

(2) Structure

The control circuit provide safe separation to the main circuit in the driver.



Note. Drivers of 22kW or less do not have a converter unit.

(3) Environment

(a) Driver (drive unit) at or above pollution degree 2 set forth in IEC/EN 60664-1. For this purpose, install the driver in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(b) Environment

Environment			Conditions
(Note 1) Ambient temperature	In operation	[℃]	(Note 2) 0 to 55
		[℉]	32 to 131
	In storage, in transportation	[℃]	−20 to 65
		[℉]	−4 to 149
Ambient humidity	In operation, in storage, in transportation		90% RH or less
Maximum altitude	In operation, in storage		1000m or less
	In transportation		10000m or less

Note 1. Ambient temperature is the internal temperature of the control box.

2. The driver 200V 3.5kW or less and 100V 400W or less can be mounted closely. In this case, keep the ambient temperature within 0 to 45℃ (32 to 113℉) or use the driver with 75% or less of the effective load ratio.

(4) Power supply

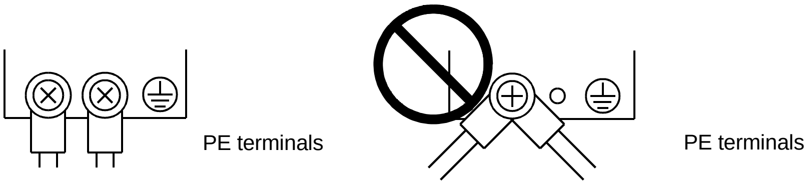
(a) This driver (drive unit) can be supplied from star-connected supply with earthed neutral point of overvoltage category Ⅲ set forth in IEC/EN 60664-1. However, when using the neutral point of 400V system for single phase supply, a reinforced insulating transformer is required in the power input section.

(b) For the interface power supply, use a 24VDC power supply with reinforced insulation on I/O terminals.

(5) Grounding

(a) To prevent an electric shock, the protective earth (PE) terminal (marked ⏚) of the driver (drive unit) must be connected to the protective earth (PE) of the control box.

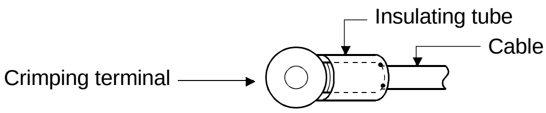
(b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect cables to the terminals one-to-one.



(c) If an earth leakage circuit breaker is used, always earth the protective earth (PE) terminal of the driver to prevent an electric shock.

(6) Wiring

(a) The cables to be connected to the terminal block of the driver (drive unit) must have crimping terminals provided with insulating tubes to prevent contact with adjacent terminals.



(b) Use the servo motor side power connector which complies with the IEC/EN Standard.
The IEC/EN Standard-compliant power connector sets are available as options.

(c) The converter unit and driver (drive unit) must be installed in the metal cabinet (control box).

(7) Peripheral devices, options

(a) Use the circuit breaker and magnetic contactor models which are IEC/EN Standard-compliant products given in this Instruction Manual.
Use a type B (Note) breaker. When it is not used, provide insulation between the driver and other device by double insulation or reinforced insulation, or install a transformer between the main power supply and driver (drive unit).

Note. Type A: AC and pulse detectable
Type B: Both AC and DC detectable

(b) The sizes of the wires given in this Instruction Manual meet the following conditions. For use in any other conditions, follow Table 5 and Annex C of IEC/EN 60204-1.

・Ambient temperature : 40℃ (104℉)
・Sheath : PVC (polyvinyl chloride)
・Installation on wall surface or open table tray

(c) Use the EMC filter for noise reduction.

(8) Performing EMC tests

When EMC tests are run on a machine/device into which the converter unit and driver (drive unit) has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.
For the other EMC directive guidelines on the converter unit and driver (drive unit), refer to the EMC Installation Guidelines (IB(NA)67310).

App. 7 Conformance with UL/C-UL standard

This driver complies with UL 508C and CSA C22.2 No.14 standard.

(1) Converter units, drivers (drive units) and servo motors used

Use the converter units, drivers (drive units) and servo motors which standard product.

Driver	Servo motor
	LE-□-□
LECSB□-S5	S5・S6
LECSB□-S7	S7
LECSB2-S8	S8

(2) Installation

The LECSB□-□ series have been approved as the products which have been installed in the electrical enclosure.

The minimum enclosure size is based on 150% of each LECSB□-□ combination.

And also, design the enclosure so that the ambient temperature in the enclosure is 55℃ (131℉) or less, refer to the spec manual.

The driver must be installed in the metal cabinet (control box).

(3) Short circuit rating (SCCR: Short Circuit Current Rating)

Suitable For Use In A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 Volts Maximum.

(4) Flange

Mount the servo motor on a flange which has the following size or produces an equivalent or higher heat dissipation effect.

Flange size [mm]	Servo motor
	LE-□-□
250×250×6	S5・S6・S7
250×250×12	S8

(5) About wiring protection

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

(6) Options, peripheral devices

Use the UL/C-UL Standard-compliant products.

Use the no-fuse breaker (UL489 Listed MCCB) or a Class T fuse indicated in the table below.

Driver	No-fuse breaker (Note)		Fuse	
	Current	Voltage AC	Current	Voltage AC
LECSB□-S5・LECSB2-S7	50A frame 5A	240V	10A	300V
LECSB2-S8・LECSB1-S7	50A frame 10A		15A	

(7) Capacitor discharge time

The capacitor discharge time is as follows. To ensure safety, do not touch the charging section for 15 minutes (20 minutes in case drive unit is 30kW or more) after power-off.

Driver	Discharge time (min)
LECSB2-S5 ･ LECSB2-S7	1
LECSB2-S8 ･ LECSB1-S5 ･ LECSB1-S7	2

(8) Selection example of wires

To comply with the UL/C-UL Standard, use UL-approved copper wires rated at 60/75℃ (140/167℉) for wiring.

The following table shows the wire sizes [AWG] and the crimping terminal symbols rated at 60℃ (140℉). The sizes and the symbols rated at 75℃ (167℉) are shown in the brackets.

Driver	Converter unit	(Note 3) Wires (AWG)			
		L_1 ･ L_2 ･ L_3 ･ ⏚	L_{11} ･ L_{21}	U ･ V ･ W ･ P_1 ･ P_2 ･ ⏚	P ･ P_2 ･ C
LECSB□-□		14(14)	16(16)	(Note 4) 14(14)	14(14)

Driver	Converter Unit	(Note 3) Wires [mm²]		
		B1 ･ B2	BU ･ BV ･ BW	OHS1 ･ OHS2
LECSB□-□		16(16)		

Note 1. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.

2. For the servo motor with a cooling fan.

3. Alphabets in the table indicate crimping tools. Refer to the following table for the crimping terminals and crimping tools.

4. To wire the driver and a LE-□-□ servo motor, use the LE-CSM-□□□ (option). To extend the wiring, use the AWG14 wire size.

Table: Recommended crimping terminals

Symbol	(Note 2) Crimping terminal	Driver side crimping terminals: Applicable tool: Body	Head	Dice	Manufacturer
a	FVD5.5-4	YNT-1210S			Japan Solderless Terminals
(Note 1) b	8-4NS	YHT-8S			
C	FVD14-6	YF-1 ▪ E-4	YNE-38	DH-122 ▪ DH-112	
D	FVD22-6			DH-123 ▪ DH-113	
(Note 1) e	38-6	YPT-60-21		TD-124 ▪ TD-112	
		YF-1 ▪ E-4	YET-60-1		
(Note 1) f	R60-8	YPT-60-21		TD-125 ▪ TD-113	
		YF-1 ▪ E-4	YET-60-1		
G	FVD2-4	YNT-1614			
H	FVD2-M3				
J	FVD5.5-6	YNT-1210S			
K	FVD5.5-8				
L	FVD8-6	YF-1 ▪ E-4	YNE-38	DH-121 ▪ DH-111	
M	FVD14-8			DH-122 ▪ DH-112	
N	FVD22-8			DH-123 ▪ DH-113	
(Note 1) p	R38-8	YPT-60-21		TD-124 ▪ TD-112	
		YF-1 ▪ E-4	YET-60-1		
Q	FVD2-6	YNT-1614			
R	R38-10	YPT-60-21		TD-124 ▪ TD-112	
S		YF-1 ▪ E-4	YET-60-1		
(Note 1) t	R60-10	YPT-60-21		TD-125 ▪ TD-113	
(Note 1) u		YF-1 ▪ E-4	YET-60-1		

Note 1. Coat the part of crimping with the insulation tube.

2. Some crimping terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

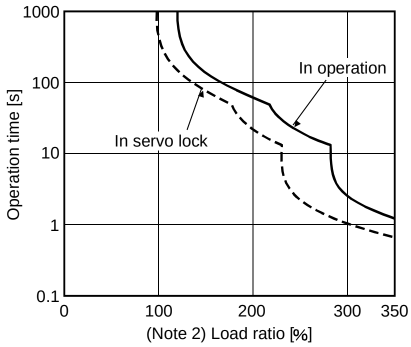
(9) Terminal block tightening torque

Driver	Tightening torque [N ▪ m]: TE1	TE2	TE3	PE	L_1/L_2/L_3/ U/V/W/ P_1/P/C/N	L_{11}/L_{12}	TE1-1 TE1-2	TE2-1	TE2-2
LECSB□-□				1.2					

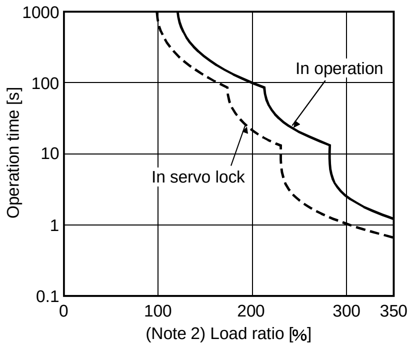
(10) Overload protection characteristics

An electronic thermal relay is built in the driver to protect the servo motor, driver and servo motor power line from overloads. The operation characteristics of the electronic thermal relay are shown below. It is recommended to use an unbalanced torque-generated machine, such as a vertical motion shaft, so that unbalanced torque is not more than 70% of the rated torque. When you carry out adhesion mounting of the driver, make circumference temperature into 0 to 45℃ (32 to 113℉) or use it with 75% or less of effective load torque.

Driver LECSB□-□ series have servo motor overload protection. (The motor full load current is 115% rated current.)



LECSB□-S5

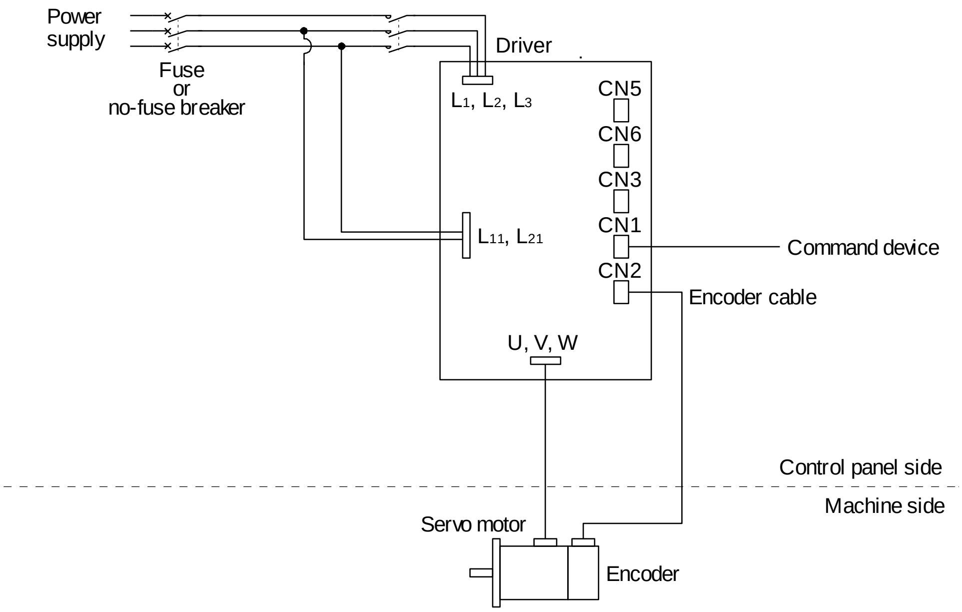


LECSB□-S7・ LECSB2-S8

(11) Figure configuration

Representative configuration example to conform to the UL/C-UL standard is shown below. The earth wiring is excluded from the figure configuration.

(a) LECSB□-□



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Apr/2012 Revision
Controller→Driver
No.LEC-OM02403
Aug/2014 Revision
Correction of words
15 SERVO MOTOR Add
No.LEC-OM02404
Jan/2015 Revision
Correction of words
No.LEC-OM02405
Mar/2015 Revision
Correction of words
No.LEC-OM02406 (No.JXC※-OMT0021)
Jan/2017 Revision
Correction of figures
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Correction of figures

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.